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Nonlinear Analysis for Automation Purposes in Computer Networks

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Abstract: *Automated network management processes have become more common in recent years. The main goal of automation is to efficiently configure a computer network. This is especially true when software and hardware problems require a rapid response. In this context, selecting appropriate features to serve as inputs for machine learning algorithms is important. It is important to choose the most appropriate features that can help in the event of a network disruption, such as a component failure that requires network equipment to be reconfigured or emerging security threats. One of the key metrics that provides insight into the state of a computer network is round-trip time (RTT). The sequence of RTT data serves as a fundamental basis for extracting relevant features. While linear analysis provides basic features, the complex nature of these processes requires more advanced analytical methods. Nonlinear time series analysis naturally becomes necessary. Features extracted using these methods provide a much more accurate assessment of the network's state. This paper presents the application of fractal analysis for feature extraction to assess network conditions and automate network configuration processes. Fractal analysis, a well-established nonlinear method, is widely recognized in the literature. This paper explores the potential of applying fractal analysis to time series containing RTT data. Simulations were performed using the GNS3 network simulator and the Python programming language.*

1. INTRODUCTION

Automation in computer networks has gained significant popularity in recent years, particularly with the rise of artificial intelligence. The emphasis is on implementing automated processes that can dynamically adjust the configuration of network devices to handle unforeseen circumstances effectively. These circumstances often involve network device failures, requiring diagnostics to identify issues and subsequent adjustments to the device configurations. This typically pertains to the configurations of routers and switches. In situations where on-the-spot repairs are not feasible, backup components are automatically activated, necessitating their configuration as well. Additionally, specific network links are activated to ensure that the resulting changes in network topology minimize the negative impact of outages. For such systems to be effective, network automation must be both flexible and adaptive, enabling it to respond efficiently to real-world challenges and complexities (Evang et al., 2024).

In addition to failures, intervention in the configuration of computer networks is also necessary in situations related to information security, such as cyberattacks. It is crucial to respond with minimal delay to mitigate potential consequences effectively. The goal of any automation process

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is to optimize the network without human intervention, ensuring that services continue to operate with minimal degradation in performance. An incident scenario may also involve increased traffic intensity without any device failures. In such cases, minimal intervention is required to maintain service functionality even under challenging conditions.

As an essential parameter for the automation process, it is necessary to provide specific features on which decisions can be based. This typically involves metrics related to the state of the computer network. The primary metric for this purpose is the round trip time (RTT), which is obtained using the well-known ping commands. RTT represents the total time taken for a packet to travel from the source to the destination node and back, essentially twice the propagation delay. By measuring the time it takes for packets to travel from the source to the destination and return, valuable insights into the state of the computer network can be obtained. This enables the creation of an RTT time series, which serves as the foundation for feature extraction required for training automation systems.

A linear statistical analysis of the RTT time series provides basic indicators of network processes. However, given the complexity of the time series, nonlinear analytical methods are needed for a more comprehensive understanding. Research has shown that the nature of RTT time series, as well as internet traffic in general, is fractal (Marie et al., 2009). Fractals are unique structures that inherently exhibit self-similarity, meaning parts of the fractal signal resemble the original signal from which they are derived. Natural fractals can be found in the geometry of coastlines, vegetation patterns, economic processes, telecommunication traffic, and especially in internet traffic (Molnár & Terdik, 2001).

The Hurst exponent is a fundamental characteristic of any fractal. Its value determines whether the observed process exhibits fractal behavior. If the Hurst exponent is greater than 0.5, the process is considered fractal and possesses long-term memory. Long-term memory implies a slow decay in the autocorrelation function of the time series, indicating a strong correlation between temporally distant samples of the series.

In this paper, in addition to basic analysis, fractal analysis of the RTT time series was performed, and the Hurst exponent was calculated. RTT time series data were collected using the ping command from a virtual machine in a GNS3 environment directed to a Google server. Parameters for RTT queries included the packet size and the number of packets sent. Custom Python scripts were developed to acquire RTT time series data, analyze the recorded sequences, and estimate the Hurst exponent using the R/S method.

The paper is organized into five chapters, with the first and last chapters serving as the introduction and conclusion, respectively. The second chapter is dedicated to a general overview of fractals. The third chapter describes the RTT metric and provides a basic analysis of the RTT time series. The fourth chapter presents the results of the fractal analysis.

2. FRACTAL PROCESSES

Fractals are mathematical structures that exhibit self-similarity, meaning their shape repeats at different scales. They are characterized by complex, irregular shapes that cannot be described by classical geometry, but rather by fractal geometry.

Fractals are often used to model natural phenomena, such as clouds, mountains, river flows, and fern leaves. Mathematically, fractals are generated through iterative processes and can have a fractal dimension that lies between whole numbers, distinguishing them from classical geometric figures.

Fractals are typically generated using iterative mathematical processes, where simple rules are repeatedly applied multiple times. For example, the Mandelbrot set, one of the most well-known fractals, is generated using iterative functions of complex numbers (Barnsley & Harrington, 1985). Fractals are characterized by their fractal dimension, denoted as D. In standard geometric shapes or objects, the dimension corresponds to whole numbers: a line has a dimension of 1, a plane has a dimension of 2, and space has a dimension of 3. However, fractals have non-integer dimensions. For instance, a fractal with a dimension of D=1.4 represents an object that exists between a line and a plane. Many signals, particularly time series, exhibit complex statistical properties and can be described as fractal objects.

The fundamental characteristic of any fractal is self-similarity, defined as a pattern that repeats across different scales or levels of magnification. This can be understood as observing an object under a magnifying glass, where smaller sections resemble the whole. Fractals are often described as processes with long-range dependence (LRD). Long-range dependence (correlation) refers to a property of certain time series or stochastic processes where correlations between values persist over long time intervals. Unlike short-range dependence (SRD), where correlations decay rapidly, LRD implies that observations, even if separated by significant time intervals, remain strongly statistically related.

The autocorrelation of a given signal indicates whether there is a relationship between the values of signal samples that are separated along the time axis. Autocorrelation is a special case of correlation when it refers to the same signal. It is calculated for different values of the correlation lag k. The autocorrelation function of a time series is computed using the following formula:

$$ACF[k] = \sum_{n=-\infty}^{+\infty} X[n] \cdot X[n+k] \tag{1}$$

Let X denote a stationary stochastic process and ACF the autocorrelation function of the time series. If there exists a real number α within the interval (0,1) and a positive constant K, then the autocorrelation function asymptotically behaves as Kk^{α} for large k.

$$\lim_{k\to\infty} \frac{ACF[k]}{K \cdot k^{-\alpha}} = 1 \tag{2}$$

If the previous equality holds, then for a stationary stochastic process X, it is said to exhibit long-range dependence (LRD). The autocorrelation function decays according to a power-law, which is significantly slower compared to the exponential decay observed in SRD (short-range dependent) processes.

To describe a time series as a process with long-range dependence, it is necessary to calculate the Hurst exponent. Over time, a variety of methods have been developed for estimating this parameter, which can be roughly divided into two main groups. The first group involves the direct application of methods to the time series, whether in the original time domain or a spectrum-based transformation domain. The second group includes linear regression techniques and Bayesian parametric methods (Zhang et al., 2023).

In this paper, the method historically the first to be used, belonging to the first group of methods in the time domain, was applied. This method is known as the rescaled range method or R/S statistic. The method begins with a time series consisting of n observations. First, the moments of the first and second orders—mean and standard deviation—are computed. Then, the rescaled range R(n) for the time series is defined using the equation:

$$R(n) = \max_{1\le k\le n} RTT[k] - \min_{1\le k\le n} RTT[k] \tag{3}$$

The standard deviation for nnn observations of a time series is denoted as S(n). Based on these two quantities, the R/S statistic is formulated using the equation:

$$RS(n) = \frac{R(n)}{S(n)} \tag{4}$$

By varying the value of nnn, a corresponding diagram can be formed that shows the values of the R/S statistic at different scales. For sufficiently large nnn, the R/S statistic asymptotically behaves as a power-law with an exponent corresponding to the Hurst exponent H.

$$E\{RS(n)\} \sim n^H \tag{5}$$

In this equation, E denotes the mathematical expectation operator. Due to the scaling nature of the relationship connecting the Hurst index with the R/S statistic, a logarithmic scale is used to plot the diagram. After logarithmic transformation, the power-law relationship becomes linear. This linear relationship allows for the determination of the Hurst index through linear regression on a logarithmic scale, where the Hurst index is the slope of the regression line (Chakraborty et al., 2004).

If the Hurst index value falls within the interval (0,0.5), the process is SRD (short-range dependent), exhibiting short-term oscillations and tending towards the mean (anti-persistence). If the value is greater than 0.5 but less than 1, the process is LRD (long-range dependent), where if the values of the time series increase, they are likely to continue increasing in the next interval (persistence). For a Hurst index value of 0.5, the process is a random walk with no memory (Reljin et al., 2006).

It is shown in the literature that the relationship between the fractal dimension D and the Hurst index is given by the equation:

$$D = 2 - H \tag{6}$$

3. ROUND TRIP TIME METRICS

Round-trip time (RTT) is a fundamental metric used to assess the state within a computer network. The scenario for estimating RTT time involves communication between two nodes in a computer network. Using the ICMP protocol, a certain number of packets of a specific size are sent from the originating node to the destination node. The time taken for the packets to propagate through the network to the originating node and back to the destination is referred to as the RTT time. If the destination node is not available, the RTT metric value does not correspond to a finite number (NaN value). In this case, it clearly indicates a lack of communication between the two nodes in the network. If the destination node is available, the estimated RTT delay value is expressed in milli-seconds. Reducing RTT time is one of the imperatives in optimizing any computer network. The series of RTT delay values for each packet forms an RTT time series. Analysis of this time series is crucial for detecting undesirable behaviors within a computer network, which may be caused by equipment failures, link interruptions between network nodes, congestion, or external security threats. The nature of the RTT time series is complex and corresponds to a fractal nature. In this sense, nonlinear fractal analysis is necessary when dealing with the RTT time series (Gezer, 2019).

The ping command, available on all computers, enables the collection of data on RTT (Round-Trip Time) values. In this study, a network was used consisting of a virtual network in the GNS3 environment and an external network connected to the tested server. For simplicity, the Google server with the IP address 8.8.8.8 was selected. The packet size can be adjusted as desired, while the number of packets is fixed at 1000. A Python script utilizing the *ping* Python library was executed on the

corresponding virtual machine. After collecting the RTT values, the time series is stored in a format suitable for further processing (.npz). Basic statistical analysis and fractal analysis, including the estimation of the Hurst exponent, are performed on the collected data (Makowski et al., 2021).

Figure 1 illustrates a typical time series of RTT values. The RTT values are expressed in milliseconds, while the x-axis represents the index value. Ideally, half of the RTT values correspond to the packet delay time between two nodes in a computer network. For the purpose of time series analysis, the average RTT value was calculated using the following formula:

$$MeanRTT = \frac{1}{N}\sum_{n=1}^{N} RTT[n] \tag{7}$$

This average value is represented on the diagram as a constant horizontal red line. It is evident that, at certain moments, the RTT parameter significantly exceeds the average value. Conversely, there are pronounced minima where the parameter value drops sharply. Such behavior of the time series is referred to as a time series with pronounced explosiveness. The fractal nature of the RTT sequence is closely linked to this pronounced explosiveness and is a natural indicator of a self-similar process.

Explosiveness can be observed in various ways and can also be defined as highly pronounced signal dispersion. The standard method for describing signal dispersion is the standard deviation, which is a measure of the second-order moment. The standard deviation is calculated using the following formula:

$$StdRTT = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}[RTT[n] - MeanRTT]^2} \tag{8}$$

In addition to the standard deviation, the ratio of the maximum value to the average value of the time series is commonly used to describe explosiveness more closely. The appropriate formula for calculating this ratio takes the following form:

$$R = \frac{max\ R\ TT}{Mean\ RTT} \tag{9}$$

For the time series shown in the figure 1, the value of this ratio is R=2.61, indicating the previously mentioned strong explosiveness of the signal.

The characteristic of fractal processes is self-similarity, meaning identical behavior at different scales when observing the signal. To observe the signal at different scales, a specific type of signal aggregation is applied. The signal is divided into non-overlapping blocks of length W. If the length of the time series is N, the total number of blocks is equal to the integer division of N by W. The block length is referred to as the aggregation level, or granularity. For each of the non-overlapping blocks, a single value is calculated to replace the samples within the entire block. There are different approaches to aggregation, including calculating the mean of the samples within the block, the sum of all sample values within the block, the median of the block, or some other similar measure. In this study, the mean of the samples at each block level was used. In this way, starting from the original block, a new series—an aggregated series—can be formed through time aggregation (Kourentzes et al., 2014). The corresponding formula for forming the aggregated signal RTTagg is:

$$RTTagg[i] = \frac{1}{W}\sum_{t=1+(i-1)W}^{iW} RTT[t], i = 1,2,\dots,\left\lfloor\frac{N}{W}\right\rfloor \tag{10}$$

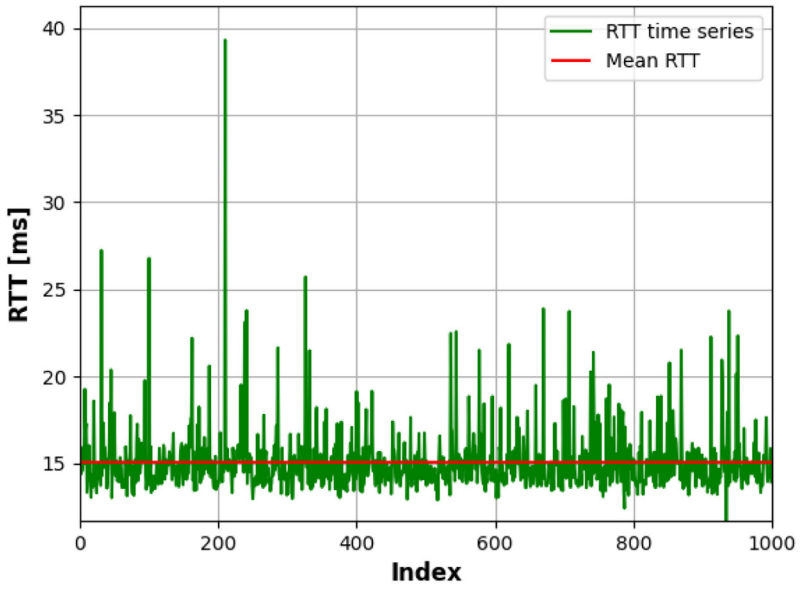

Figure 1. RTT time series plot

Source: Own calculations

In Figure 2, two aggregated series for two different aggregation levels (W=10 and W=20) are presented. It is noticeable that aggregation does not influence the behavior of the signal in terms of explosiveness. High RTT parameter values relative to the average value remain present. When the parameter R is recalculated for the aggregated signals, the values obtained are R10=4.09 and R20=2.71, respectively. This demonstrates that explosiveness remains strong. Aggregation does not affect the nature of the signal, which is understandable because fractal signals exhibit similar behavior at different scales or aggregation levels. The signals are self-similar to each other, which refers to the previously mentioned phenomenon of self-similarity. In an ideal fractal, this property remains independent of the scale. However, in real cases, there is a critical aggregation level at which the property of self-similarity is lost as a hallmark of fractals. In such a case, the next level of analysis involves considering the RTT series as multifractals—specifically, calculating the multifractal spectrum.

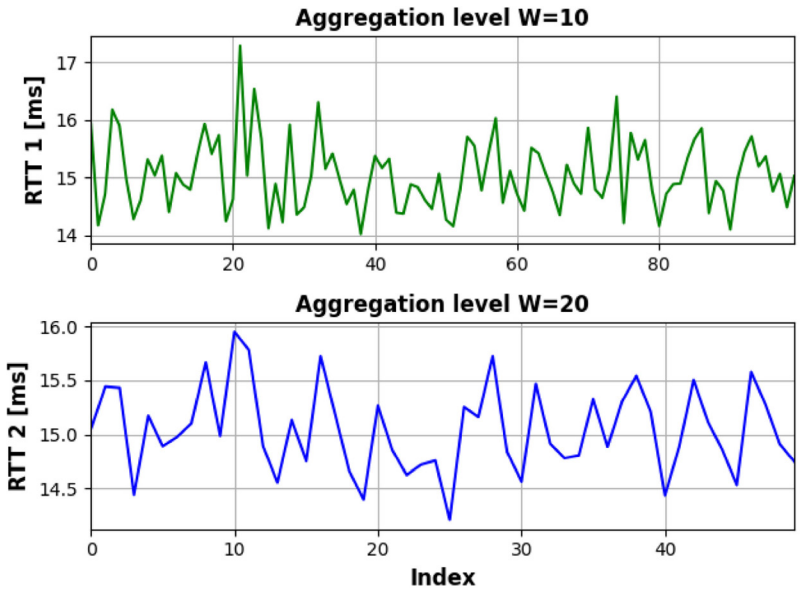

Figure 2. RTT time series plot for different aggregation levels W

Source: Own calculations

The fractal property of self-similarity can be observed not only through the analysis of the original and aggregated time series but also by examining the autocorrelation function. Figure 3 shows the autocorrelation function for the RTT time series. It is noticeable that the values decrease slowly with increasing lag. This is because, in fractal processes, there is a strong correlation between values even for larger lags. This property is known as long-range dependence (LRD), in contrast to short-range dependence (SRD). The decay of autocorrelation can be described by a power-law, where the exponent can be linked to the Hurst exponent as a fundamental descriptor of the fractal time series. Calculating the Hurst exponent is essential for the nonlinear analysis of RTT time series.

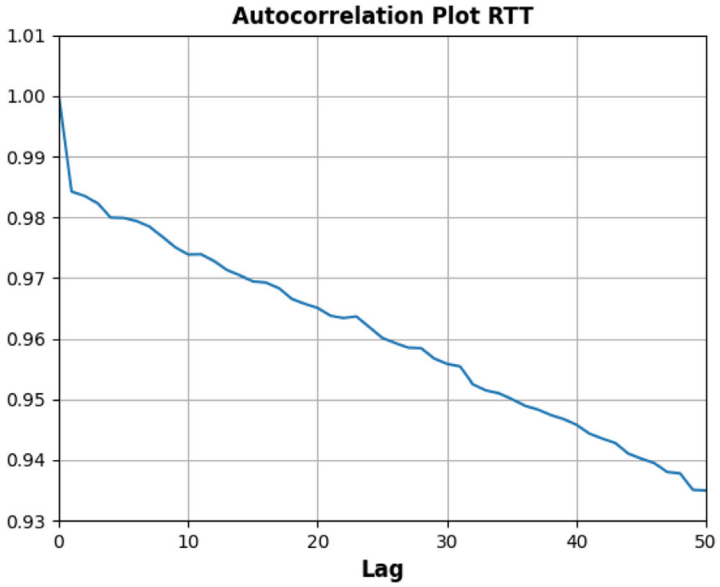

Figure 3. Autocorrelation function of the RTT time series for different lag values
Source: Own calculations

4. FRACTAL ANALYSIS OF RTT TIME SERIES

Since the RTT time series exhibits fractal properties, a fractal analysis was performed using methods from RS (R/S) statistics. Figure 4 shows the relationship of the RS statistics at different scales on a logarithmic scale. In this example, the Hurst index for the RTT time series is H=0.904, which was calculated using equation 5 and applying linear regression to the RS diagram. This value falls within the range 0.5<H<1, indicating a long-range dependence process. The Hurst index reflects the fluctuation characteristics of the time series in terms of temporal flow. Moreover, the estimated value for this RTT series is relatively high. A decrease in this value for the RTT series can indicate certain abnormal behaviors in the operation of the computer network. In this way, the Hurst index can be seen as a type of indicator for the state of a computer network. Since the RTT time series is fractal, its fractal dimension must also be defined. In this example, based on the equation for estimating the Hurst exponent, the calculated fractal dimension is D=1.096.

The behavior of the Hurst exponent is examined for different packet sizes sent to estimate RTT delay. For various packet sizes, which represent powers of two (ranging from 32 to 256), RTT responses were recorded, resulting in the corresponding time series. For each of these obtained time series, the RS statistics and the corresponding Hurst index were calculated. The number of samples in each time series is 1000. Using linear regression, the slope coefficient (k=0.00031) and the intercept on the y-axis (n=0.767) were estimated. With an increase in packet size, there is an observed rise in the value of the Hurst index, which remains consistently high with values greater than 0.5.

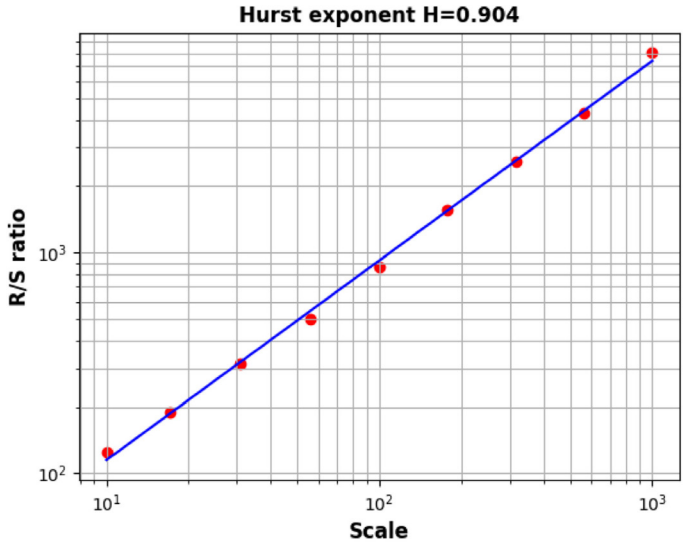

Figure 4. Estimation of the Hurst exponent value
Source: Own calculations

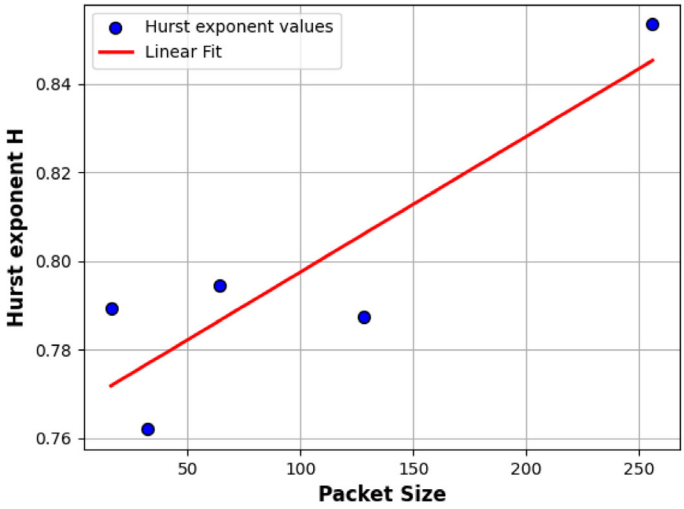

Figure 5. Dependence of the Hurst exponent on packet size for RTT value estimation
Source: Own calculations

5. CONCLUSION

For the automation of computer networks, it is crucial to identify representative features that can be used in training and applying appropriate algorithms. The primary metric for evaluating the performance of computer networks is the RTT metric. Features derived from it are very important for understanding the state of computer networks. In this study, both basic and fractal analyses of RTT time series were performed. These methods are a natural choice given the fractal nature of the RTT time series. The analysis showed that the RTT time series is a long-range dependence (LRD) process with long-term memory. The value of the Hurst exponent can indicate the occurrence of certain disturbances in the operation of a computer network. Due to the complexity of the RTT time series, it is necessary to consider multifractal analysis for the next level. Examining multifractal spectra can provide a fuller insight into the processes within networks that cannot be captured by basic monofractal analysis.

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The Importance of Security Protocols in Wireless Computer Networks

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Abstract: *Wireless networks have become an essential part of modern digital infrastructure, playing a key role in contemporary computer networks. Their primary purpose is to enable communication and access to information resources without relying on physical connections. The convenience and adaptability offered by wireless technologies have significantly increased their use across various settings, from households to large-scale enterprises. However, as their usage grows, so do the associated security risks. Wireless networks are particularly vulnerable to attacks such as malware infiltration and unauthorized access to sensitive information. Consequently, securing these networks has become a vital aspect of network management. This paper explores the significance of security protocols designed to safeguard wireless networks. After analyzing several security protocols, special attention will be given to WPA3 (Wi-Fi Protected Access 3) protocol, highlighting its advancements over earlier versions, such as WPA2. Additionally, the authors will analyze common threats targeting wireless networks and explain their protection.*

1. INTRODUCTION

The wireless medium is a vital element of contemporary network infrastructures, providing enhanced flexibility and seamless connectivity for devices on a global scale. In Cisco network setups, wireless communication transmits binary data as electromagnetic signals over designated radio or microwave frequencies. By eliminating the requirement for physical cabling or network ports, this medium offers dynamic connectivity for end devices. This advantage has driven the widespread integration of wireless solutions, establishing them as the preferred method for accessing home, enterprise, and industrial networks.

However, wireless technology has its limitations that network administrators must consider. Coverage is a prominent challenge, as wireless signals perform optimally in open spaces. Materials such as concrete, steel, and other structural barriers can weaken signals and restrict effective coverage areas. Additionally, wireless signals are vulnerable to disruptions from devices like landline-based cordless telephones, certain fluorescent lighting systems, and microwave appliances, which can impair performance.

Wireless networks are also prone to increased security threats. The lack of a physical barrier allows unauthorized users to exploit vulnerabilities more easily. Therefore, implementing advanced security measures is imperative. Protocols such as WPA3 (Wi-Fi Protected Access 3) offer enhanced encryption and authentication capabilities, safeguarding wireless communications across modern

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enterprise environments. Another limitation arises from the shared nature of the wireless medium. WLANs operate in a half-duplex mode, allowing only one device to send or receive data at any given time. As the number of connected devices grows, available bandwidth per device decreases, which can be challenging in high-density usage scenarios.

While wireless solutions are particularly effective for offering portability and adaptability, wired technologies like Ethernet over copper and fiber optics continue to support modern network infrastructures. By integrating wireless access points with high-capacity wired connections between routers, switches, and core devices, administrators can achieve a robust balance of scalability, reliability, and performance within their networks.

This study examines the critical role of security protocols in protecting wireless networks from vulnerabilities. The focus will be on exploring various security mechanisms, with a particular emphasis on the WPA3 (Wi-Fi Protected Access 3) protocol. The discussion will highlight its enhancements over the earlier WPA2 version and its ability to address modern security challenges. This paper is organized as follows: Chapter 2 presents a brief review of the primary IEEE standards for wireless networks. Chapter 3 focuses on wireless security protocols, with a particular emphasis on WPA3, highlighting its significance and advantages. Chapter 4 evaluates common threats to wireless networks, while Chapter 5 proposes effective strategies to mitigate these risks by using WPA3.

2. IEEE STANDARDS IN WIRELESS NETWORKS

The guidelines developed by the Institute of Electrical and Electronics Engineers (IEEE) play a crucial role in defining the functionality, interoperability, and performance of wireless technologies. These standards govern the Data Link and Physical layers within the OSI reference model, forming the foundation for creating reliable and secure wireless communication systems. To address specific challenges in data transmission over radio frequencies, wireless communication relies on a wide range of IEEE standards that enable devices to exchange information efficiently and reliably. IEEE standards are designed to ensure that devices can reliably communicate over wireless channels, providing users with seamless connectivity and higher throughput. Some of the key aspects covered by IEEE guidelines (Rappaport, 2024) include:

1. Converting Digital Data into Radio Signals: One of the fundamental functions of wireless communication is the transformation of digital information into electromagnetic waves. This process requires modulating the digital signal into an appropriate radio frequency format, ensuring accurate data transmission over wireless channels.
2. Selecting Transmission Frequencies and Power Levels: To minimize interference and improve signal quality, IEEE standards define optimal frequency ranges and power levels for transmission. This ensures reliable communication while reducing the likelihood of network congestion.
3. Receiving and Decoding Data: Once transmitted, data must be properly received and interpreted by the target device. IEEE standards include protocols for signal reception and error correction, preserving data integrity and minimizing losses.
4. Antenna Design: The quality of antennas directly impacts the performance of wireless systems. IEEE guidelines direct their construction to achieve optimal transmission and reception while minimizing interference, particularly in densely populated urban areas.

Today, various IEEE standards are widely implemented in wireless networks, including Wi-Fi (IEEE 802.11), Bluetooth (IEEE 802.15), WiMAX (IEEE 802.16), and Zigbee (IEEE 802.15.4).

Each of these standards addresses specific user needs, providing unique advantages in different environments. For instance, Wi-Fi, based on the IEEE 802.11 standard, is the most widely used wireless communication technology in modern networks. It is central to Wireless Local Area Networks (WLANs), providing high-speed connectivity for devices in homes, businesses, and public spaces. Wi-Fi facilitates fast and convenient internet access for devices such as laptops and smartphones. One of the key features of Wi-Fi is its use of the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocol. This protocol allows devices to "listen" to the network channel before transmitting data, ensuring that multiple devices can share the same medium without causing interference or collisions. Over the years, the IEEE 802.11 protocol has evolved, with several revisions improving data rates, range, and security. From 802.11a/b/g to the more recent 802.11n/ac/ax standards, each iteration has provided increased performance, making Wi-Fi a scalable solution for a wide range of applications (Qureshi & Asghar, 2023). A comparison of different 802.11 standards in terms of the radio frequency used and the maximum flow rate that can be achieved is shown in Table 1.

The IEEE 802.15 protocol governs Bluetooth, a technology designed for short-range wireless communication. Bluetooth is primarily used in Wireless Personal Area Networks (WPANs), facilitating connections between devices within a limited range of up to 100 meters. Its primary advantage lies in its low power consumption, making it ideal for use in a wide variety of portable and battery-powered devices, such as keyboards, computer mice, headsets, and smartwatches. Bluetooth operates in the 2.4 GHz ISM band and uses a frequency-hopping spread spectrum to minimize interference. It supports data transfer rates sufficient for peripherals and small devices, with its applications extending into IoT environments where power efficiency is a crucial factor.

For areas requiring broader coverage and higher data throughput, WiMAX (IEEE 802.16) provides a powerful solution. WiMAX is designed to deliver high-speed wireless broadband services over larger distances than traditional Wi-Fi, with a range of up to 50 kilometers. WiMAX is particularly well-suited for providing broadband internet access in rural or underserved areas, where traditional cable or DSL infrastructure may not be available. Unlike Wi-Fi, which is typically used in local environments like homes and offices, WiMAX can support Wireless WAN (Wide Area Networks), enabling service providers to offer internet access over vast geographical areas. It utilizes a point-to-multipoint architecture, where a central base station communicates with multiple end-user devices, ensuring high-speed data transfer even in remote locations. WiMAX provides a viable alternative to wired broadband technologies, offering scalability and flexibility in its deployment (Mokeresete & Esiefarienrhe, 2022).

Zigbee (IEEE 802.15.4) is a protocol designed for low-data-rate, low-power communication, making it ideal for Internet of Things (IoT) applications. Zigbee is typically used in scenarios where devices need to communicate over short distances with minimal power consumption, such as in smart homes, industrial automation, and environmental monitoring systems. Zigbee devices are known for their long battery life, making them perfect for use in sensors, smart meters, lighting systems, and other IoT devices (Mishra & Kumar, 2022). Operating in the 2.4 GHz ISM band, Zigbee is optimized for low-power communication, allowing for large-scale deployments of devices in smart environments. The technology supports mesh networking, where devices can relay data to one another, enhancing the range and reliability of the network.

In addition to the protocols discussed above, other wireless technologies such as 4G/5G cellular networks and satellite communications are further expanding the potential for connecting devices globally. These technologies are enabling new applications in fields such as autonomous vehicles,

healthcare, and smart cities. As the demand for seamless, high-performance wireless communication continues to grow, the role of guidelines like those developed by IEEE will be instrumental in shaping the future of connectivity. The integration of Wi-Fi, Bluetooth, WiMAX, Zigbee, and other wireless protocols into modern networks ensures that users can access data and services in ways that were once unimaginable. Whether providing high-speed internet in urban areas or connecting low-power IoT devices in remote environments, these technologies will continue to evolve, offering greater flexibility, performance, and reliability to meet the diverse needs of users and businesses alike.

Table 1. The comparison of various 802.11 standards

IEEE standard	Radio frequency	Description
802.11	2.4 GHz	Data rate up to 2 Mb/s
802.11a	5 GHz	Data rate up to 54 Mb/s Not interoperable with 802.11b ili 802.11g
802.11b	2.4 GHz	Data rate up to 11 Mb/s It provides greater coverage than 802.11a and better penetration in company buildings
802.11g	2.4 GHz	Data rate up to 54 Mb/s Compatible with 802.11b
802.11n (Wi-Fi 4)	2.4 i 5 GHz	Data rates in range 150 – 600 Mb/s It requires multiple antennas using MIMO technology
802.11ac (Wi-Fi 5)	5 GHz	Data rate in range 450 Mb/s – 1.3 Gb/s Supports the use of up to eight antennas
802.11ax (Wi-Fi 6/6e)	2.4, 5 GHz i 6 GHz	High-Efficiency Wireless (HEW) Able to use 1 GHz and 7 GHz frequencies
802.11be (Wi-Fi 7)	2.4, 5 GHz i 6 GHz	Data rate up to 46 Gb/s, doubles the size of the widest channel of Wi-Fi 6 at 320MHz.

Source: Own research

3. WIRELESS SECURITY PROTOCOLS

As wireless networks continue to evolve and gain widespread adoption, they have increasingly become targets for malicious activities. Cybercriminals aim to exploit these networks by injecting malware or stealing sensitive user data. As wireless technology evolves, attackers adapt with new methods, driving the ongoing creation of stronger security measures. The need for effective protection has made wireless network security a critical aspect of safeguarding user information, ensuring data integrity, and maintaining confidentiality during transmission. To address these challenges, various security protocols have been developed to defend against unauthorized access and cyber threats. Among the most notable protocols are WEP (Wired Equivalent Privacy), WPA (Wi-Fi Protected Access), WPA2, and the latest iteration, WPA3. Each successive protocol has introduced enhanced features designed to bolster network security (Halbouni et al., 2023).

Introduced in 1997, WEP was the first attempt to implement wireless security, aiming to provide a level of encryption equivalent to that of wired networks. WEP used hexadecimal keys of 64 or 128 bits to encrypt data, offering basic protection by preventing intercepting. However, it was a static encryption scheme, meaning that the same encryption key was used across the entire network, rendering it vulnerable to various types of attacks. WEP's primary goal was to prevent "Man-in-the-Middle" (MITM) attacks, but over time, its weaknesses became apparent. The encryption algorithm used by WEP could be easily cracked by attackers, especially with the development of more sophisticated tools. Due to these security vulnerabilities, WEP was officially retired in 2004 by the Wi-Fi Alliance, marking its obsolescence in modern wireless networks.

To overcome the shortcomings of WEP, the Wi-Fi Alliance introduced WPA in 2003. WPA aimed to significantly improve the security of wireless networks by introducing dynamic key generation. WPA employed the Temporal Key Integrity Protocol (TKIP) to generate new keys for each data packet, enhancing the security of data transmissions. In addition, WPA increased the initialization vector size to 48 bits, further strengthening the encryption process and making it more resistant to attacks that relied on repeated vectors. WPA also introduced the Extensible Authentication Protocol (EAP) for improved authentication and used the IEEE 802.1X standard to control access to the network. This made WPA far more secure than WEP by preventing unauthorized access and tampering with data packets. Furthermore, WPA implemented centralized network management via RADIUS servers, simplifying network administration, particularly in larger environments.

WPA2, introduced as an improvement over WPA, further enhanced security by replacing the TKIP encryption algorithm with the Advanced Encryption Standard (AES). AES supports key sizes of 128, 192, or 256 bits, providing a far stronger encryption mechanism compared to WPA's TKIP. WPA2 also introduced the Counter mode Cipher block chaining Message authentication code Protocol (CCMP), which is based on the Robust Security Network (RSN) concept. CCMP allows for dynamic key generation and message integrity checking, ensuring that data is encrypted securely during transmission. This shift from TKIP to AES greatly enhanced the security of wireless networks, making WPA2 the preferred protocol for many years. WPA2's adoption of stronger encryption and better authentication methods made it a significant advancement in securing wireless networks.

The latest iteration of wireless security, WPA3, was introduced by the Wi-Fi Alliance to address the challenges posed by increasingly sophisticated cyber threats. WPA3 builds on the security foundations of WPA2 while introducing several new features to further strengthen network protection. One of the most significant innovations in WPA3 is the use of Simultaneous Authentication of Equals (SAE), a robust password-based authentication protocol that is resistant to offline dictionary attacks. SAE ensures that passwords are not exchanged in plaintext, reducing the risk of interception by attackers. Additionally, WPA3 uses a unique session key for each individual session, further securing the communication between clients and access points. Unlike its predecessors, WPA3 also incorporates stronger encryption standards, such as Galois/Counter Mode Protocol with 256-bit encryption (GCMP-256) and Hash-based Message Authentication Code (HMAC), providing enhanced protection for both personal and enterprise networks. However, WPA3 is not backward compatible with older devices, which necessitates upgrading hardware to support the new protocol.

WPA3 introduces multiple modes of operation, each designed to provide optimal security for different use cases. For personal networks, WPA3-Personal employs SAE for password-based authentication, offering enhanced security even with simple passwords. WPA3-Enterprise, on the other hand, is designed for business environments, requiring protected management frames and offering advanced encryption with 256-bit keys. Additionally, WPA3-Enterprise supports multiple EAP methods for authentication, providing flexible options for enterprise security. WPA3 also includes the "Wi-Fi Enhanced Open" mode, which enhances privacy in open networks by encrypting traffic even without a password. This feature prevents passive eavesdropping on open Wi-Fi networks, using 256-bit encryption and 384-bit keys for protection. Table 2 briefly compares the listed security wireless protocols and their main characteristics.

The Simultaneous Authentication of Equals (SAE) protocol is a fundamental improvement in WPA3, offering significant resistance to offline attacks. The vital feature of SAE is the use of Zero-Knowledge Proof (ZKP) techniques. These techniques allow the client and the AP to authenticate each other without revealing the actual password. ZKP proves that the client knows the correct password without

having to send it over the network, thereby ensuring a higher level of privacy and security. This method of authentication is a crucial defense against attacks that attempt to expose or steal passwords from unsuspecting users. The SAE authentication process begins with an exchange of initial messages between the client and the AP. In this initial phase, both parties engage in cryptographic operations to compute a "shared secret." This secret key serves as the foundation for further communication and secures the authentication process. SAE's reliance on a shared secret ensures that the system only grants access to devices that possess the correct credentials, strengthening overall network security.

Table 2. The comparison of security wireless protocols

Authentication Method	Encryption	Session key	Level of security	Description
Wired Equivalent Privacy (WEP)	RC4	64/128 bit	Very low	The original 802.11 specification was designed to protect data using an encryption method called Rivest Cipher 4 (RC4) with a static key. WEP is no longer recommended and should not be used.
Wi-Fi Protected Access (WPA)	TKIP/RC4	128 bit	low	The Wi-Fi Alliance standard that uses WEP but protects data with a much stronger encryption algorithm called Temporal Key Integrity Protocol (TKIP). TKIP changes the key for each packet, making it much harder to hack.
WPA2	AES/CCMP	128 bit	Moderate	Encryption uses the advanced Advanced Encryption Standard (AES). AES is currently considered the strongest encryption protocol.
WPA3	AES/CCMP AES/GCMP	128/256 bit	High	It represents the next generation of Wi-Fi security. All devices with WPA3 enabled use the latest protection methods, prohibit outdated protocols, and require the use of Protected Management Frames (PMF).

Source: Own research

One of SAE's most important defenses is its resistance to brute-force attacks. Traditional systems are often vulnerable to attackers who try multiple password combinations in rapid succession. In contrast, SAE limits the number of authentication attempts a client can make. Each attempt requires interaction between the client and the AP, which slows down the process and makes it more difficult for attackers to perform exhaustive searches for the correct password. This design adds an additional layer of protection, especially in scenarios where attackers may be trying to crack a weak password.

SAE further utilizes elliptic curve cryptography (ECC), a form of public-key cryptography that is highly efficient and secure. ECC allows for the generation of smaller, more efficient cryptographic keys while still providing the same level of security as traditional methods with much larger key sizes. This contributes to the overall performance and robustness of the SAE protocol, especially in mobile and resource-constrained environments.

4. THREATS AND ATTACKS IN WIRELESS LAN NETWORKS

Various types of attacks can occur in wireless LAN networks, with the most common being packet sniffing and decryption. Sniffing, also known as packet capturing, is a technique used by attackers to monitor and analyze network traffic without permission. This process is carried out using various tools and methods that allow the attacker to intercept data as it passes through the network. Tools for sniffing, often referred to as "sniffers" or "network analyzers," include

popular applications like Wireshark, Tcpdump, and Ettercap. Sniffing can be passive, where the attacker simply monitors traffic without interfering with the communication between legitimate users, allowing the attacker to collect sensitive data such as usernames, passwords, and other confidential information. Active sniffing, on the other hand, involves the attacker changing or redirecting packets within the network. This method includes attacks like Man-in-the-Middle (MITM), where the attacker sits between two communicating parties and intercepts or alters the exchanged data. Preventing sniffing is achieved by encrypting sensitive data, which is done using the WPA3 security protocol (Rahman & Tomar, 2018).

Decryption is the process of converting encrypted data back into its original, readable form. While this process is necessary for users to access protected information, it poses a significant security risk when carried out by unauthorized parties. Attackers can decrypt data using brute-force attacks, trying all possible key combinations until they find the correct one. This method can be slow and less effective against modern encryption methods. Preventing decryption is done through the use of strong encryption protocols like AES and RSA, which provide high levels of security when properly implemented.

Additionally, there are Denial-of-Service (DoS) and Distributed Denial-of-Service (DDoS) attacks. A DoS attack is carried out by sending a large number of requests or specially crafted packets to a target in order to overload the system and deny services to legitimate users. These attacks can be carried out in various ways, including flooding attacks, where the attacker sends large amounts of traffic to the target using protocols like ICMP (ping flood) or UDP (UDP flood), or attacks that exploit vulnerabilities in software or protocols. For example, attacks can exploit vulnerabilities in the TCP/IP protocol. A DDoS attack is a more advanced version of a DoS attack, where the attacker uses a large number of compromised computers (bots) to carry out the attack. These computers form a botnet, which sends massive amounts of traffic to the target in a coordinated manner. The key characteristic of DDoS attacks is their distributed nature, with traffic coming from multiple sources, making it difficult to stop and trace the source. Due to the large number of compromised devices, DDoS attacks can generate much higher traffic volumes than traditional DoS attacks. Figure 1 illustrates DDoS attacks.

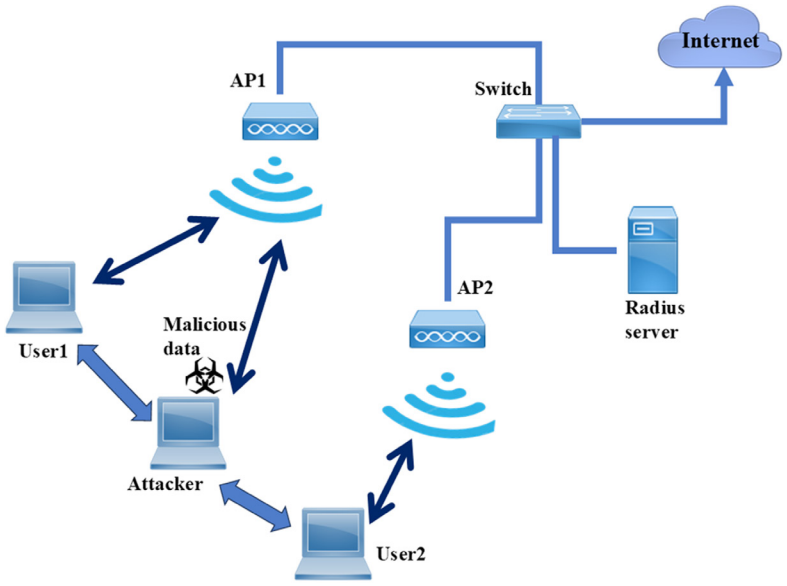

Figure 1. The illustration of DDoS attack in wireless LAN network

Source: Own illustration

The presence of a Rogue Access Point (AP) is another threat in wireless LAN networks. A rogue AP is a wireless access device connected to the network without permission or knowledge of the network administrator. These rogue APs may be set up maliciously by an attacker or unintentionally by users trying to extend the range of the wireless network. Key characteristics of a rogue AP attack include:

1. Unknown infrastructure: The rogue AP may be physically installed on the network or configured as an unauthorized wireless access point.
2. Security vulnerabilities: Rogue APs often lack adequate security measures, making it easier for attackers to gain access to the network.
3. Packet sniffing: Attackers can use a rogue AP to intercept and analyze network traffic.

An Evil Twin attack is a specific type of rogue access point attack where the attacker sets up a wireless access point that has the same SSID (Service Set Identifier) as a legitimate network. The goal of these attacks is to deceive users into connecting to the fake network, thereby allowing the attacker access to their data. Key characteristics of an Evil Twin attack include the imitation of a legitimate network, with the attacker using the same SSID and often a stronger signal to lure users in. Data theft occurs when users, unknowingly connected to the Evil Twin network, send their sensitive information, such as passwords, emails, and other private data, to the attacker.

A Man-in-the-Middle (MitM) attack is another form of interception where the attacker can both intercept and alter the communication between a user and the legitimate network.

The consequences of rogue AP and Evil Twin attacks can be severe, leading to the theft of sensitive data. Attackers can gain access to confidential information, such as passwords, financial details, and personal data, which can lead to serious security breaches.

5. WIRELESS NETWORK PROTECTION WITH WPA3

WPA3 introduces several security enhancements, one of the most important being Management Frame Protection (MFP). MFP is designed to prevent attackers from pretending to be access points (AP) and carrying out deauthentication attacks. In such attacks, an attacker can send fake deauthentication frames to a device, causing it to disconnect from the network. This type of attack can be disruptive and is often used as a starting point for other attacks, such as Man-in-the-Middle (MitM) attacks. With MFP, WPA3 ensures that only valid management frames from the actual AP are accepted by the client, effectively blocking attempts to pretend to be the AP and protecting the integrity of the communication between the client and the network. By enhancing the security of management frames, MFP makes it more difficult for attackers to carry out malicious actions, especially in public or less secure environments. WPA3 offers several protection modes customized to the specific needs of individuals and organizations. The three main WPA3 protection modes include WPA3-Personal, WPA3-Enterprise, and Wi-Fi Enhanced Open. WPA3-Personal is aimed at protecting individual users through SAE encryption. This mode significantly improves security over WPA2 by using SAE to defend against offline password-cracking attempts. Even users with simpler passwords will benefit from the higher level of protection provided by SAE. Additionally, WPA3-Personal allows users to choose passwords that are easy to remember while maintaining strong encryption standards. This balance between user convenience and security makes WPA3-Personal ideal for home networks and smaller deployments (Lamers et al., 2021).

In contrast, WPA3-Enterprise is designed for businesses and organizations that require a higher level of security. Based on WPA2-Enterprise, WPA3-Enterprise mandates the use of protected

management frames for all WPA3 connections. This ensures that management traffic remains secure, reducing the risk of attackers manipulating network data. WPA3-Enterprise also supports various authentication methods through the Extensible Authentication Protocol (EAP), providing flexibility for organizations that need to integrate with existing systems. With 128-bit encryption, a 256-bit key, and enhanced frame protection, WPA3-Enterprise offers a more secure and scalable solution for large networks (Halbouni et al., 2023).

Wi-Fi Enhanced Open, on the other hand, is specifically designed for public networks, such as those found in cafes or airports, which typically do not require passwords to connect. However, these networks are particularly vulnerable to passive eavesdropping and attacks. Wi-Fi Enhanced Open addresses this vulnerability by encrypting traffic, even when no password is used. This approach prevents unauthorized users from intercepting network communication, thereby increasing privacy for all users. It employs advanced encryption standards, including 256-bit encryption and 384-bit keys, to ensure security in environments where traditional WPA2 or WPA3 protection may not be applicable.

6. CONCLUSION

As wireless networks continue to evolve, securing these systems has become a paramount concern. In this context, several security protocols have been developed to address vulnerabilities in wireless communication, ensuring the integrity, confidentiality, and authenticity of data transmitted across networks. This paper provides an in-depth exploration of these protocols, focusing on the progression from WEP (Wired Equivalent Privacy) to WPA3 (Wi-Fi Protected Access 3), highlighting the advancements in security measures that each successive protocol brings. The evolution of wireless security protocols from WEP to WPA3 demonstrates the growing complexity of securing wireless networks against an ever-expanding range of cyber threats. Each successive protocol has introduced advanced encryption techniques, dynamic key management, and improved authentication methods to protect data integrity and confidentiality. WPA3, with its enhanced encryption standards, SAE authentication, and protection against brute-force and offline attacks, represents the next step in securing modern wireless networks. WPA3 represents a significant advancement in wireless security protocols, offering a range of features designed to mitigate the growing risks faced by modern wireless networks. From the introduction of SAE, which improves protection against offline and brute-force attacks, to the enhanced management frame protection that thwarts impersonation attempts, WPA3 offers comprehensive safeguards for both individual users and enterprise networks. By implementing stronger encryption methods, better authentication techniques, and robust defenses against common attack vectors, WPA3 is poised to become the standard for secure wireless communication in the coming years. However, as with any security system, it is essential to remain vigilant and adapt to emerging threats to ensure the continued safety of wireless communications.

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Managing Cloud Security

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Abstract: *Cloud computing has become the technology of choice for companies seeking the agility and flexibility necessary to accelerate innovation and meet the expectations of today's modern consumers. However, migrating to more dynamic cloud environments requires new security approaches to ensure that data remains protected across online infrastructures, applications, and platforms. Cloud security encompasses the cybersecurity policies, best practices, controls, and technologies designed to safeguard applications, data, and infrastructure in these environments. Its primary goals are to protect storage and networks from internal and external threats, manage access and data, ensure compliance, and facilitate disaster recovery. This includes implementing security policies, practices, controls, and technologies such as identity and access management and data loss prevention tools to defend against unauthorized access, online attacks, and insider threats. This paper aims to highlight the challenges of cloud security management to guide security professionals in adopting a cloud-based approach that enhances security without increasing risk.*

1. INTRODUCTION

More and more organizations are recognizing the key advantages and importance of Cloud platforms compared to traditional infrastructure systems. As digitalization and global connectivity become increasingly prominent, many companies are transitioning to Cloud solutions because they offer greater flexibility, scalability, and efficiency in managing IT resources. In comparison to traditional systems, Cloud platforms enable faster adaptation to market changes, easier access to advanced technologies, and reduced operational costs. This approach allows companies to focus on their core activities, while IT infrastructure is managed and maintained outside of their internal organization.

However, with the growing adoption of Cloud platforms, new security threats also emerge that need to be carefully monitored. The security of Cloud services is particularly crucial, as many of them require access to the public network, meaning they are vulnerable to potential attacks from malicious entities. At the same time, there is a need for certain services to be made available only through private, secure networks. This presents a challenge for organizations that must balance accessibility with data protection to ensure the maximum security of their systems and users. Security becomes a key factor in decision-making when it comes to choosing which Cloud services to use and how to integrate them into the business infrastructure (Zajeganović et al., 2023).

In this context, technologies and techniques used to build and manage Cloud services are constantly evolving to meet increasingly sophisticated security requirements. These changes may

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render some previous reference architectural models obsolete, as new technologies require new approaches. For example, various security protocols and encryption methods are continually being improved to ensure real-time data protection, which also involves innovations in network architecture design. Therefore, regular alignment with new standards and best practices in the industry is necessary (Ahmadi, 2024).

One of the key reference architectural models used in the Cloud industry is the model developed by the National Institute of Standards and Technology (NIST). This model provides detailed guidance and recommendations for building secure and efficient Cloud systems. By implementing the NIST model, organizations can apply best practices related to data protection, access management, and ensuring the reliability and availability of services.

In addition to NIST, there are other international standards, such as ISO/IEC 22123, which provide additional guidelines for building secure Cloud solutions. These models serve as a foundation for the development and implementation of Cloud services, with a focus on data protection, risk management, and compliance with regulations. Furthermore, with an increasing number of organizations using multiple Cloud platforms simultaneously, there has been a need for new models like the CSA Enterprise Architecture Model. This model facilitates the integration and alignment of services across different platforms, helping organizations create efficient and secure multi-cloud architectures. This approach is especially useful for organizations that want to deploy Cloud services across multiple locations, leveraging the strengths of different Cloud providers while maintaining high standards of security and interoperability.

In summary, to ensure security and efficiency in the Cloud environment, organizations must utilize reference models that enable the implementation of the latest technologies, alignment with international standards, and responsible risk management.

This paper will present the architectural models of cloud computing, followed by an introduction to the shared responsibility model concerning security, depending on the applied cloud model. Furthermore, tools that enable a clear distribution of responsibilities in the cloud will be introduced, along with an example of a simple cloud security process model. Finally, the paper will emphasize the critical aspects to consider when choosing service models and cloud computing deployment models to ensure robust security.

2. ARCHITECTURE MODELS

Cloud computing encompasses a wide range of technological techniques that are continuously improving, making any existing reference or architectural models potentially outdated and inadequate from the outset. For example, one way to approach cloud computing is by viewing it as a multi-layered system, where Software as a Service (SaaS) is built on Platform as a Service (PaaS), which is, in turn, built on Infrastructure as a Service (IaaS). While this model may not be universally applicable to all real-world scenarios, it provides a useful reference for understanding the basic structure of cloud environments. This complex system is further facilitated by the use of Application Programming Interfaces (APIs). APIs allow for efficient communication between various components within cloud systems, and many of them are provided to users so that they can manage their cloud resources and configurations.

The most commonly used API protocols in the cloud are REST (Representational State Transfer), which operates over the HTTP protocol, making it highly suitable for internet services. APIs are

often presented as remote services within web interfaces, enabling users to manage cloud resources such as virtual machines or networks. This level of cloud management is the fundamental distinction from the protection of physical infrastructure. While physical infrastructure security can rely on direct physical access controls, cloud environments lack such direct access. Therefore, cloud security must be designed considering the risk that an attacker could gain remote access through the management level, making the security of these systems more complex.

In the context of cloud services, there are different models that allow organizations to access various levels of infrastructure, platforms, and applications. Each of these models provides specific benefits and capabilities, depending on the needs of the user and their willingness to take on responsibility for certain aspects of their IT infrastructure.

Infrastructure as a Service (IaaS) is the most basic level of cloud service, providing users with access to the infrastructure necessary to run applications and systems. Under the IaaS model, users can utilize resources such as server capacity, data storage, network connectivity, virtual machines, and network devices, all without the need to invest in or maintain physical hardware. This allows organizations to quickly scale their capacity and infrastructure as needed without worrying about physical infrastructure. Through IaaS, businesses can efficiently manage their resources while also reducing costs associated with hardware procurement and maintenance.

The platform as a Service (PaaS) model offers greater complexity and flexibility compared to IaaS. This model allows users to develop, test, and deploy applications without the need to worry about the underlying infrastructure on which the applications run. PaaS includes comprehensive development platforms, which include operating systems, development tools, databases, data storage, and other services that facilitate easier application management. The PaaS model is ideal for organizations that want to focus on application development and innovation while relying on the cloud environment to handle operational aspects such as scalability, security, and availability. This model speeds up product development and reduces infrastructure-related costs.

Software as a Service (SaaS) is the highest level of cloud service, allowing users to access applications over the internet without the need to install or maintain them on their devices. Applications offered under the SaaS model cover a wide range of use cases, from business tools and project management applications to specialized data analytics or computational services. Users pay a subscription to access these applications, while the full administration, maintenance, and updating of the software solutions is the responsibility of the cloud service provider. The SaaS model is suitable for organizations that want to avoid the technical challenges associated with installing and maintaining software solutions, as well as for entrepreneurs who prefer to use applications based on a monthly or annual subscription.

In addition to these core models, there is a broader concept called Anything as a Service (XaaS), which encompasses all types of services that can be delivered over the internet, such as Security as a Service (SECaaS), Database as a Service (DBaaS), Identity as a Service (IDaaS), and Artificial Intelligence as a Service (AIaaS). These additional services span different service models such as IaaS, PaaS, and SaaS, but they are specific and provide users with access to specialized functions that complement the core services (Moguli & Rothman, 2024).

3. SHARED SECURITY RESPONSIBILITY MODEL (SSRM)

To achieve effective control over all cloud service models, it is necessary to implement the Shared Security Responsibility Model (SSRM). This model defines the boundaries of responsibility between cloud service providers (CSPs) and cloud service customers (CSCs) in detail, which is illustrated in Figure 1.

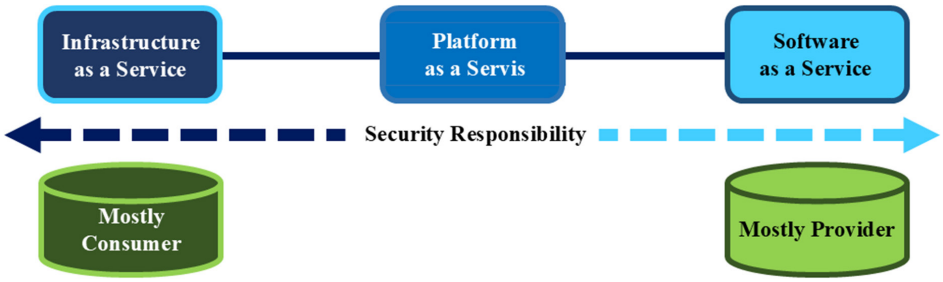

Figure 1. Shared Security Responsibility Model (SSRM)
Source: Own illustration

SSRM serves as a foundation for understanding which party is responsible for specific aspects of security, clearly delineating tasks such as protecting data, applications, infrastructure, and networks. This clarity enables cloud users to better comprehend their obligations regarding security while service providers take responsibility for implementing the appropriate controls at the infrastructure and platform levels (Sisodia & Khan, 2022). Understanding SSRM is essential because it provides users with the ability to plan and organize their security strategies effectively, particularly concerning data and system protection. Depending on the service model (IaaS, PaaS, or SaaS), the responsibilities of CSPs and CSCs vary. For example, in the Infrastructure as a Service (IaaS) model, users have greater control and responsibility for security, whereas, in the Software as a Service (SaaS) model, a larger portion of security responsibilities lies with the provider.

Proper implementation of this model allows organizations to optimize their cloud strategies, reduce operational costs, and enhance security. A clear understanding of responsibility allocation enables users to identify gaps in existing controls and address them with their security measures. Moreover, understanding this model helps organizations evaluate alternative providers if current CSPs do not meet their security requirements. To establish a clear and effective division of security responsibilities in the cloud, it is necessary to follow well-defined steps and recommendations. These guidelines not only facilitate communication and collaboration between CSPs and CSCs but also contribute to compliance with international standards and regulations (Chauhan & Shiaeles, 2023).

Cloud service providers must ensure comprehensive documentation that details internal security controls and functionalities available to users. This documentation provides precise information about data protection measures, risk management processes, and available tools. With transparency in these areas, CSCs can make informed decisions when selecting the most suitable provider and service model. For instance, if a CSP does not meet specific standards or user requirements, the organization can evaluate alternatives that better align with its needs.

In addition to documentation, service providers must carefully design and implement security controls within their purview. This includes protecting network infrastructure, encrypting data, managing access, and monitoring activities. The quality of these controls directly affects user trust and compliance with regulations such as GDPR, HIPAA, or ISO/IEC 27001. When controls

are properly implemented, the risk of security incidents decreases, and users' confidence in the safety of their systems and data increases.

Then, cloud service users should develop a matrix that clearly defines the responsibilities of all involved parties. This matrix should specify who is responsible for implementing specific security controls to avoid overlapping responsibilities or ambiguities. For example, in the IaaS model, users are responsible for the security of applications and data, while CSPs are responsible for the security of the physical infrastructure. Best practices also include aligning the matrix with regulatory requirements, such as PCI DSS standards for financial transactions or the NIST risk management framework.

To enable organizations to successfully manage complex cloud security challenges, specialized tools and frameworks are indispensable. One of the leading authorities in this field, the Cloud Security Alliance (CSA), has developed a set of tools that directly support the implementation of recommendations and standards for cloud security. These tools provide insights into key controls, facilitating a transparent understanding and enhancement of security practices.

The CAIQ (Consensus Assessments Initiative Questionnaire) is a standardized questionnaire designed to provide a detailed overview of the security and compliance controls implemented by cloud service providers (CSPs). Through this tool, CSPs can transparently demonstrate how they meet various security standards, such as ISO 27001, SOC 2, or GDPR. The documentation provided via CAIQ allows cloud service customers (CSCs) to:

1. Evaluate potential providers based on their compliance with requirements and standards.
2. Understand which security controls are available and how they can be used to enhance the protection of data and applications.
3. Make informed decisions based on detailed analysis of facts and available resources.

This questionnaire simplifies communication between CSPs and CSCs, ensuring a clear picture of the security levels offered by each provider, thereby reducing the risk of non-compliance with critical standards.

The Cloud Controls Matrix (CCM) is a comprehensive framework designed for mapping cloud-specific security controls. This tool not only identifies key controls but also links them to relevant international standards, such as PCI DSS, NIST, and HIPAA. The CCM offers the following key benefits for organizations relying on cloud services:

1. Enables detailed mapping of responsibilities between CSPs and CSCs, clearly defining who is responsible for specific security aspects.
2. Assists organizations in identifying gaps in existing controls and establishing strategies to address them.
3. Serves as a guide for aligning with various industry standards and regulations, simplifying compliance audits.

Unlike CAIQ, which provides a detailed overview at the level of individual CSPs, the CCM is a tool that allows organizations to build their security strategies based on pre-defined controls and frameworks.

By combining CAIQ and CCM, organizations can gain deeper insights into the security aspects of their cloud operations. These tools allow for improved transparency between CSPs and CSCs, to reduce risks associated with ambiguities regarding security responsibilities and to enhance

compliance with key regulations and standards, thereby increasing customer and partner trust. By leveraging these tools, organizations can not only identify current security deficiencies but also proactively implement measures to ensure a secure environment for their data and applications in the cloud over the long term. Thus, CSA tools become indispensable resources for anyone looking to leverage the benefits of cloud computing while maintaining a high level of security and compliance. A clearly defined allocation of tasks improves security, reduces the risk of incidents, and ensures alignment with legal and industry standards. In this way, organizations can fully capitalize on the advantages of cloud computing, ensure business continuity, and protect their systems and data from potential threats over the long run.

4. A SIMPLE CLOUD SECURITY PROCESS MODEL

In Figure 2, a basic model of cloud security processes is shown, which is crucial for establishing an effective system for protecting data and applications in a cloud environment. The process consists of several steps, each with a specific function in ensuring that security requirements are correctly implemented and maintained in line with the organization's needs.

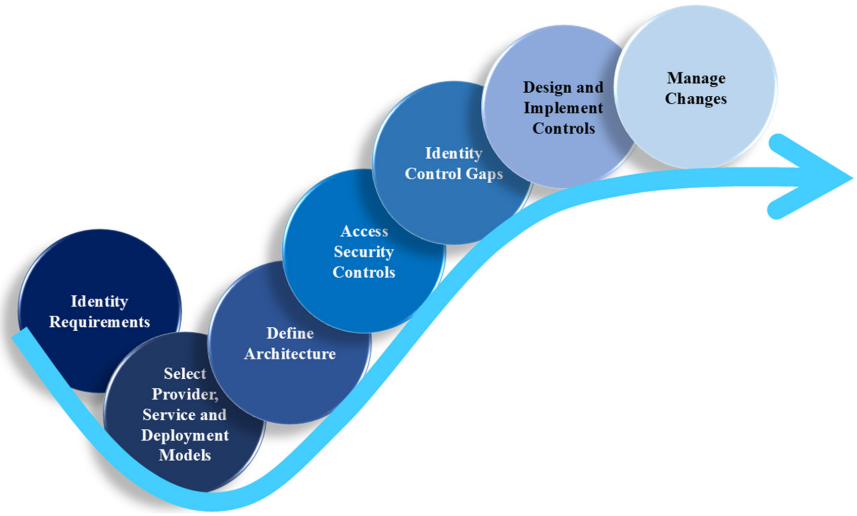

Figure 2. A model of cloud security processes
Source: Own illustration

The first critical step in the cloud security management process is identifying all security and compliance requirements, along with an analysis of existing security controls. This step is of great importance as it allows organizations to gain insight into what security measures are already implemented in their environment, as well as to identify additional controls or protection measures, they need to implement to achieve the desired level of security. During this phase, organizations also assess how their data and systems align with applicable industry standards, such as GDPR or ISO/IEC 27001, as well as legal regulations specific to their operations.

Once the basic security requirements are defined, the organization must make a strategic decision about choosing a cloud service provider (CSP). This choice should be carefully aligned with the organization's needs, taking into account the type of service that needs to be used (IaaS, PaaS, SaaS) and the deployment model. For instance, when selecting the IaaS model, users take on more responsibility for the security of their data, while in the SaaS model, a larger portion of the responsibility is assumed by the CSP. Since security is directly tied to the chosen provider and model, the CSP selection is critical for efficiently managing data security and protecting systems in the cloud.

After the cloud service provider and deployment model are chosen, the next step involves designing and defining the overall system architecture and its key components. This step encompasses both hardware resources, such as server and network infrastructure, and software components, including applications and tools that will be used in the cloud environment. It is crucial to focus on how the architecture will support the implementation of all security measures and ensure effective data protection.

Once the architecture is set, the organization must perform a detailed evaluation of the existing security controls provided by the chosen CSP. This includes analyzing the available tools and data protection mechanisms, access and authentication systems, as well as systems for monitoring and threat detection. Evaluating these controls enables the organization to identify weaknesses in the current security measures and pinpoint areas that require additional protection. Based on this analysis, the organization can identify security gaps that need to be filled, which is a critical step in enhancing the overall security strategy.

After identifying the gaps, the next step is to design and implement appropriate new controls to strengthen system protection. These controls may include additional data protection measures, such as enhanced encryption methods, further user authentication measures, or expanded systems for detecting and preventing attacks. The implementation of these controls must be thorough and precise to ensure that all areas of the system are properly protected. The organization needs to carry out rigorous testing of the effectiveness of these controls to verify that they truly provide the required protection and reduce the risk of potential threats.

5. CONCLUSION

Given that security challenges in the cloud environment are continuously evolving, the final critical step in the security management process is effective change management. Security policies and controls applied in the cloud must be flexible enough to adapt to new technological advancements, the emergence of new threats, as well as changes in legislation and industry regulations. Due to the rapidly evolving environment, organizations must regularly review and update their security guidelines and policies, as well as adjust security controls in response to emerging risks. This ongoing process of monitoring and adjustment is crucial for maintaining a high level of protection, ensuring data security, and safeguarding uninterrupted business operations. Furthermore, the continuous adaptation and improvement of security practices enable organizations to effectively deal with new threats and stay compliant with changes in legislation as well as industry standards and norms. Real-time adjustments help organizations maintain an optimal level of security, while also allowing the flexibility necessary to carry out business activities without disruption.

Cloud security is based on a shared responsibility between the cloud service provider (CSP) and the end users, i.e., businesses. As we move down the layers in the SPI (Software as a Service, Platform as a Service, Infrastructure as a Service) model, the responsibilities of the CSP gradually decrease, while the responsibilities of the user (CSC) increase. Therefore, organizations need to understand the precise division of responsibilities in every cloud project to successfully implement security measures and ensure adequate protection of their data and systems. Effective cloud security depends on a clear understanding of who is responsible for which aspects of protection in each of the mentioned layers and service models.

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The Use of Artificial Intelligence in Phases of Food Quality and Food Safety of Supply Chain

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Food supply chain;
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Abstract: *Artificial intelligence (AI) is based on the development of algorithms and calculation models with which computing systems can process and analyze large amounts of data, make predictions and make decisions based on these analyses. AI has also proven useful in the food processing sector.*

This paper provides a review of an emerging field in the food processing sector, referring to quality and safe food supply chains, controlled by AI to avoid human error. It has the potential to revolutionize the food sector in several ways, including increasing food quality and food safety.

The field is of great significance from economic, food safety and public health points of view. The application of artificial intelligence is hindered by social and economic barriers. These barriers can be overcome by disseminating good practices among the participants of the food supply chain. By using the AI-based system, food production and online delivery processes can be efficiently handled.

1. INTRODUCTION

Artificial intelligence (AI) includes the development of algorithms and computational models. They allow computing machines to process and analyze large amounts of data and based on this analysis make predictions or decisions.

AI reflects the ability of computer program-based computing machines to perform tasks that require human intelligence and involve learning, reasoning, solving complex problems, and making decisions. AI includes machine learning (ML), deep learning, natural language processing and cognitive computing, computer vision, and robotics.

AI is used in the agri-food sector to improve productivity, efficiency, and sustainability. It can revolutionize the agri-food sector in predictive analytics, supply chain optimization, food processing and packaging, quality control, and food safety. AI technologies can revolutionize the agri-food sector by improving food processing efficiency, reducing food waste, and increasing food safety and quality.

The use of artificial intelligence (AI) applications in the agri-food sector can help food producers and distributors make better decisions, improve efficiency, reduce food waste, and improve food safety and sustainability.

In the manufacture of foodstuffs, there was a risk of products being withdrawn from packaging lines and urgently disposed of if the expiry date is incorrectly stated. If the expiry date exceeds the actual date, consumers will use the product after its safe period, and thus risk getting sick.

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If the expiration date is mentioned too early, consumers will not consume the product, considering that the product has exceeded the shelf life and thus will have losses in the budget. AI offers solutions to avoid such situations.

2. IMPLICATIONS OF ARTIFICIAL INTELLIGENCE FOR THE AGRI-FOOD SECTOR

In the food industry, AI is used to optimize food processing operations and detect substances that accidentally appear on production lines (Subeesh & Mehta, 2021).

AI is used to identify, arrange and sort food by size, weight, shape and color, also helping to reduce waste. For a special purpose, AI can be used to monitor food safety, prevent consumers from getting sick, and improve public health. AI is used to analyze data provided by sensors and cameras located on production lines to detect potential sources of contamination.

AI has significant roles and potential applications in several food sectors. AI can make major contributions to the development of the food industry, and these contributions can be grouped into three categories as follows: food quality management, food safety management and food waste management (Monteiro & Barata, 2021).

Food processed under the control of robotic systems is safe. Automatic control must be ensured in each phase of processing, the entire processing chain must be monitored through various technologies based on software or robotic solutions. The automated system has several advantages for the food industry, such as increased productivity, quality of processed products, hygiene and safety (Sahni et al., 2021).

The introduction of automation and robotics equipment must ensure certain standards without introducing new hazards. The introduction of automation can have a positive impact, as it allows people to be removed from processing lines, as they are the most unpredictable source of contamination.

Physical hazards such as foreign objects that cause illness or injury to consumers may also occur during processing. Some potential food safety hazards may arise through the application of new technologies whose hazards are not yet fully elicited (e.g. genetically modified plants or nanotechnologies). To ensure food safety, some specific actions must be directed toward reducing or eliminating these potential hazards.

The use of AI and automation of manufacturing processes can accelerate data analysis, allowing for the rapid identification of deficiencies on manufacturing lines and potential food safety hazards. This allows for rapid intervention before potentially contaminated products reach consumers and thus helps prevent disease. Consumers' concerns about safe food are growing day by day.

In order to eliminate the risk of contamination and thus avoid food poisoning of consumers, good hygiene is necessary during the processing, storage and sale of food. Using image processing techniques taken from automatic processing lines, various characteristics of food products such as size, shape, color and texture can be analyzed. These characteristics can be useful in the quality control phase of the processed food product.

3. ROLE OF AI IN THE FOOD PROCESSING

AI technologies and intelligent automation systems used in the food processing industry contribute to optimizing technological processes and improving their efficiency.

The capabilities of intelligent systems with various tasks such as smart food packaging, product sorting, and foreign object detection are correlated along with various AI technologies. Also, supply chain management, which includes equipment cleaning, is coordinated together with products developed by various AI technologies.

AI technologies are used to analyze large amounts of data from production processes. Based on this data, monitoring patterns can be identified and predictions can be made to optimize production and improve the quality of processed food products. By using AI tools such as fuzzy logic, manufacturers can make accurate predictions and adjust their processes on manufacturing lines to achieve higher-quality finished products.

3.1. Intelligent Food Packaging

In the production sectors of the food industry, proper packaging of products is a time-consuming task. Food packaging aims to protect food, display the product and its characteristics, ensuring sanitation on the transport lines. Packaging protects food from damage caused by biological, chemical and physiological reasons throughout the entire food logistics system.

The visual aspect of the packaging is essential in consumers' evaluation of the quality of packaged food, it is the first impression of the product (Ben Ayed & Hanana, 2021). Using visual communication technology, with good visual communication ability, a packaging design can be improved by obtaining a commercial image of the packaging.

The development of AI-based packaging systems is a difficult task in the fruit and vegetable sector due to the diversity of their shapes, colours and sizes. Thus, a large amount of data is required to train the AI system properly. Other smart tools, such as robotic systems, can play a key role in significantly reducing the costs involved in the packaging process (Chen, 2019). For example, robotics can be used to automate the packaging process, improving the speed and efficiency of the process. Robots can be used to sort, remove impurities, and inspect food products to ensure that they are properly packaged and meet quality standards. Robotics can be used for management work, ensuring that materials to be packaged are available in continuous flow on automated packaging lines, reducing the risk of the automated line running empty.

With AI algorithms, data on product characteristics, environmental conditions, and other factors can be analyzed, and optimal packaging materials and patterns can be identified to improve the quality of the ready-to-package product and extend shelf life. In addition, AI can provide greater transparency and visibility into the supply chain, and the entire logistics process, and help improve food safety.

For high-quality food and high safety of consumers, it is required to verify the correctness of the expiration date, printed on the packaging of food products. Food information printed on food packaging is very important for food safety. Incorrectly labeled information about products on food packaging, such as the expiration date, can cause food poisoning. Moreover, such incidents

will entail additional financial costs for food producers. Such a situation causes large recalls of products, which were to be delivered and becomes a very important concern for food producers.

To verify the date code, one can use an automated AI solution, which takes photos of each date code, and verifies the date code programmed for that food product, allowing food processing companies to obtain a full traceable inspection for processed food products. The production line will automatically stop if the date code is incorrect, and thus processors can remove those products that have the incorrect date code from the supply chain, protecting consumers while reducing labor costs and food waste.

4. ASSEMBLY OF FOOD PRODUCTS – MAKING A SANDWICH - CASE STUDY

The automation of food production is exemplified, in our article, for the operation of assembling food products to obtain a sandwich, a food product consisting of a large number of discrete components. Through automation, manual operations have been eliminated in the production of sandwiches.

The proposed automated sandwich manufacturing system uses industrial robots and a transfer system to automate the entire manufacturing process. Due to the use of robots, assembly lines must be fenced with a protective fence to prevent human operators from entering the robots.

In our example, a scene shown in Figure 1, presents a virtual intelligent system to prepare the sandwiches.

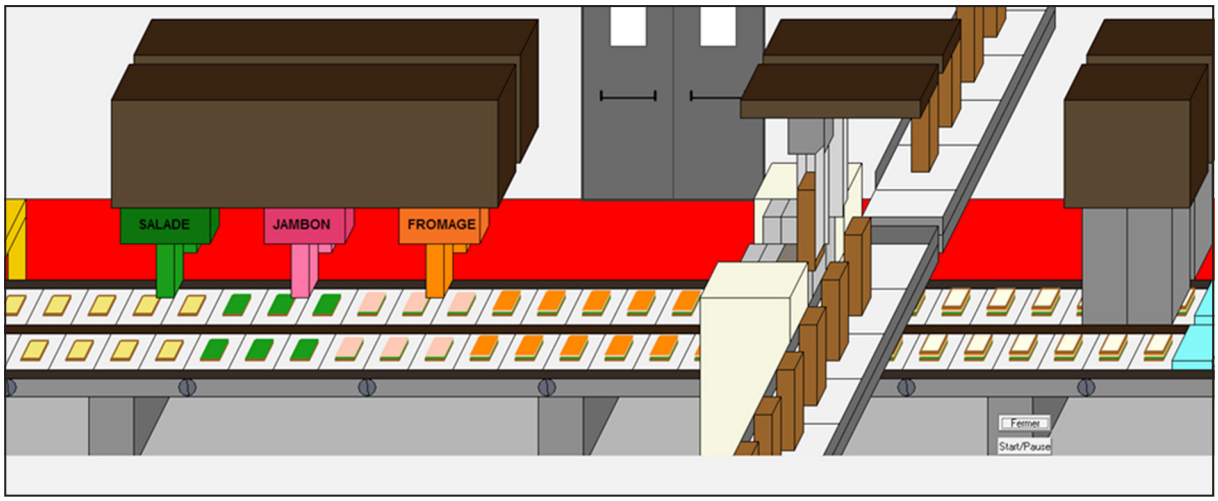

Figure 1. Using the virtual prototyping for design evaluation in an automatic system to make sandwiches – Virtual model with controls

Source: Own processing

The technical development of a product begins with numerical analysis and behavioral simulation, performed in a virtual scenario using Information Technology. Three-dimensional modeling and behavioral simulation through moving visualization introduce a new dimension to structural and visual representation.

From its origins, the idea of modeling has been the same, but it has taken on many forms of expression. These expressions are principally the result of technological advances in producing imagery, using Information Technology in the thinking process of the project.

Design thinking is an iterative process that design teams use to understand the needs of beneficiaries. The design thinking process is a collaborative process by which the designer's sensibilities and methods are employed to answer people's needs by redefining the project data. Design thinking converts needs into demands which helps designers become more innovative and more creative.

Using virtual prototyping for the design evaluation of automatic systems makes it possible to design different models and adapt these models to changing needs. Any modifications can be made in the design stage. The users can become involved just before the project's completion to declare their preferences. Inevitably, traditional ways of thinking and working had to make way for more innovative approaches such as virtual prototyping.

The main distinctive feature of virtual prototyping is its capacity to create realistic scenarios, to perform experimental research regarding automatic systems. The prototype structures - starting from the most basic problems and leading up to more complicated cases - include numerous scenarios of automatic systems to make sandwiches.

In the proposed system the ingredients included: two slices of bread, salad, hams, and two slices of cheese. This is considered by the industry to represent the most difficult sandwich-handling scenario.

The automated system consists of continuously running conveyor systems that transport bread slices and sandwich assemblies between workstations. This conveyor system consists of two belts, each belt carrying a slice - the upper and lower slice - which will be assembled to form a sandwich.

One slice of bread is placed on each strip, and as it moves along the line, additional ingredients are added to the bottom slice. After all the ingredients are added, the second slice is provided from the buffer box and placed on top of the first slice.

Studies made on the current virtual manufacturing lines have identified many individual processes necessary for sandwich construction:

1. Placing the ingredients – the individual ingredients are placed on a single slice of bread.
2. Topping – a second slice of bread is placed on top of the first slice.
3. Packaging – two sandwiches are packaged to form a single package.
4. Delivery - the sandwich package is delivered using the same type of conveyor.

The experimental results illustrate the very good performance of the described method.

5. CONCLUSION

The AI and automated system has several advantages for the food industry, such as improved productivity, product quality and profitability, improved hygiene and safety, and worker safety. Moreover, the use of automated systems helps to reduce injuries and decrease the cost of labour.

The integration of artificial intelligence and automatic systems in the food sector represents a pivotal moment in the food industry, driving sustainable development. The use of AI and automatic systems in production processes, is increasing food safety and food quality, and waste reduction across the sector. One of the major challenges in the automation of food production is the assembly of food products from a large number of discrete components.

AI in the food industry facilitates accurate demand forecasting, inventory, and supply chain management. It also empowers food manufacturers to address climate-related risks and enhance sustainable agricultural practices. Effective utilization of AI technologies can propel the food industry toward a sustainable future that is technologically advanced, and socially responsible.

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Differences Between Generations X, Y, Z Regarding Life Satisfaction and the Use of Artificial Intelligence in Slovenia

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Artificial Intelligence (AI);
Slovenia

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Abstract: *This study presents novel findings on the utilization of artificial intelligence among Generations X, Y, and Z in Slovenia. Through a survey of 722 individuals, we explored differences in AI usage and life satisfaction across these generations. Our focus was on three prominent AI models: ChatGPT, Gemini, and Bing.*

The primary hypotheses were: H1: There is a statistically significant difference in Summary Satisfaction with Life (SumSWL) among different generations and H2: There is a statistically significant difference in the use of AI language models (GPT, Gemini, and Bing) among different generations.

Our findings confirm a clear generational divide in AI adoption. Younger generations, particularly Generation Z, demonstrate a higher propensity for using AI tools compared to older generations. Among the analyzed AI models, ChatGPT emerged as the most popular, especially among younger demographics. However, there are no significant differences in Summary Satisfaction with Life (SumSWL) between any of the generational pairs.

1. INTRODUCTION

This research investigates the relationship between generational differences and the adoption of AI language models, specifically GPT, Gemini, and Bing. Additionally, the study examines whether there is a statistically significant difference in Summary Satisfaction with Life (SumSWL) among the three generations.

The primary hypotheses are:

H1: There is a statistically significant difference in Summary Satisfaction with Life (SumSWL) among different generations.

H2: There is a statistically significant difference in the use of AI language models (GPT, Gemini, and Bing) among different generations.

The study analyzes data from a sample of 722 individuals representing three generations: Generation X, Generation Y, and Generation Z. Data were collected through a survey that asked participants about their use of GPT, Gemini, Bing, and their overall life satisfaction.

The research aims to shed light on the factors influencing the adoption of AI language models among different generations and to identify potential trends and implications for future AI development and usage. Moreover, it seeks to explore the relationship between generational differences and overall life satisfaction.

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2. LITERATURE REVIEW

Lin et al. (2023) explored generational satisfaction with AI chatbots in the U.S. and China, focusing on differences among Generations X, Y, and Z. Their findings revealed that cultural and generational factors significantly influence preferences for conversational AI, with younger generations valuing the utility of chatbots in daily life more than older ones. These insights emphasize the importance of age-specific and culturally informed designs for AI systems.

A study published in the Asian Journal of Social Science and Management Technology investigated how artificial intelligence (AI) and e-service quality impact customer satisfaction among Generation Z users of Shopee in Indonesia. Using online questionnaires and statistical analysis methods, the research involved 150 respondents and found that AI enhances customer satisfaction by improving advertising interactions and communication (Maemunah et al., 2025). Additionally, e-service quality was shown to boost satisfaction by providing clear information, solving problems, protecting data, and responding to complaints. This research contributes to better e-commerce service strategies and enriches the literature on AI and e-service quality for Gen Z in e-commerce.

Generational differences in the adoption of AI-powered mental health virtual assistants were analyzed in a study by Alanzi and Alsalem (2023). The research highlighted how younger generations are more receptive to using AI in mental health management, while older generations exhibit lower acceptance and trust levels. These findings underline the need for tailored approaches to enhance the trust and effectiveness of mental health technologies.

Wang and Xu (2024) investigated Generation Z's satisfaction with AI-powered smart homestays in China, linking technological features to perceived value and loyalty in the tourism industry. The findings suggest that Gen Z is more inclined toward innovative, technology-driven accommodations compared to other generations. This indicates that AI integration is a crucial factor in enhancing user satisfaction in the hospitality sector.

The differences in AI adoption for educational purposes among Generations X, Y, and Z were examined by Chan and Lee (2023). Their research revealed that Gen Z exhibits higher interest and readiness to integrate AI in learning environments compared to older generations, who show less enthusiasm. This generation gap underscores the importance of designing tailored educational tools to bridge adoption disparities.

Lissitsa and Kagan (2025) explored the moderating effect of self-reliance on the relationship between social media addiction, loneliness, and life satisfaction. Their study identified distinct psychological patterns across Generations X, Y, and Z, showing how generational attitudes toward self-reliance and technology influence overall well-being.

A comparative analysis of life satisfaction and work-life balance among Generation X, Y, and Z entrepreneurs in Europe was conducted by Gosztonyi (2023). Utilizing AI-driven regression models, the study identified motivational and operational differences influenced by generational dynamics. These findings shed light on how each generation's unique characteristics affect entrepreneurial behavior.

The role of AI in promoting environmental sustainability through Generation Z's use of AI products was examined in a cross-cultural study by Al-Sharafi and Al-Emran (2023). By comparing attitudes in Turkey and Malaysia, the research found that Gen Z demonstrates a strong commitment to sustainable practices, emphasizing the importance of eco-friendly AI innovations.

Bhatnagr and Rajesh (2024) explored generational contrasts in satisfaction with AI features in digital banking apps. Their research, applying the expectation confirmation theory, revealed that Gen Z has higher expectations for AI-driven features like personalized recommendations and efficiency compared to Gen Y. This highlights the importance of incorporating generational insights when developing digital banking strategies.

3. METHODOLOGY

3.1. Questionnaire

The study utilized the Satisfaction with Life Scale (SWLS) to measure life satisfaction. Participants were asked about their use of AI tools, including OpenAI ChatGPT, Google Bard-Gemini, Bing, and other AI tools. They reported the number of hours per week they used these tools and whether their life satisfaction had changed since using them. Demographic information, such as gender and age, was also collected. The study explored generational differences as well. Data were collected in April 2024 and analyzed using IBM SPSS22.

3.2. Sample

The provided data present (Table 1) the frequency and percentage distributions of different generations in the sample.

Generations:
- **Generation X:** 224 individuals (31.0%) belong to Generation X.
- **Generation Y:** 217 individuals (30.1%) belong to Generation Y.
- **Generation Z:** 281 individuals (38.9%) belong to Generation Z.

Table 1. The frequency and percentage distributions of different generations

	Frequency	Percent	Valid Percent	Cumulative Percent
Generation X	224	31	31	31
Generation Y	217	30,1	30,1	61,1
Generation Z	281	38,9	38,9	100
Total	722	100	100	

Source: Own research

This indicates that Generation Z is the largest group in the sample, followed by Generation X and Generation Y.

Table 2. The frequency and percentage distributions of different gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	197	27,3	27,3	27,3
Female	525	72,7	72,7	100
Total	722	100	100	

Source: Own research

Gender:
- **Male:** 197 individuals (27.3%) are male.
- **Female:** 525 individuals (72.7%) are female.

This shows that the sample is predominantly female (Table 2), with a much higher proportion of females compared to males.

4. DISCUSSION-CONFIRM THE HYPOTHESIS

H1: *There is a statistically significant difference in Summary Satisfaction with Life (SumSWL) among different generations.*

Table 3. The Summary Satisfaction with Life

	N	Mean	Std. Deviation	Std. Error
Generation X	224	23,4063	6,00225	0,40104
Generation Y	217	23,1106	5,54416	0,37636
Generation Z	281	22,1922	6,25518	0,37315
Total	722	22,8449	5,98596	0,22277

Source: Own research

Generation X has the highest mean score (23.41), followed by Generation Y (23.11), and Generation Z has the lowest (22.19). This suggests that Generation X reports the highest average score on the SumSWL measure (Table 3).

The provided SPSS output presents an ANOVA analysis and subsequent post-hoc tests to examine differences in SumSWL (Summary Satisfaction with Life) across three generations: X, Y, and Z.

Table 4. ANOVA analysis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	205,626	2	102,813	2,884	0,057
Within Groups	25629	719	35,645		
Total	25834,626	721			

Source: Own research

ANOVA Analysis:

The ANOVA (Table 4) indicates that there is no significant difference in SumSWL among the three generations ($F(2, 719) = 2.884$, $p = 0.057$). This means that, overall, the average SumSWL scores are not significantly different between the generations.

Post-Hoc Tests:

To pinpoint where the differences might lie, post-hoc tests were conducted using the Bonferroni correction (Table 5). The results of the post-hoc tests show: **No significant differences:** None of the pairwise comparisons between generations reached statistical significance at the Bonferroni-adjusted alpha level. This suggests that there are no significant differences in SumSWL between any of the pairs of generations (X and Y, X and Z, Y and Z).

Table 5. Post-Hoc Tests

(I) Different Generations		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Generation X	Generation Y	0,29565	0,56868	1	-1,0689	1,6602
	Generation Z	1,21408	0,53477	0,07	-0,0692	2,4973
Generation Y	Generation X	-0,29565	0,56868	1	-1,6602	1,0689
	Generation Z	0,91843	0,53955	0,267	-0,3763	2,2131
Generation Z	Generation X	-1,21408	0,53477	0,07	-2,4973	0,0692
	Generation Y	-0,91843	0,53955	0,267	-2,2131	0,3763

Source: Own research

Based on the ANOVA and post-hoc tests, there is no significant difference in SumSWL among generations X, Y, and Z. This suggests that the average satisfaction with life is not significantly different across these generations. **H1 is not accepted.**

H2: *There is a statistically significant difference in the use of AI language models (GPT, Gemini, and Bing) among different generations.*

Generation Z (see Table 6) has the highest percentage of users who have used OpenAI ChatGPT (74.70%), indicating a strong adoption rate among the youngest generation. Generation X and Generation Y have similar usage rates, with approximately half of each generation having used ChatGPT (48.20% and 48.80%, respectively).

Table 6. Have you ever used OpenAI ChatGPT? * Different Generations

			Different Generations			Total
			Generation X	Generation Y	Generation Z	
Have you ever used OpenAI ChatGPT?	yes	Count	108	106	210	424
		% within Different Generations	48,20%	48,80%	74,70%	58,70%
	no	Count	116	111	71	298
		% within Different Generations	51,80%	51,20%	25,30%	41,30%
Total		Count	224	217	281	722
		% within Different Generations	100,00%	100,00%	100,00%	100,00%

Source: Own research

The chi-square tests (Table 7) indicate a statistically significant relationship between generations and OpenAI ChatGPT usage (Pearson Chi-Square = 48.652, df = 2, p = 0.000). This suggests that the observed differences in usage are not due to chance.

Table 7. The relationship between different generations (X, Y, and Z) and the use of OpenAI ChatGPT

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	48.652[a]	2	0
Likelihood Ratio	50,178	2	0
Linear-by-Linear Association	38,655	1	0
N of Valid Cases	722		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 89.57.			

Source: Own research

Overall, the usage rates for Google Bard-Gemini are relatively low across all generations. Only a small percentage of individuals have reported using it (Table 8).

Table 8. Have you ever used Google Bard-Gemini? * Different Generations

			Different Generations			Total
			Generation X	Generation Y	Generation Z	
Have you ever used Google Bard-Gemini?	yes	Count	21	22	43	86
		% within Different Generations	9,40%	10,10%	15,30%	11,90%
	no	Count	203	195	238	636
		% within Different Generations	90,60%	89,90%	84,70%	88,10%
Total		Count	224	217	281	722
		% within Different Generations	100,00%	100,00%	100,00%	100,00%

Source: Own research

The chi-square tests (Table 9) indicate that there is no statistically significant difference in the use of Google Bard-Gemini among the three generations (Pearson Chi-Square = 5.103, df = 2, p = 0.078). This suggests that the observed differences in usage are not statistically significant.

Table 9. The relationship between different generations (X, Y, and Z) and the use of Google Bard-Gemini

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.103a	2	0,078
Likelihood Ratio	5,007	2	0,082
Linear-by-Linear Association	4,399	1	0,036
N of Valid Cases	722		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 25.85.			

Source: Own research

Across all three generations (Table 10), the usage rates for Bing are relatively similar, ranging from 18.8% to 20.3%.

Table 10. Have you ever used Bing? * Different Generations

			Different Generations			Total
			Generation X	Generation Y	Generation Z	
Have you ever used Bing?	yes	Count	42	44	57	143
		% within Different Generations	18,80%	20,30%	20,30%	19,80%
	no	Count	182	173	224	579
		% within Different Generations	81,30%	79,70%	79,70%	80,20%
Total		Count	224	217	281	722
		% within Different Generations	100,00%	100,00%	100,00%	100,00%

Source: Own research

The chi-square tests (Table 11) indicate that there is no statistically significant difference in the use of Bing among the three generations (Pearson Chi-Square = 228, df = 2, p = 0.892). This suggests that the observed differences in usage are not statistically significant.

Table 11. The relationship between different generations (X, Y, and Z) and the use of Bing

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.228a	2	0,892
Likelihood Ratio	0,23	2	0,891
Linear-by-Linear Association	0,173	1	0,678
N of Valid Cases	722		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.98.			

Source: Own research

The analysis supports Hypothesis 2, which posits a relationship between generation and ChatGPT usage, but rejects the implied hypotheses regarding relationships between generation and the use of Google Bard/Gemini and Bing. Specifically:

- ChatGPT: The chi-square test yielded a highly significant result ($p < 0.001$), indicating a statistically significant relationship between generation and ChatGPT usage. This supports Hypothesis 2.
- Google Bard/Gemini: The chi-square test was not significant ($p = 0.078$), demonstrating no statistically significant difference in Google Bard/Gemini usage across generations. Therefore, the hypothesis of a relationship is rejected.

- Bing: The chi-square test was also not significant ($p = 0.892$), showing no statistically significant difference in Bing usage across generations. Consequently, the hypothesis of a relationship is rejected.

Hypothesis 2 (regarding ChatGPT) is accepted, while the implied hypotheses concerning Google Bard/Gemini and Bing are rejected.

5. CONCLUSION

This study investigated the relationship between generational differences and the adoption of AI language models, specifically GPT, Gemini, and Bing, as well as the impact on Summary Satisfaction with Life (SumSWL) among Generations X, Y, and Z. The primary hypotheses were that there would be significant generational differences in both SumSWL and the use of AI language models.

Our findings confirmed a clear generational divide in AI adoption. Generation Z demonstrated a significantly higher propensity for using AI tools, particularly OpenAI ChatGPT, compared to Generations X and Y. The chi-square tests indicated a statistically significant relationship between generations and the use of ChatGPT, supporting Hypothesis 2. However, no significant differences were found in the usage of Google Bard-Gemini and Bing among the generations, suggesting that these tools may not yet be as widely adopted or recognized.

Regarding life satisfaction, the ANOVA and post-hoc tests revealed no statistically significant differences in SumSWL among Generations X, Y, and Z. This indicates that, despite the varying levels of AI adoption, the overall life satisfaction scores were similar across the generations, leading to the rejection of Hypothesis 1.

These findings align with previous research mentioned in the literature review. For instance, Lin et al. (2023) also found that younger generations, particularly Generation Z, have a higher preference for conversational AI, emphasizing the importance of age-specific designs. Similarly, Alanzi and Alsalem (2023) highlighted the greater receptiveness of younger generations to AI in mental health management, while older generations showed lower acceptance levels. Additionally, Chan and Lee (2023) observed that Generation Z exhibits higher interest and readiness to integrate AI in educational settings compared to older generations.

In conclusion, while younger generations, particularly Generation Z, are more inclined to adopt AI language models like ChatGPT, this increased usage does not translate into significant differences in life satisfaction among the generations. These findings highlight the importance of considering generational preferences in the development and deployment of AI technologies, as well as the need for further research to understand the complex relationship between AI usage and life satisfaction. The study's results are consistent with previous research, reinforcing the generational divide in AI adoption and the necessity for tailored approaches to AI system design.

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A Smart City From an Economic Perspective Through the Lens of Bibliometrics

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Abstract: *New technologies are changing the way individuals live, but they are also impacting the way entire cities function as they strive to implement these technologies to improve the quality of life for their citizens and businesses, but also to improve their own business, governance and transportation to make them a more desirable place to live. A smart city goes beyond the benefits offered by the use of digital technologies by making better use of available resources with less emissions, providing safer urban areas, providing more interactive and responsive city governance and monitoring the needs of vulnerable groups. As the new era and the use of new technologies inevitably face many challenges and new problems, this implies that the topic of smart cities is becoming an attractive area for research in various fields. The aim of this paper is therefore to present a bibliographic review of papers dealing with the topic of smart cities from the field of economics, using the Web of Science Core Collection database. The paper will show the clustering of the field in terms of keywords, authors, countries and journals. The bibliometric analysis will highlight areas that have not yet been sufficiently explored.*

1. INTRODUCTION

Many authors have tried to give their definition of the smart city to distinguish what makes a city smart. At the same time, however, terms such as digital city, knowledge-based city or intelligent city have also emerged in the academic literature, representing a different concept depending on the author and in some cases a synonym for smart city (Lee et al., 2013, Dameri, 2017). For this reason, it is very difficult to give a universal definition of a smart city, but it is very easy to see that all definitions are imbued with similar characteristics that distinguish a smart city, such as information and communication technology (Galati, 2018), which improves the quality of life of citizens through accessibility, transparency, modern means of transport, etc. In recent years, the development of urban areas has affected the quality of life and citizens, who need to bring urban services and involvement in decision-making closer through transparency and openness, but with the optimisation of available resources. To achieve this, it is necessary to sensitise the city administration, but also to train, through investment in human resources, the employees of the cities as well as the residents themselves, so that they can use these digital services and bring the smart city to life in the truest sense of the word. From all of the above, it is clear that the economic perspective is very important, and for this reason, it is necessary to emphasise the smart economy as one of the 6 dimensions of a smart city. It is also important to emphasise that sustainability, with its 17 SDG standards, is reflected in the dimensions of a smart city, which is shown in the following text and in the analysis itself.

2. LITERATURE REVIEW

If we observe the development of smart city definitions over the last 25 years, we can say that they have remained conceptually similar, albeit with a different focus. Thus, one of the earlier definitions (Hall et al., 2000) dealing with the smart city concept is the one in which the city is described as one

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that monitors and integrates all conditions for all critical infrastructures in order to optimise resources and plans the prevention of cessation of all activities with a security component, all in order to maximise the availability of services for its citizens. Subsequently, Giffinger et al. (2007) offers in his work a definition of a smart city as a city that achieves good results by considering in advance how to improve results in the areas of economy, human resources, management, mobility, environment and housing, pointing out that these components are achieved with the active participation of citizens in initiatives that promote progress and smart solutions, all with the aim of improving services to citizens.

Since 2010, IBM has included the information and communication technology (ICT) component in the story of a smart city, as well as the problems of the environment, education and human capital (Lombardi et al., 2012), and Marsal-Llacuna et al. (2015) introduces in its definition of a smart city, in addition to the factors already mentioned, the concept of collaboration between different economic actors to promote innovation in the public and private sector economy. The cross-sectional analysis of the definitions of smart cities over the years ends with the definition of the Urban Learning Centre (2024), according to which there is no uniform definition of a smart city. This is followed by the European Commission's definition, in which a smart city is defined as a place where traditional services and networks become more efficient through the use of digital solutions to benefit citizens and businesses, and technology as such is only a means to improve the urban environment in terms of quality of life, sustainability, etc.

The smart city is a concept that has recently been very often associated with urban growth, energy efficiency, efficiency in transport and traffic, but also with efforts to involve citizens in decision-making and improve their quality of life through transparency and digitalisation of public services. Some authors point out that the objectives of this concept translate into better services for citizens, better governance, social justice and better educational and economic opportunities (Lehr, 2018). The 6 pillars on which the concept of a smart city is based are therefore Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living and Smart Governance, which Giffinger et al. (2007) refer to as the 6 dimensions of the smart city. These 6 dimensions comprehensively cover all considerations of other authors on the concept of the smart city and have become the basis for various comparisons, rankings and other analyses of cities as urban environments in order to achieve benchmarking (Srok et al., 2022; Babić et al., 2022).

If we look at the city through the prism of smart dimensions, we can see that they are linked to almost all Sustainable Development Goals (SDGs), which was also stated in the scientific paper *Smart cities and sustainable development goals (SDGs): A systematic literature review of co-benefits and trade-offs* by Sharifi et al. (2024). This latest paper offers a very interesting perspective on the smart city, its dimensions and its connection with the SDG standards concluding that exploring synergies and conflicts allows for a more comprehensive understanding of the interactions between smart cities and SDGs. From all this, it can be concluded that the topic of smart cities is very topical and therefore worth analysing through work from the field of economics. In the background of the observations and analyses, the objectives of this paper will therefore be to:

- analyse how interesting the topic of smart cities is for researchers in the field of economics,
- identify the areas on which future research should focus and the current issues based on key concepts.

3. BIBLIOMETRIC ANALYSIS

The analysis was carried out by filtering works in the Web of Science database based on the term "Smart Economy", which included all terms containing the word Smart City and its derivatives in English, concerning the Topic category, which was used to philter the works by Title, Abstract,

Keyword Plus and Author Keywords. In this way, 17,325 scientific publications were filtered out of the observed category over the years, with the filtering in relation to the field of business administration filtering out 935 of them, of which 639 were journal articles, while in the last 10 years, there were even 613 in this category, which indicates that the topic gained the greatest popularity in the last 10 years, as even 95.9% of the papers in this field in the observed period were written based on the selected keywords (Figure 1).

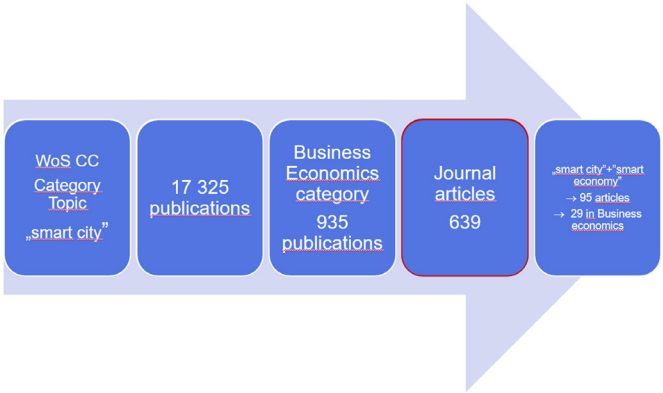

Figure 1. Description of filtering process of articles in Web of Science database
Source: Own research

Even if the keyword "smart economy" is included in the filtering as one of the six dimensions of a smart city, there are only 29 articles in the Business Economics category (Figure 1). As the bibliometric analysis has to be conducted on a larger sample of papers, a further analysis of the keywords and citations is carried out on 639 journal articles from the Business Economics category.

If we focus on the number of papers over the years, we can determine that the concept of smart city was brought to life in 2008, when the first paper on smart city was published. Since then, the number of publications has increased as well as the number of citations until it peaked in 2024. with more than 90 journal articles (Figure 2)

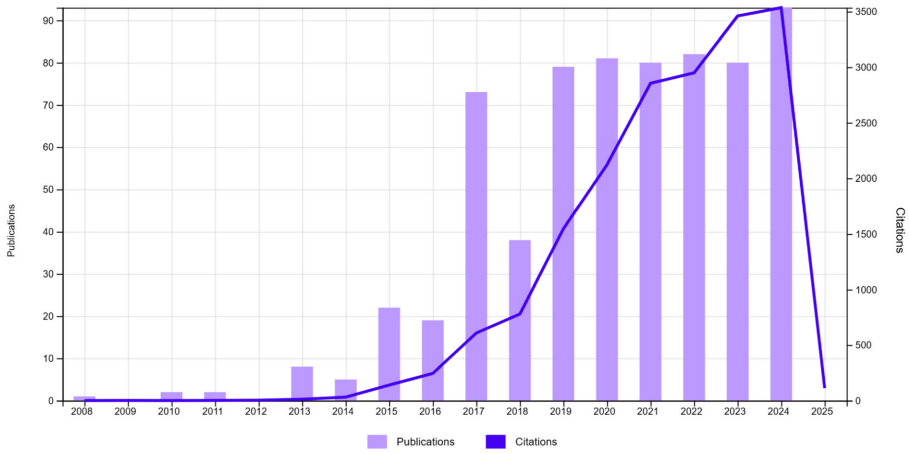

Figure 2. Description of the filtering of articles in the Web of Science database
Source: Own research using WoS database

Further research revealed that when we look at the categories from the Web of Science, most of the papers are from the field of Management, then Business and economics, followed by Business Finance, Operations Research, Urban Studies, and others (Figure 3).

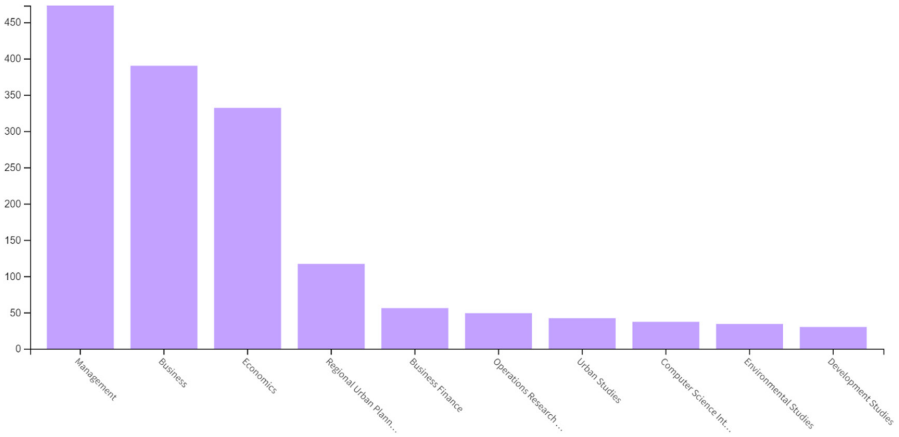

Figure 3. Number of journal articles according to WoS categories
Source: Own research using WoS database

In a further study, we used the VOSViewer to analyse 639 papers and their keywords, summaries and titles from the field of economics, with the help of which the relationship between the most frequent words was graphically displayed and clustered into several subject areas. By analysing the keywords, we can determine how they are distributed in 6 clusters (Figure 4) and it is significant that there are exactly six of them, as well as the smart dimensions of the city. In the center are the two words city and smart city, which appear most frequently in the papers, but are also associated with most of the other keywords. This light blue cluster consists of 4 words and is related to the smartness of the city, sustainability, urban planning and urban development, i.e. it reflects the smart dimension of the smart environment. The yellow cluster is related to energy efficiency, foreign investment, growth or could be related to the smart economy dimension in light of the smart dimensions. The green cluster has to do with management, and services and coincides with the smart governance dimension, while the dark blue cluster has to do with public value, teaching, knowledge and urban innovation and is associated with the smart people dimension. The red cluster has to do with technology, i.e. the keywords infrastructure, ICT, internet are associated with the Smart Mobility dimension, while the purple cluster, which has to do with urban initiatives, conceptual framework and innovation, reflects the Smart Living dimension.

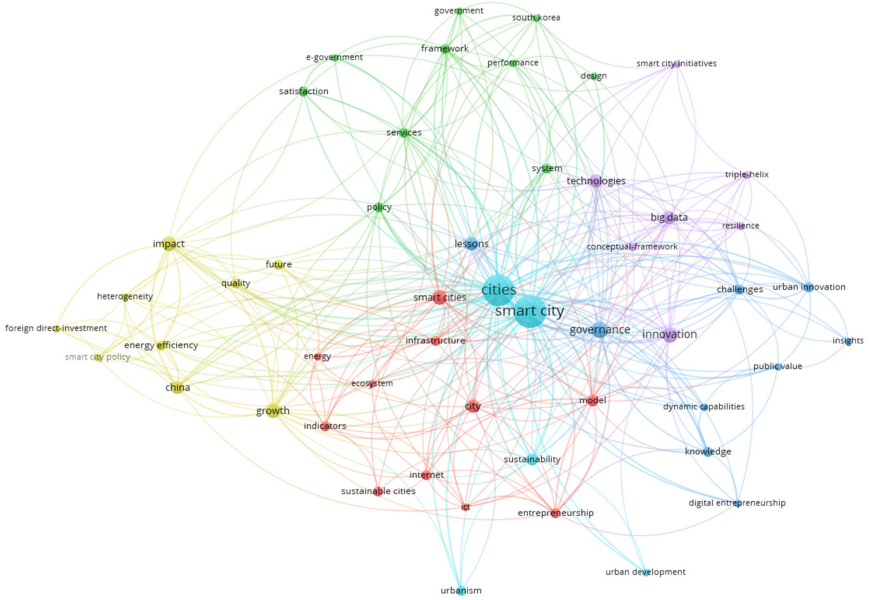

Figure 4. Graphical representation of the most frequent keywords set in 6 clusters
Source: Own analysis using WoS database and VOSViewer

If we analyse the number of publications by country (Figure 5) on the topic of smart cities from the field of economics, we can see that China accounts for the most publications, followed by the United States of America, Italy, England and Spain. This information is not surprising, as China is a country with incredible economic and technological growth, which is certainly reflected in the development of urban areas and which is indirectly reflected in the publications from the field. Another country, the USA, is also very advanced and undoubtedly a leader in the technology and solutions necessary for the development of smart urban environments, while countries such as Spain, France, England and Italy are very focused on the quality of life of their citizens, so we find in this the motivation of numerous authors who write about the development of smart cities. The Scandinavian countries are advanced by standard and it is no surprise that their scientists are striving to improve the performance of the already smart Scandinavian cities.

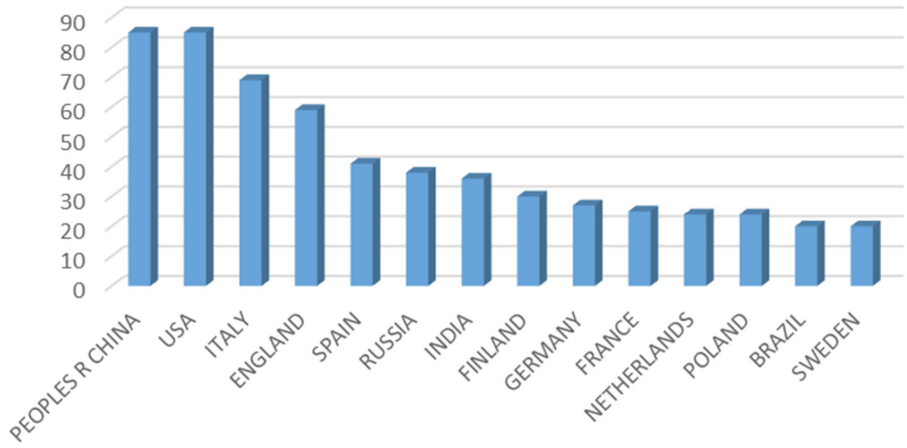

Figure 5. Graphical representation of countries with highest number of publications from the field
Source: Own analysis using WoS database

As expected, the most cited publications by country correspond to the number of papers published, albeit in a slightly different order. The first country is still the People's Republic of China, followed by Italy, South Korea, Norway, Poland, Russia and only then the USA.

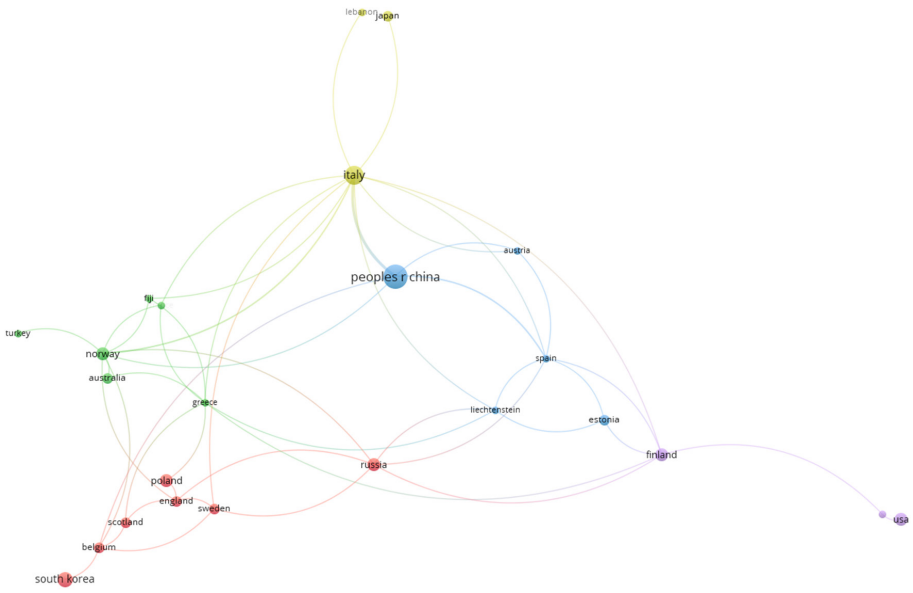

Figure 6. Graphical representation of the most frequently cited countries set in 5 clusters
Source: Own analysis using WoS database and VOSViewer

If we look at and analyse the number of publications by publisher (Figure 7), Elsevier is undoubtedly the leader, followed by Springer Nature, Emerald Group Publishing, Taylor & Francis and Sage, while the others have remained the same in terms of the number of publications on the smart city. Surprisingly, MDPI, which is often found in the top three places in this type of analysis, is not among the top 11 publishers and is in 13th place in the current analysis.

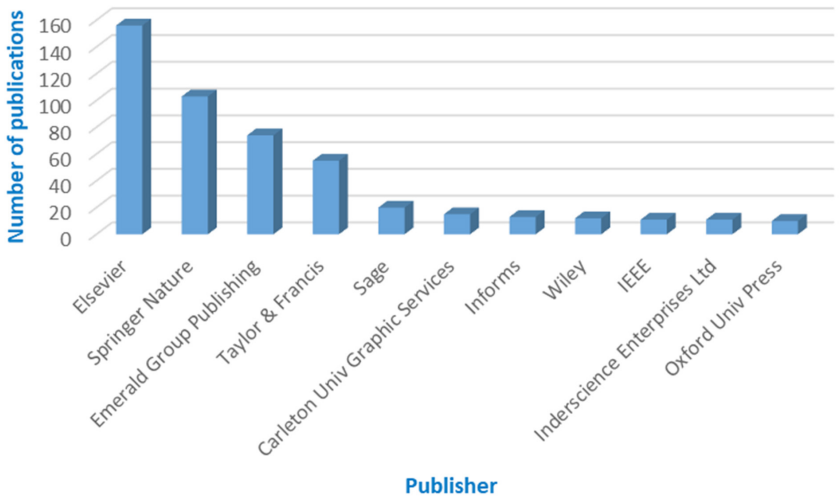

Figure 7. Graphical representation of Publishers according to publications from the field
Source: Own analysis using WoS database

A further analysis of the journals of the aforementioned publishers shows that the most frequently cited journals are Technological Forecasting and Social Change and Economic Analysis and policy, which are represented by Elsevier and are in the red cluster.

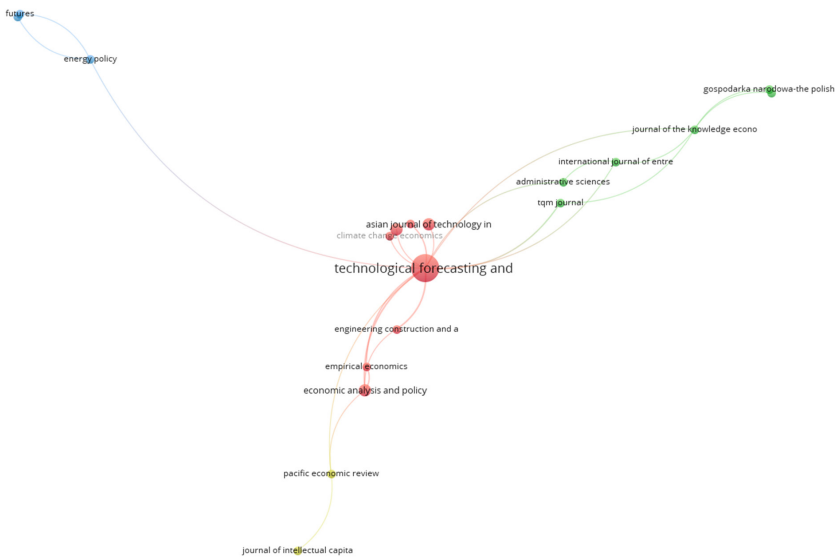

Figure 8. Graphical representation of the most frequently cited journals in 4 clusters
Source: Own analysis using WoS database and VOSViewer

The journals *Energy policy* and *Futures*, which are also represented by Elsevier and are the only representatives of the blue cluster, are followed by *Empirical Economics* and *Journal of the Knowledge Economy* as representatives of Springer and *The TQM Journal* as representatives of Emerald. Finally, there is the *Asian Journal of Technology Innovation*, which represents the publisher Taylor & Francis.

In further research, we wanted to find out how many researchers from the region in the field of economics deal with the topic of smart cities in their research and how many papers have been published per country. A look at Table 1 shows that Italy and Spain publish the most papers in the European context, while the countries in the region have published very few papers on smart cities in the last 17 years, which is particularly evident when it comes to papers in the field of economics. If we compare the other European countries and the Republic of Croatia, we can conclude that Croatian authors could strengthen research in the field of economics on the topic of smart cities, because it is a topical issue that last year had the largest number of published papers in the observed period, which is irrefutable proof of the relevance of this topic.

Table 1. European countries ranked according to the number of publications

COUNTRY	TOTAL number of publications	Business and economic field
Italy	768	69
Spain	537	41
Poland	303	24
Germany	288	27
Romania	102	10
Slovakia	54	7
Serbia	41	6
Croatia	32	4
Slovenia	29	4
BIH	10	1
Montenegro	1	1

Source: Own research

It can also be stated that the Republic of Croatia does not lag behind countries from the region such as Slovenia, Serbia, Bosnia and Herzegovina and Montenegro. The author's work from the Republic of Croatia focuses primarily on the decision-making process that integrates the energy, economic and environmental systems of the city (Lugaric & Krajcar, 2016), smart city initiatives (Manfreda & Mijač, 2024) and the ranking of cities in terms of smart city dimensions.

4. FUTURE RESEARCH DIRECTIONS

The analysis has shown that the topic of the smart city has been very relevant in recent years, especially in the last year, when the number of publications in scientific journals has increased and the number of citations has also risen in parallel. It is worth emphasising that the trend of recent publications on smart cities is related to the green economy, the environment and the focus on citizens through transparency, citizens' initiatives and education. This paper provides a brief overview and analysis of papers from the Web of Science database filtered by topic based on the keywords in the title, abstracts and keywords of the articles. What is missing in this paper is the elaboration and deeper analysis of the papers and their topics over the years as well as the citations in order to get a more thorough representation of the last years. It also proposes an overview of the works of the most cited countries and a comparison of the works in terms of the approaches and specific topics they address, taking into account the geographical region. It should also be noted that this analysis is limited to the use of only one database, selected keywords, type of scientific work, English language and scientific field. Further research can therefore focus on a detailed review of the literature in this area to explore the topic of the smart city in more detail.

5. CONCLUSION

This study provides a detailed overview of the bibliometric indicators of works on the topic of Smart Cities Economy. The bibliometric analysis has shown that this topic is very topical, especially in recent years. The analysis also showed that the number of published scientific papers and citations increased significantly in the three years characterised by the COVID-19 pandemic. Authors only began to focus more intensively on the topic in 2013, and since then a rapid increase in research interest and publications has been observed. In earlier works, the authors dealt with semantics and mainly with definitions and everything that makes a city smart, while more recent topics focus more on urban services, sustainability, management, green economy, digitalisation, traffic optimisation and services for citizens to improve the quality of life.

Although the popularity of the topic has increased in the field of economics, Croatian authors and authors from the region have not yet recognised the topic of smart city as worthy of research, which is evident from the analysis itself and the number of contributions, which is less than 10. Therefore, this analysis has identified a scientific gap between Croatian authors and authors from the region compared to other European authors. From the point of view of trends in the field of economy, it can be stated that the topic of smart cities is one of the current top issues. Therefore, we conclude that Croatian authors have the opportunity to utilise the niche in this gap and fill it with valuable works from this field.

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National Tourism Policies and Sustainability: A Comparative Study of EU Countries

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Sustainability;
Tourism planning;
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Tourism strategy;
EU countries

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Abstract: *The main goal of this study is to analyze the national tourism plans of the 27 EU countries, and understand the significance attributed to the theme of sustainability in these strategic documents. This work was based on a methodology of document analysis. Based on the list of the 27 member states of the EU, research was carried out on the existence of national tourism plans that are currently in force. A content analysis was performed.*

The research resulted in the identification of 25 national strategic plans that were carefully analyzed. Of the documents analyzed, the theme of sustainability is very common and is included in most of the strategic visions defined.

The main limitation of the study is related to the methodology used. Researching and interpreting the strategic documents was also challenging, as many of the strategic plans were only available in the country's national language, with no English versions.

Based on the analysis carried out, it is possible to reflect on the commitment that each member state has made in relation to the development of tourism in its territory: whether sustainability is a fundamental premise, or if it is not a major concern.

1. INTRODUCTION

Tourism is a major economic activity with a broad influence on economic growth and job creation in Europe (Alfaro Navarro et al., 2020). It is also an important mechanism for reinforcing Europe's image in the world, projecting values and promoting the products and services of their countries (Andrés et al., 2019). But while tourism development causes diverse positive impacts, it is also responsible for some negative ones at an economic, environmental and sociocultural level. It is in this context that the role of tourism planning should be mentioned.

Planning of tourist activities is a tool for guiding tourism actions in such a way as to create benefits and well-being beyond the industry and tourism destinations (Saarinen et al., 2017). Thus, strategic planning in tourism should be considered an instrument of the economic, environmental and social policy of a country that ensures more sustainable development (Var & Gunn, 2020). It can contribute to promoting social cohesion and can ensure a more balanced and better distribution of equipment, infrastructure, economic activities and uses of the territory (Bailoa & Cravo, 2020).

Despite the importance of the topic, tourism policies and the processes of tourism planning and policymaking are topics of notable neglect (Dredge & Jamal, 2015). Some studies have served as inspiration for this study, but there is still much to be done. For example, Ruhanen (2004) analyzed the tourism plans of 30 local tourism destinations in Queensland (Australia) to determine the extent to which sustainability principles, particularly strategic planning and stakeholder participation, were included in the planning process. Collins-Kreiner and Ram (2021) analyzed national tourism strategies

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for five countries (Australia, Austria, Brazil, China, Israel and Italy) during the Covid-19 pandemic, while Nicholls et al. (2021) examined 22 destination plans relating to Wales. This study revealed that there are many opportunities for improvement in the tourism sector. Nonetheless, a combined document analysis of the national tourism plans of the European Union (EU) member states has not been performed until now. The main objective of this study is to ascertain the importance attributed to the theme of sustainability in these tourism plans. The methodology used in this study was document analysis, whereby the documents containing the national tourism strategies were collected and analyzed.

The paper is divided into five sections. After the introduction, a literature review is carried out. In this part can be found a theoretical development about the concepts of tourism planning and sustainable planning. Subsequently, in the methodology section, we outline the research approach and methods used to gather information. Next, the main findings of our study appear in the results section. Finally, in conclusion, we summarize the key findings and contributions of our study, refer to its main limitations and leave some suggestions for future studies.

2. LITERATURE REVIEW

The concept of tourism planning emerged as a response to the detrimental impacts of the growing development of tourism (Pato & Duque, 2023). Dredge and Jamal (2015) propose that the models for tourism planning emerged in the 1960s and were reinforced in the 1970s, supported by landscape architecture, and urban and regional planning.

It was formally acknowledged by UNWTO in 1994 in the document "National and Regional Tourism Planning: Methodologies and Case Studies" that tourism development should be planned (Inskeep, 1994). Initially, attention was focused on the economic aspects, but later, attention to the physical aspects of the destination prevailed (Sosa, 2023). The development of tourism must take all the dimensions of the territory and population into consideration. For that reason, the social and cultural aspects of tourism development were also gradually incorporated, to a greater extent in the new millennium (Andriotis, 2001). It is also recognized that beneficial partnerships are essential for tourism planning (Pato & Duque, 2023; Wanner & Pröbstl-Haider, 2019). In other words, planning as a field of research and practice is derived from practitioners from diverse fields sharing their stories and contributing to the well-being of their territory (Dredge et al., 2016).

Several countries, aware of the importance of tourism planning in the development of countries, have developed strategic plans. Tourism planning at the national level represents the most important policies to develop this sector in a country (Bailoa & Cravo, 2020). Also, these national strategies for tourism help align public and private investment and direct resources in tourism to achieve national goals (Torkington et al., 2020).

Another crucial element of tourism planning is the growing concern about the sustainability of the sector. The beginning of the twenty-first century has been characterized by considerable changes in the tourism sector, as competition is becoming increasingly global rather than regional and governments are losing their capacity to intervene in the market (Costa, 2006). Moreover, the environmental, social and economic problems caused by the tourism industry are increasingly evident. Within this context, the re-invention of tourism planning has become one of the priorities on the planners' agenda (Costa, 2006) because of the need to ensure sustainable environments.

Sustainable planning for tourism can be regarded as a strategy focused on how to encourage tourism development while minimizing potential negative impacts (McLoughlin, 2017). Although there

are several definitions of the concept of sustainable tourism, it can be understood as a "normative orientation that seeks to redirect societal systems and behavior on a broad and integrated path toward sustainable development (...) integrating social, cultural, economic and political alongside environmental issues" (Bramwell et al., 2017, p. 6). Indeed, more than ever, sustainable tourism planning requires an understanding of the meaning of sustainable development and the guiding values for promoting sustainable tourism (Costa, 2014).

Several European countries and regions have paid attention to the role of sustainability in tourism planning. For instance, Andriotis (2001) identified several problems caused by excessive tourism that affected the Greek island of Crete. He studied the solutions that were applied to the territory and that are included in strategic plans. However, the conclusion of the study shows that greater investment is needed in the planning of tourism activity at local and regional levels. Dodds (2007) studied one of the Mediterranean's most popular sun, sea and sand tourist resorts - Calviá (in Mallorca, Spain). In her study, Dodds (2007) outlines the motivations behind establishing a sustainable tourism policy, the process, successes, obstacles to implementation and lessons learned. More recently, Pato and Duque (2023) completed a national analysis, focusing on tourism plans in Portugal, and the study revealed the growing focus on sustainability in national planning.

At a macro level, the European Union has the ambition to promote greener tourism as part of the broader objective of developing a more sustainable and responsible ecosystem. This process involves coordinated action and the involvement of all players in multilevel governance: industry, destinations, national and regional and local authorities, but also tourists (European Commission, 2023b). As an activity that is based on the cultural and natural heritage and the traditions of each country, tourism needs to reconcile economic growth and sustainable development through planning (Andrés et al., 2019)

3. METHODOLOGY

Since the objective of this study is to analyze strategic plans and their content, the methodology used was document analysis. According to Liasidou (2019, p. 77), "document analysis helps in understanding and identifying what was said or written versus what was applied to shed light on the historic development of tourism". This methodology has already been used and validated in other studies such as Collins-Kreiner and Ram (2021) and Pato and Duque (2023).

Based on the list of the 27 member states of the EU, research was carried out on the existence of national tourism plans that are currently in force. Using the Google search engine, the authors researched the concepts of national tourism plan, national tourism strategy and national tourism policy associated with the name of each of the 27 EU countries. The research was conducted in English to obtain more comprehensive results that could be analyzed by the authors. An Excel file was prepared in which several topics are identified, such as: whether the country has a national tourism plan (in force); whether the document is available for public consultation; the language used in the document; whether concerned with the concept of sustainability is visible; and whether the document's strategic vision refers to sustainability. This research intends to answer these and other pertinent questions.

4. RESULTS

The EU consists of an economic and political union that has worked for peace, prosperity and the wellbeing of its citizens for more than 60 years. From six founding countries in the 1950s (Belgium, Germany, France, Italy, Luxembourg, the Netherlands), it has grown into a current union of

27 countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden). See Figure 1.

It was created after the Second World War and what "started as an economic project to help raise living standards in post-war Europe has led to the creation of the world's largest single-market area, where people, goods, services and money can move freely" (European Commission, 2023, p. 4). In terms of tourism, Europe is the world's number one tourist destination (Roman et al., 2020) and tourism is the third largest socio-economic activity in European Union territory, making a critical contribution to the EU's gross national product and to employment (Santos & Cincera, 2018).

Figure 1. European Union countries
Source: European Commission (2023a, p. 8)

The search found 25 strategic plans. There were only two countries for which it was not possible to consult the strategic documents: Belgium, which does not have a tourism plan, but a document with some recommendations for the sector, and Croatia, whose document is not yet available for consultation.

One of the major challenges the researchers faced was the fact that many plans found were written in the official language of the countries and did not have an English version. There were 11 plans written in English - Austria, Estonia, Finland, Greece, Ireland, Italy, Malta, Netherlands, Portugal, Slovenia and Spain. The remaining 14 documents – Bulgaria, Cyprus, Czechia, Denmark, France, Germany, Hungary, Latvia, Lithuania, Luxembourg, Poland, Romania, Slovakia,

Sweden - were written in other languages such as Bulgarian, Czech, Latvian, French, German, Hungarian, among others. Since the authors do not have a mastery of all the languages used in these plans, the solution found was to translate the documents using the Google Translate tool.

Since the aim of this article is to see if the issue of sustainability is relevant to the national tourism strategies of EU countries, the authors have focused their attention on defining the strategic vision. The definition of the strategic vision is one of the main elements of (tourism) planning. According to Bibri and Krogstie (2019, p. 6), "vision construction is about identifying the desired future state, which consists of vibrant descriptions of audacious goals and targets, as well as reflective statements addressing the aspired future". The vision is the reflection of the path that the destination wants to follow and the image it wants to project for residents, visitors and professionals in the sector.

Table 1 presents a compilation of the information taken from the analyzed plans. In the table, the authors have indicated (underlined) all the times that the words sustainable and sustainability appeared in the countries' vision. The concepts appear associated with the strategic visions of 16 countries: Austria, Bulgaria, Croatia, Czechia, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Malta, Portugal, Slovakia, Spain and Sweden. There are other situations where the concept does not appear explicitly, but the meaning is there, using expressions like climate-friendly (Cyprus), every person must benefit from tourism (Netherlands) or global green boutique destination (Slovenia).

Table 1. Strategic visions defined in EU countries' national tourism plans

EU countries	Strategic Vision
Austria	On the way to the most sustainable tourism destinations in the world. The goal is sustainable tourism involving all enterprises, employees, local people and guests. (Source: Plan T - Master Plan for Tourism)
Bulgaria	Bulgaria: preferred destination for sustainable tourism in the four seasons. (Source: Updated National Strategy for Sustainable Development of Tourism in the Republic of Bulgaria 2014–2030)
Cyprus	Establishing Cyprus as a year-round, higher-quality, digitally smart, climate-friendly, and widely accessible destination, where all residents can benefit from tourism. (Source: National Tourism Strategy 2030)
Czechia	Czechia, a destination with sustainable tourism centres in all regions. (Source: Strategy of the Czech Tourism Agency and Czech Republic Destination for 2021–2025)
Denmark	Denmark is internationally recognized as one of the most innovative countries for business tourism and meetings. (Source: Meet Denmark's Strategy)
Estonia	It is time to change the way we promote Estonia to the world. Whereas once we celebrated our destinations, today we are working to champion the world-leading experiences our visitors can encounter. Experiences that are remarkable, memorable and above all, sustainable. (Source: Visit Estonia Brand Strategy and Story)
Finland	Finland is the world's leading sustainable travel destination. We add value to our society and customers and care of our unique environment. Finland is the first choice for mindful travellers. (Source: Visit Finland Strategy 2021–2025)
France	Destination France: a plan for reconquering and transforming tourism. (Source: Destination France …)
Germany	A concrete vision is not defined, but several strategic objectives are mentioned instead: exploiting the diverse potential of tourism; strengthening the competitiveness of Germany as a tourist location; design of a modern, barrier-free, reliable and sustainable mobility and digital infrastructure; striving for quality tourism, in harmony with nature and culture; strengthening economic development in other parts of the world and making a contribution to peace, tolerance and international understanding; support for environmentally and climate-friendly development of tourism. (Source: National Tourism Strategy)
Greece	To showcase and fuse the uniqueness of Greek nature, Greek culture, Greek hospitality, and the Greek lifestyle through a multitude of tourism products and experiences which can address many and diverse markets, making Greece one of the most competitive and sustainable tourism destinations worldwide. (Source: Greek Tourism 2030)
Hungary	According to the Hungarian vision, these will be the characteristics of national tourism in 2030: the main sector of sustainable economic development; quality experience offer; availability and wide access, innovative solutions; a strong tourism country brand; and an attractive career. (Source: Tourism 2.0)
Ireland	To lead the development of a tourism industry that is on its way to making an even bigger and more sustainable contribution to Ireland's economy, environment, society and culture. (Source: Strategy to 2023: from survival to recovery)

Italy	Italy is destined to reassert its leadership on the tourism market, making the beauty of its heritage and land a unique and distinguishing factor to achieve competitiveness and appeal. Tourism once again becomes the heart of the development model and can contribute to the sustainable and long-term management of natural and cultural resources, while generating economic and social benefits for local areas. (Source: The Strategic Plan for Development of Tourism 2017-2022)
Latvia	Latvia wants to achieve: improvement of the state body; long-term tourism development; and smart money investment. (Source: How to develop tourism in Latvia? Tourism Marketing Strategy 2018–2023)
Lithuania	The vision for the territory is not defined in the document; only the tourism brand is mentioned: Lithuania. Real is beautiful. (Source: Tourism Sector Development study)
Luxembourg	People, regions and economy: value-oriented tourism as an active driver for a better quality of life and stay. (Source: People, regions and economy - Tourism Strategy Luxembourg)
Malta	To manage and formulate the future development of tourism to Malta in line with sustainability principles through strategies aimed at making best use of the country's natural capital and cultural attractions in a way which balances the welfare and well-being of the country's residents and the maximization of visitor economic value and satisfaction. (Source: Malta Tourism Strategy 2021-2030)
Netherlands	The strategy points out that every Dutch person must benefit from tourism by 2030. (Source: Perspective Destination Netherlands 2030)
Poland	Establish Poland as a recognized tourist brand that is innovative, sustainable and accessible to diverse audiences. (Source: Strategic diagnosis for the needs of Polish marketing communication in tourism until 2030)
Portugal	Establish tourism as a hub for economic, social, and environmental development throughout the entire territory, positioning Portugal as one of the most competitive and sustainable tourism destinations in the world. (Source: Tourism Strategy 2027)
Romania	By 2035, Romania will be recognized as a high-quality tourist destination, available all year round, based on the uniqueness of its cultural and natural heritage, and offering services of international standard. The country will be among the leaders in tourism competitiveness rankings, due to strategic investments in infrastructure, education, marketing and promotion, which will provide unique experiences for visitors and attract relevant tourists from Europe and around the world. (Source: Romania's National Strategy for Tourism Development 2023-2035)
Slovakia	Slovakia will become a world leader destination through balanced of development when using "Slovakness" in the socio-economic development of the country and distribution of wealth in an inclusive and sustainable way. (Source: Mapping Study Slovakia: Unity of the Slovak Tourism Industry)
Slovenia	Slovenia is a global green boutique destination for demanding guests who are seeking a diverse and active experience, peace of mind and personal benefits. (Source: Slovenian Tourism Strategy 2022-2028)
Spain	The objective of this plan is to lay the foundations for the transformation of Spanish tourism towards a model of sustained and sustainable growth, which allows us to maintain its position of world leadership. (Source: Sustainable Tourism Strategy of Spain 2030)
Sweden	In 2030 Sweden wants to be the world's most sustainable and attractive destination based on innovation. (Source: Swedish National Tourism Strategy 2021-2030)

Source: Own elaboration (retrieved and adapted from the original tourism plans)

5. CONCLUSION

The importance of planning tourist activity is a topic that has been worked on by many authors for several decades. A national tourism strategy defines the main policy orientation of tourism development and provides guidelines to produce regional and local plans in the territory (Bailoa & Cravo, 2020).

The main objective of this study was to identify and analyze the national tourism plans of the 27 EU countries. In this analysis, the emphasis was on the concept of sustainability. The goal was to see if countries are effectively committed to adopting more sustainable tourism practices, or if the scenario was otherwise. It was found that of the 27 EU countries, 16 show their commitment in a very clear and evident way and expose this intention in the strategic vision, as a central element in the planning process. Some countries make no direct reference to the concept of sustainability, but the principles that guide this concept are implicit in the document, especially care for the quality of life of residents and concern for the benefits that tourism can bring to the community and local businesses. Without a strategy focused on sustainability, it is not possible to achieve development that can bring benefits to all stakeholders. A more in-depth study would be needed, with evidence

collected in each of the 27 countries, to ascertain whether this commitment to sustainability is in fact real or if it turns out to be a greenwashing strategy.

An element that is also worth mentioning concerns the reference to the COVID-19 pandemic, which recently affected the tourism sector worldwide. All plans that were drawn up after the year 2020 contain a reference to the pandemic. The perspective presented is mainly one of recovery and resilience, showing that tourist destinations are recovering from the losses sustained and that they have set new goals.

The main limitations of the study are related to the methodology used, which is only qualitative and uses the technique of document analysis. Another limitation was the researching and interpreting process related to the strategic documents as many of the strategic plans were only available in the country's national language, with no English versions.

As suggestions for future research, the authors consider that it would be pertinent to carry out a study with an evaluation of the results obtained when these plans end. That is, most of the documents have the year 2030 as a time limit, where an analysis could be made, based on national data and statistics for each country, to find out whether the proposed targets were met and the actions implemented. A more in-depth analysis of sustainability issues is also suggested for countries that are effectively committed to these issues, for example, seeing whether the 17 SDGs are referred to in the plan and analyzing the defined objectives and actions that will make it possible to materialize the vision.

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Sustainable Project Management in Tourism Using Green Funds in Serbia

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Abstract: *The research analyzes the synergy between project management and green financial instruments for sustainable tourism development in Serbia. It examines the possibilities of financing sustainable tourism projects through green funds and analysis good practices in managing environmentally sustainable projects. The research is based on the collection of secondary data and uses analytical-synthetic, hypothetical deductive, and comparative methods. The research results show the potential of green funds in the projects of tourism in the field of climate change mitigation and adaptation, sustainability cross-sectors of agriculture, forestry, and tourism, decarbonization and circular economy, pollution reduction and biodiversity conservation, sustainable rural development, green tourism initiatives, energy-efficient infrastructure and sustainable mobility, energy efficiency and emission reduction. A lack of experts and complex procedures for accessing funds are the main observed obstacles. The authors recommend project management education and simplification of procedures for accessing green funds while encouraging public-private partnerships for long-term sustainability.*

1. INTRODUCTION

The study focuses on exploring the opportunities that green funds offer in financing sustainable tourism projects in Serbia. Serbia actively participates in global initiatives for sustainable development through the implementation of numerous projects supported by green funds and financial institutions. Among these initiatives, according to criteria such as investment volume, visibility, alignment with Serbia's green transformation goals and their measurable impact on sustainable development in the region, the most significant are the Green Climate Foundation (GCF), the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), as well as the EU for Green Agenda in Serbia Program.

The research is based on secondary data. Through the application of qualitative methods, the green funds in Serbia have been identified, analyzed and compared with the aim of improving sustainable tourism project initiatives.

Special attention is paid to identifying challenges, such as the lack of professional staff and complex procedures for applying for green funds. In the paper, the authors offer recommendations for improving the capacities of the tourism industry and encouraging public-private partnerships, which would ensure the long-term sustainability of tourism projects in Serbia.

2. MATERIAL AND METHODOLOGY

Tourism can be one of the most important drivers of global improvement in the economic, social, and environmental aspects of human society (Edgell, 2020). Tourism companies must ensure

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continuous monitoring of their activities and the natural environment to detect problems at an early stage and prevent more serious losses (Presbury & Edwards, 2010). Following the above, the concept of sustainable tourism developed in the early 1990s (Roblek et al., 2020), making it a leading priority in global efforts to preserve the environment and improve the quality of life of local communities (Trišić et al., 2023). In the context of the development of the concept of sustainable tourism, project management and the effective use of financial instruments, such as green funds, play a dominant role in achieving the goals of sustainable tourism (Soares et al., 2023). Projects in the field of sustainable tourism that might be subject to support from green funds are in the field of reducing greenhouse gas (GHG) emissions and adapting to the impacts of climate change (Filonchyk et al., 2024), then integrating sustainable practices in agriculture, forestry, tourism and renewable energy to ensure long-term environmental and economic benefits (Raihan & Tuspekova, 2022; Bathaei & Štreimikienė, 2022), transitioning to low-carbon systems and promoting the reuse and recycling of resources to reduce waste (Chu et al., 2021; Wang et al., 2022), reducing environmental pollution and preserving biodiversity as essential components of ecosystem health (Wang et al., 2022), improving rural economies through sustainable practices that balance development with environmental protection, promoting tourism projects that are consistent with environmental sustainability (An et al., 2019), such as ecotourism and community tourism (Alexandra & Barbosa, 2023), supporting the development of energy-efficient buildings and transport systems that also benefit tourism (Yan & Phucharoen, 2023; Karvounidi et al., 2024), and encouraging the adoption of energy-saving technologies and practices to reduce emissions (Ma et al., 2023).

The research methodology provides a comprehensive overview of the subject and the achievement of the research objectives. It is based on the analysis of secondary data. The analytical-synthetic method was used for the systematic analysis of the collected data. By breaking down complex information into simpler elements and synthesizing them into coherent insights, the research aims to identify key trends and models of green finance in Serbia, understand the relationships and interactions between various factors, and draw meaningful conclusions relevant to the focus of the research. The comparative method was used to assess the similarities and differences between different financing mechanisms, programs and their application to sustainable development and tourism projects. This approach includes a comparison of the key characteristics of green funds (focus, the scope of funding, advantages, and limitations) and the comparative advantages and applications of green funds according to the following criteria: the type of support, focus on tourism, simplicity of application, and potential for large projects. By applying the comparative method, the applicability of funding mechanisms across project sizes and sectors was assessed, as well as the requirements and outcomes of various international and regional programs were analyzed. By combining these methods, the research provides a rigorous and structured analysis, providing a reliable basis for conclusions and recommendations. Using the hypothetical-deductive method, hypotheses were formulated, and their validity was examined.

Hypothesis One: Projects that are aligned with international standards, such as national climate plans or ESG criteria, have a higher chance of receiving financial support from international funds.

Hypothesis Two: Smaller and innovative projects, focused on decarbonization and sustainable rural development, are more likely to receive funding through programs than through banks.

Hypothesis Three: Large infrastructure projects, such as energy-efficient buildings and sustainable mobility, have significant potential to gain support from banks.

Hypothesis Four: Partnerships with local authorities and international organizations increase the chances of receiving funds through programs.

3. RESULTS AND DISCUSSION

The research highlights several key green funds and initiatives that support sustainable tourism and environmental projects in Serbia. The GCF, EU for Green Agenda in Serbia, EIB and EBRD funds were selected based on their significant financial support, global and regional visibility, alignment with Serbia's green transformation goals, and their measurable impact on sustainable development in the region. The Ministry of Agriculture, Forestry, and Water Management of the Republic of Serbia, as the national competent authority, cooperates with the GCF on access to financing for climate-related projects, including sustainable tourism. The GCF supports preparedness activities (strengthening institutional capacities, developing strategic documents, supporting projects at an early stage, engaging stakeholders and providing technical support for applications) and offers grants or co-financing for projects that are in line with Serbia's climate goals. The GCF has financed 4 projects in Serbia with 92.6m. The Nationally Determined Contribution (NDC) is the basic document through which Serbia formalizes its climate goals under the Paris Agreement, which includes a 33.3% reduction in GHG emissions by 2030 compared to the base year of 1990 (Republic of Serbia, 2022). Examples of projects supported by GCF in cooperation with UNDP Serbia, include achieving resilience to climate change through financing the development of water resources management infrastructure, such as irrigation and water conservation systems, to reduce the risk of droughts and floods in agricultural communities, and supporting renewable energy sources such as solar panel installations and power generation systems in remote communities that have limited or no access to a stable electricity supply. Projects must prove their contribution to the goals of climate action, such as energy efficiency, resource management or biodiversity conservation. It is necessary to have the capacity to produce quality project documentation and demonstrate the ability to manage the project. Partnerships between local authorities, the private sector and non-governmental organizations are encouraged to increase the impact and sustainability of projects. Projects are often implemented with the support of national institutions, which facilitate access to the GCF through preparation and application. Projects must have a clear plan of how they will contribute to local communities and climate resilience such as the reduction of GHG emissions, increase energy efficiency and enable local communities to adapt to climate challenges (Green Climate Fund, n.d.; United Nations Development Programme, n.d.-c; Ministry of Environmental Protection of the Republic of Serbia, n.d.).

The European Union (EU), in partnership with UNDP and other stakeholders, is leading the EU for Green Agenda in Serbia Program, offering grants and co-financing for innovative projects in five areas: decarbonization, circular economy, environmental degradation, biodiversity and sustainable rural development. The program includes funding for pilot projects that can promote green tourism. (European Commission, 2022). EU LIFE is an EU financial instrument that provides support to projects in the field of environment and climate, such as projects that promote the use of bicycles and public transport in smaller communities, and initiatives in the field of green tourism - the development of sustainable tourist facilities that use solar systems and environmentally friendly practices (European Commission, n.d.). For ecotourism projects, UNDP offers financial support and expertise through various financing mechanisms, such as green investment grants, ensuring that projects meet criteria for reducing carbon emissions and contributing to biodiversity conservation. These projects are assessed on the basis of their potential environmental, social and economic impacts and are often financed through a performance-based payment system. UNDP works with local governments, universities and businesses to strengthen the capacity of small and medium-sized enterprises in the tourism sector. This collaboration emphasizes the need for green transformations, sustainable business practices and a focus on local cultural and environmental

assets. The EU has allocated 7.2 million euros for this program, while additional funds have been provided by other donors, including the governments of Sweden (1.58m dollars in 2022), Switzerland (7.1m dollars in 2022), and Serbia (0.8m dollars in 2022) (United Nations Development Programme, n.d.-a, n.d.-b, 2024).

The EIB is a major financier of green projects in Serbia, including initiatives related to renewable energy, energy efficiency, sustainable infrastructure and sustainable transport. The EIB has been active in Serbia since 1977 and has so far supported the implementation of 100 sustainable investment projects worth €8.03 billion. The bank supports the private and public sectors offering loans and grants on favorable terms for initiatives that focus on energy efficiency, waste management and biodiversity conservation. For projects in Serbia, the EIB gives priority to those that comply with EU environmental standards, focusing on promoting the development of green tourism. This may include financing energy-efficient accommodation, sustainable infrastructure in tourist destinations and initiatives that minimize environmental impact. The EIB works closely with local authorities, businesses and international partners to ensure that the projects financed meet long-term sustainability objectives. Financial terms vary depending on the specifics of the project, but the bank typically offers competitive interest rates, long repayment periods, and technical assistance to ensure the project's success. To access financing, entities need to demonstrate the environmental benefits and sustainability of their tourism projects. In 2019, the EIB secured a loan of 140 million euros for the construction of the Niš-Merdare highway, known as the Peace Highway. The Peace Highway will connect southern Serbia and Priština and will become part of the road network that leads via Tirana to Durres, thus connecting Serbia with ports on the Adriatic Sea. This is a priority infrastructure task that enables the economic, tourism and social development of the country, as well as stronger connectivity of the entire region. This project, supported by an EU-WBIF grant of 40.6 million euros, represents a step towards reconciliation in the region and a successful example of cooperation between the EIB and the EU in financing countries that are candidates for EU membership (European Investment Bank, n.d.; Western Balkans Investment Framework, n.d.; Koridori Srbije, n.d.).

The EBRD focuses on investments aligned with the Paris Agreement, supporting energy-efficient and climate-friendly projects. With a large portfolio in Serbia, the EBRD offers financing for businesses that incorporate sustainability into tourism. It finances several projects in the field of sustainable development. It supports energy efficiency, renewable energy and sustainable infrastructure projects. Programmes such as the Green Economy Financing Facility (GEFF) provide financing for small and medium-sized enterprises (SMEs) investing in green technologies and energy efficiency. The EBRD supports eco-tourism projects in Serbia through financial instruments such as loans and equity investments. Projects must contribute to sustainability, including energy efficiency, conservation of natural resources and reduction of negative environmental impact. Priority is given to projects that involve local communities and promote sustainable practices. Access to financing requires compliance with international environmental standards and transparency in management. (EBRD, n.d.).

The EBRD's strategy in tourism is based on the management and development of green and sustainable buildings, the development of an inclusive and competitive hospitality and tourism sector, the promotion of urban regeneration initiatives for more competitive, and greener cities, and the diversification of sources of financing for real estate development and ownership through Capital markets, facilitating the resilience of the sector. The EBRD invests in commercial, logistics and residential real estate, as well as in hospitality and hotel assets, as well as in underutilized brownfield sites, clustered asset portfolios and key locations in cities (EBRD, 2019).

Out of 365 projects in Serbia, 8 projects are in the field of Properties and Tourism, out of 9437 million euros of total EBRD investment in Serbia, 284.49 million euros were invested in the Properties and tourism sector, which is a share of about 3% compared to investments in other sectors. Out of 161 projects in the Property and Tourism sector in the period 1996-2024, there were 8 projects in Serbia in the period 2003-2023, of which 7 are private projects and 1 is a state project. Of the completed projects, one is a private one in the repaying status, while one is a state project in the disbursing status. Out of the 28 years that EBRD funds have been available in the Property and Tourism sector, Serbia has been using the funds for 20 years with a project share of 5% compared to other EBRD beneficiary countries (European Bank for Reconstruction and Development, n.d.).

A comparative analysis of key green funds for financing sustainable ecological projects in tourism in Serbia is presented in tabular (Table 1).

Table 1. Comparative Analysis of Key Green Funds for Financing Sustainable Tourism Projects in Serbia

	Green funds			
Key characteristics	**GCF**	**EU for Green Agenda in Serbia Program**	**EIB**	**EBRD**
Focus	Projects that contribute to climate change mitigation and adaptation. It especially supports projects that integrate sustainability in agriculture, forestry, tourism, and renewable energy sources.	Decarbonization, circular economy, pollution reduction, biodiversity, and sustainable rural development. The program supports innovative projects, including green tourism initiatives.	Financing major infrastructure projects, including energy-efficient buildings and sustainable mobility can contribute to tourism.	Projects that improve energy efficiency and reduce emissions, including sustainable tourism practices.
Scope of funding	Medium to large grants and co-financing, supported by national and local authorities.	Grants for innovation and pilot projects, with additional funds from bilateral donations (Sweden, Switzerland, Serbia).	Large loans for public and private sectors, with support from the EU.	Medium to large investments for private and public sectors.
Advantages	Global focus with strong financial capacity. Support for projects that are part of national climate goals.	Targets local communities and small businesses. Help in compliance with EU standards.	Very large financing capacity. Support for the development of infrastructure with an impact on sustainable tourism.	Wide range of sectors covered. Projects aligned with the Paris Agreement.
Limitations	Complex application process. Requires compliance with international climate standards	Focused on specific areas within sustainability. Funds are often intended for small and medium-sized projects.	Focused on infrastructure projects, less on direct tourism initiatives. Complex procedures and higher minimum amount for applications	High requirements for compliance with ESG criteria. Focus on sectors with a higher return on investment.

Source: Author's processing

The GCF is a key global mechanism for financing projects dealing with climate change. Its focus on climate change mitigation and adaptation makes it attractive for projects in sectors such as renewable energy, sustainable tourism, agriculture, and forestry. However, the complex application process and the need to comply with international standards can be a challenge for smaller organizations and local communities. National authorities often play an intermediary role, which can facilitate the process, but also requires additional coordination. The author recommends that organizations with the capacity to meet complex requirements should explore this option,

especially if their projects have a significant impact on reducing GHG emissions and are consistent with national climate plans. Also, it is important to secure partnerships with local authorities and international experts to increase the chances of a successful application.

The EU for Green Agenda in Serbia Program has a specific focus on the topics of decarbonization, biodiversity, and sustainable rural development, which makes it suitable for smaller-scale projects, including innovative and pilot initiatives. Local businesses and communities can benefit significantly because of the emphasis on small and medium-sized projects. However, the limitation in the number of funds and the specific thematic directions mean that the program is not ideal for projects that go beyond the defined priority areas. The authors recommend this program to small and medium-sized businesses and local organizations to take advantage of this chance to finance innovative solutions, especially if they are focused on decarbonization and sustainable development. Partnerships with national and international organizations can further assist in aligning with EU standards and obtaining funding.

The EIB is an extremely powerful financing mechanism for large infrastructure projects. Projects such as energy-efficient buildings, sustainable mobility, and tourism contributing to green infrastructure have a high chance of support. However, the high minimum number of applications and the complex procedure limit this option to large actors, such as public institutions and large companies. The lack of a specific focus on tourism further narrows the potential applications. This option is best suited for large projects with long-term infrastructure goals. Public institutions and large corporations should focus on the synergy between sustainable development and tourism. The authors recommend hiring professional consultants to prepare applications and ensure the financial viability of the project.

The EBRD offers flexibility in financing different sectors, including energy efficiency and sustainable tourism practices. The focus on projects aligned with the Paris Agreement and ESG criteria makes it suitable for companies that want to implement green initiatives. However, high standards and return on investment requirements limit access to smaller projects. The authors recommend this source of financing to companies and organizations that can develop projects of medium and large scale and that can meet ESG standards. It is useful to involve sustainability experts early in project development to meet the bank's requirements.

The green funds of GCF and EBRD give priority financial support to projects that are aligned with international standards, such as national climate plans or ESG criteria. This confirms Hypothesis One. The EU for Green Agenda in Serbia Program supports smaller and more innovative projects, focused on decarbonization and sustainable rural development, which is not the practice of EIB and GCF banks, which are focused on large infrastructure projects, such as energy-efficient buildings and sustainable mobility, thus confirming Hypothesis Two and Hypothesis Three. GCF and the EU for Green Agenda in Serbia Program are green funds that particularly value projects based on the partnership of local authorities and international organizations, thus confirming Hypothesis Four.

Comparative advantages and applications of key green funds for financing sustainable ecological projects in tourism in Serbia are presented in tabular (Table 2).

For small and innovative projects, the EU for Green Agenda Programme provides the most affordable option. For large infrastructure projects, the EIB and the EBRD offer significant financial capacity. For projects related to climate change, the GCF is ideal, but with a more demanding application process. The selection of the fund depends on the size of the project, the area of focus and the ability to meet the fund's criteria (Milojković et al., 2023; Milojković, 2023).

By considering the support of the analyzed key green funds in Serbia, the authors observe four types of green financing in Serbia: grants, co-financing, loans and investments. Due to the complexity of the access to green funds (GCF and EIB have a complex procedure for accessing funds, while the EU for Green Agenda in Serbia Program and EBRD have a moderately complex procedure), it is necessary to work on education in project management and on simplifying the procedures for accessing green funds. The analysis of the four key green funds in Serbia indicates that only for Green Agenda in Serbia Program has a direct focus on tourism, while the EBRD, despite the Property and Tourism Sector Strategy 2020-2024, focuses projects on properties, such as retail parks and science and technology parks, while direct support for tourism projects in Serbia is absent.

Table 2. Comparative Advantages and Applications of Key Green Funds for Financing Sustainable Tourism Projects in Serbia

Green Fund	The Type of Support	Focus on Tourism	Simplicity of Application	Potential for Large Projects
GCF	Grants/Co-financing	Indirectly	Low	High
EU for Green Agenda Programme	Grants	Directly	Medium	Medium
EIB	Loans	Indirectly	Low	High
EBRD	Investments/Loans	Indirectly	Medium	High

Source: Author's processing

4. FUTURE RESEARCH DIRECTIONS

Future and emerging trends in green finance reflect the growing need for responsible and sustainable investments to address the challenges of climate change, biodiversity conservation, and sustainable development. Key trends expected in the future include the increased use of ESG standards, the development of new green finance instruments, the digitalization of green finance, social inclusiveness of sustainable development, the valuation of natural capital, regional specificities of climate change, financing of green technologies, green microfinance for SMEs, green banking, green contracting, etc.

5. CONCLUSION

The EU for Green Agenda in Serbia Program is best suited for small and innovative projects in Serbia, while the EIB and EBRD offer larger financial capacities for infrastructure projects. The GCF is suitable for climate change projects but requires a complex application process. Access to funds such as GCF and EIB is complex, while the procedures of the EU Program and the EBRD are moderately demanding. This complexity can be a barrier for organizations that do not have sufficient experience in project management. Only the EU for Green Agenda in Serbia Program directly supports projects in the field of tourism, while the EBRD, despite its asset and tourism sector strategy, mainly supports infrastructure projects such as science and technology parks but does not provide direct support to tourism projects. There is a clear need to improve capacity in project management and education on the procedures for accessing green funds. The authors recommend: (1) Strengthening education on project management through organizing trainings and workshops for local governments, tourism organizations and SMEs in the field of project management, especially in the context of sustainable tourism and introducing practical guides on preparing projects for accessing green funds; (2) Adjusting and simplifying procedures for accessing funds such as the GCF and EIB, with the mediation of national institutions or special bodies to support applicants; (3) Encouraging cooperation with the EBRD and other institutions by initiating a dialogue with the EBRD in order to define specific programs for financing tourism projects in Serbia and using the existing EBRD strategy for the tourism

sector (2020–2024) to create new initiatives that will also include small tourism projects; (4) Focus on projects with climate impact by designing tourism projects to contribute to carbon reduction, energy efficiency and nature conservation, which would make them more competitive for GCF financing; (5) Improve the visibility of the EU for Green Agenda in Serbia Program by promoting the opportunities of this program among tourism businesses and local communities, in order to make the most of direct support for tourism projects; (6) Develop financing models for tourism by encouraging public-private partnerships (PPPs) in tourism with the support of green funds and designing models that combine grants, co-financing and loans to ensure the sustainability of projects. By improving the capacity to access green funds and simplifying procedures, it is possible to significantly increase the number of funded projects in the field of sustainable tourism. Investing in projects with climate and environmental impact can attract more funding from green funds, while better cooperation with international institutions can enable the development of new tourism support programs.

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Assessment of National Statistical System and Tourism Evidence in Serbia

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Abstract: *The development and accuracy of national tourism statistics are crucial for effective policy-making and sustainable growth in the tourism sector. The paper assesses Serbia's current national statistical tourism system, focusing on its alignment with international standards and the need for further enhancements. Despite progress in data collection for accommodation statistics and tourism participation, challenges persist in integrating comprehensive demand-side data and fully establishing Tourism Satellite Account. The study underscores the importance of improving data accuracy, reliability, and international data dissemination to strengthen Serbia's tourism statistics, ultimately supporting more effective policy-making, strategic planning, and long-term competitiveness in the global tourism market.*

1. INTRODUCTION

Accurate and comprehensive statistical data systems are crucial for making informed decisions, developing strategic plans, and promoting sustainable growth in the tourism industry. Such systems offer a detailed understanding of various aspects of tourism, aiding government activities and enabling well-informed policy-making. Reliable and standardized tourism statistics are paramount in the rapidly evolving global tourism sector. These statistics form the foundation for evaluating tourism's economic, social, and environmental impacts, guiding infrastructure development, policies, and marketing strategies that align with national priorities and international standards.

The focus of this paper is to assess the current state of Serbia's national statistical system in tourism. The aim is to evaluate Serbia's alignment with international best practices in tourism statistics and identify areas for improvement that would enhance data accuracy, reliability, and utility. The assessment aims to provide actionable insights to support the further development of Serbia's tourism statistics, contributing to more effective policy-making and sustainable tourism growth.

2. LITERATURE BACKGROUND

An advanced national statistical system is not only pivotal for the efficient monitoring and assessment of tourism development activities but also for ensuring that decisions are evidence-based and align with the diverse needs and aspirations of communities at both national and local levels (Endhartiko, 2016; Hasyim et al., 2020; Abesadze et al., 2023). By enabling a comprehensive collection and analysis of data, such systems facilitate the evaluation of tourism's multifaceted impacts - economic, social, and environmental - thus guiding infrastructure development, policy formulation, and promoting

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diverse forms of tourism (Nikolskaya, 2019). Moreover, establishing a robust and integrated national statistical system enhances tourism-related employment statistics' accuracy, trustworthiness, and dependability. Precise employment data is essential as it forms the foundation for a comprehensive assessment of the economic impact of the tourist sector, including its contributions to GDP and job creation. For instance, the Tourism Satellite Account (TSA) is a comprehensive statistical tool providing in-depth insights into employment and human resource issues within the tourism sector, underscoring the importance of precise data in understanding tourism's macroeconomic significance (Eurostat, 2017). The TSA's role is particularly highlighted in the work of Milenkovski et al. (2019), who emphasize that quality tourism statistics are the foundation for sound tourism research and effective policy-making, particularly in emerging and competitive markets. Enhancing the national statistical system also fosters the development of specialized expertise in analyzing tourism statistics, improving the practical application of statistical methods within the industry and the theoretical understanding of tourism dynamics. Sabou et al. (2012) argue that integrating diverse data sources can enrich statistical analysis and provide a more nuanced understanding of tourism trends and impacts. Pratt and Tolkach (2017) argue that tourism statistics are complex and politically influenced, stressing the importance of critically analyzing and rigorously applying methods to ensure that the data is accurate, unbiased, and truly reflective of the state of the tourism sector.

Effective statistical data collection methods, including observation, interviews, literature studies, and recording, remain essential for gathering detailed information that supports the provision of facilities, infrastructure, financial aid, and promotion of tourism destinations. These methods are critical for identifying priority locations, analyzing changing traveler demographics, recognizing preferred activities, and understanding expenditure trends. Comprehensive and high-quality data is thus indispensable for formulating effective tourism policies and strategies that enhance the overall tourism experience while maximizing economic benefits (Mariani et al., 2018; Dwyer et al., 2004). Integrating advanced technologies and sophisticated data analysis techniques ensures that the tourism sector remains competitive and capable of adapting to emerging trends and challenges. Recent technological developments further amplify the importance of integrating traditional statistical methods with big data and Artificial Intelligence (AI). Incorporating AI into tourism statistics has revolutionized data collection and analysis processes, offering enhanced precision, efficiency, and the ability to process real-time data. The integration makes better decision-making and policy development possible, making conducting more thorough and dynamic assessments of tourist trends easier. Several authors (Viglia et al., 2016; Buhalis & Sinarta, 2019; García-Madurga & Grilló-Méndez, 2023) highlight how AI technologies like machine learning and predictive analytics are being leveraged to gain deeper insights into tourism dynamics, ultimately contributing to a more responsive and adaptive tourism management system.

The study by Frechtling and Hara (2016), which was one of the starting points for our research, provides a critical assessment of the global state of national tourism statistics, revealing significant disparities in the comprehensiveness of Systems of Tourism Statistics (STS) across countries. Their analysis shows that only 11% of countries possess the most complete and robust STS, capable of supporting comprehensive tourism policies and economic planning. The study also highlights the urgent need for capacity building in lower-tier countries, where tourism statistics are rudimentary and insufficient for meaningful analysis. The authors advocate for international collaboration and targeted support to enhance the statistical capabilities of these nations, emphasizing that improved STS are essential for informed decision-making, effective policy formulation, and the overall development of the tourism sector. The significance of a globally harmonized approach to tourist data is highlighted by this research, as it is essential for precise cross-national comparisons and the strategic management of tourism at both the national and international levels.

3. METHODOLOGY FOR TOURISM STATISTICS AT A GLOBAL LEVEL

Various initiatives from international organizations have significantly influenced establishing and enhancing national statistical systems in tourism. These organizations have provided comprehensive frameworks and standardized methodologies to ensure the collection and analysis of reliable and comparable tourism data on a global level. The initiatives aim to address the diverse aspects of tourism statistics, including data definitions, classifications, and sources, thereby enhancing the consistency and comparability of data across different countries. By developing robust statistical frameworks, these organizations support countries in measuring the economic impact of tourism, understanding market trends, and formulating evidence-based policies. The collaborative efforts of international bodies such as the UNWTO, Eurostat, and the OECD have been pivotal in promoting best practices and fostering global cooperation in tourism statistics. Initiatives like these aid in accurately assessing tourism activities and facilitate better planning and strategic development, ultimately contributing to the sustainable growth of the tourism sector.

The following section provides an overview of key documents and initiatives that have shaped the global approach to tourism statistical systems.

1. United Nations World Tourism Organization (UNWTO) Standards
    a. International Recommendations for Tourism Statistics (IRTS) (2008) (United Nations, 2010) - The document offers a comprehensive framework for collecting and compiling tourism statistics, providing guidelines that ensure data consistency and comparability across different countries. The IRTS 2008 addresses various aspects of tourism statistics, including definitions, classifications, and data sources.
    b. Tourism Satellite Account: Recommended Methodological Framework (2008) (UN et al., 2010) - The TSA framework is designed to measure the economic contribution of tourism to the national economy. It provides a structured approach to compiling tourism-related data, covering aspects such as tourism expenditures, production, employment, and gross value added.
2. Eurostat Initiatives
    a. Methodological Manual on Tourism Statistics - The manual provides detailed guidelines for collecting, processing, and disseminating tourism statistics within the EU. It aims to harmonize the statistical practices of member states, facilitating accurate and comprehensive data collection.
    b. Tourism Satellite Accounts in Europe (2016 Edition) (Eurostat, 2017) - Eurostat has undertaken initiatives to standardize the compilation of tourism statistics across European Union member states. The 2016 edition of this document outlines the methodologies for creating TSAs, ensuring that the data is reliable and comparable.
3. Organisation for Economic Cooperation and Development (OECD, 2018) Guidelines
    a. OECD Tourism Trends and Policies - The OECD regularly publishes reports that provide insights into tourism policies and their effectiveness based on comprehensive data collection and analysis. These publications help countries benchmark their tourism performance and policy outcomes.
4. World Bank Initiative for Sustainable Tourism
    a. Databank – The World Bank has developed a comprehensive Global Tourism Dashboard, a databank dedicated to tourism statistics. This platform compiles and standardizes tourism data from various countries, offering a global overview that facilitates cross-country comparisons. The Global Tourism Dashboard includes a wide range of indicators, such as tourist arrivals, tourism expenditures, and economic impact metrics.
    b. Tourism for Development: Tourism Diagnostic Toolkit (Perrottet & Twining-Ward, 2019) – The Toolkit was developed under the Tourism for Development knowledge series and

is a vital resource for evaluating and enhancing the tourism sector. The Toolkit offers a structured approach to diagnosing a country's current state of tourism, focusing on strengths, weaknesses, opportunities, and threats. The practical guidelines provided in the toolkit help identify critical areas for improvement and strategic development. Access to this Toolkit ensures that countries can systematically assess their tourism potential and implement targeted actions to maximize economic benefits and enhance the overall tourism experience.

Initiatives and documents from various international and regional organizations have significantly advanced tourism statistical systems on a national level. Improved data collection methodologies, standardized guidelines, and enhanced statistical frameworks have collectively contributed to a better understanding of tourism trends and impacts. By adopting these advanced practices, countries can monitor and evaluate tourism activities more effectively, identify priority areas for development, and allocate resources efficiently. The detailed insights from robust tourism statistics also help craft targeted marketing strategies, improve infrastructure planning, and foster sustainable tourism practices. As a result, these advancements are vital in enhancing national tourism sectors' overall effectiveness and strategic planning.

4. TOURISM IN SERBIA – POLICY PERSPECTIVE

Serbia, situated in the Balkan Peninsula of Central Europe, boasts a diverse array of natural, geographical, historical, and climatic assets that create ideal conditions for developing various types of tourism. According to forecasts by the UNWTO (2021), these forms of tourism are expected to become leading trends in international travel in the coming years. Recognizing this potential, the Government of the Republic of Serbia has designated tourism as a priority sector for socio-economic growth and development, which is best exemplified by the adoption of the third Strategy for Tourism Development of the Republic of Serbia for the period 2016-2025 (RS Official Gazette no. 98/2016). However, despite the strategic focus and the country's rich resource base, Serbia's tourism sector underperforms relative to its capabilities and market opportunities. The key indicators show that tourism development lags well behind what could be achieved given the country's abundant resources and favorable conditions. Enhancing infrastructure, improving service quality, and promoting Serbia as a prime tourist destination are essential steps needed to capitalize on its full potential. Additionally, there is a need for comprehensive marketing strategies and more substantial international partnerships to boost Serbia's visibility on the global tourism stage. With targeted efforts and strategic investments, Serbia can bridge this gap and realize its vision of becoming a leading destination in the region.

Among the main problems in Serbian tourism is an outdated tourism strategy that has not adequately considered the digitalization of tourism marketing and management, leaving the sector lagging behind its regional competitors. Furthermore, the Strategy did not define specific market segments based on thorough market research, leading to a disconnect between tourism products and their target audiences. Also, the previous Strategy did not sufficiently recognize emerging tourist markets such as Asia and the Middle East, nor did it adapt to the changing dynamics brought about by the COVID-19 pandemic, underscoring the importance of regional tourists and visa-free travel arrangements. Despite these shortcomings, some aspects of the Strategy remain relevant. Key foreign markets for incoming tourism, such as regional and nearby EU countries, remain important. The strategic geographic clusters of Serbian tourism offerings are still in place, although coordination and support from regional tourism organizations are inconsistent, while efforts to digitalize the tourism industry, including implementing the *eTurista* platform, represent

a critical step forward. However, challenges in the platform's implementation, discrepancies in data collection, and a lack of consistent usage by accommodation providers indicate that more work is needed to integrate this tool fully into the national statistical system.

The legal framework supporting tourism development has also been improved, including introducing new laws and strategic marketing plans. However, the absence of a comprehensive reporting system and regular evaluations of the Strategy's progress has hindered the effective monitoring and adjustment of tourism policies. While Serbia has made strides in certain areas of tourism development, significant challenges remain. Addressing these issues through updated strategies, improved digitalization, targeted marketing, and better coordination among stakeholders is essential for realizing the full potential of Serbia's tourism sector.

Given the information provided above, it is feasible to offer suitable suggestions. Serbia should enhance digitalization in tourism marketing and management through advanced digital tools and platforms. Conducting thorough market research to define and reach specific tourist segments and increasing efforts to attract tourists from emerging markets such as Asia and the Middle East are essential. Investing in infrastructure improvements to support and enhance the tourist experience and building stronger international partnerships with international tourism organizations and neighboring countries are crucial. Establishing regular evaluations and a comprehensive reporting system to monitor and adjust tourism policies effectively is necessary. Additionally, developing targeted promotional strategies to boost Serbia's visibility as a prime tourist destination on the global stage and enhancing tourism data quality and availability are vital steps to realize Serbia's tourism potential fully.

For Serbia to achieve its goals in national tourism and address all identified shortcomings, it must have comprehensive and high-quality tourism data. In the following section, an overview of the current state of this field in 2024 will be presented.

5. ASSESSMENT OF THE TOURISM DATA QUALITY AND AVAILABILITY IN SERBIA

5.1. Methodology & data

The United Nations World Tourism Organisation (UNWTO) guidelines for establishing and assessing national tourist data are followed in the present research. The methodology is based on the adherence to two primary UN statistical standards: the International Recommendations for Tourism Statistics 2008 and the Tourism Satellite Account: Recommended Methodological Framework 2008. These standards ensure that the tourism statistics collected are accurate, reliable, and internationally comparable, which is essential for effective policy-making and economic analysis.

The need for a robust statistical framework, guided by established principles, became particularly evident during the 1980s when Central European countries transitioned from centrally planned economies to market-oriented democracies. The Conference of European Statisticians developed the Fundamental Principles of Official Statistics in 1991 to ensure that these emerging economies could produce reliable and appropriate data. These principles, adopted at the ministerial level by the European Economic Commission in 1992, have since been recognized for their broader global relevance, underscoring the importance of reliable statistics in supporting democratic governance, economic stability, and public trust.

The data collection process involved developing and disseminating a detailed questionnaire designed based on Eurostat's Methodological Manual for Tourism Statistics (Eurostat, 2014, Version 3.1,),

the UN's International Recommendations for Tourism Statistics 2008, and the Tourism Satellite Account: Recommended Methodological Framework 2008. The questionnaire aimed to assess compliance with these international standards among the Western Balkan economies (WB6). It covered the following key segments: (a) Basic tourism statistical concepts; (b) Supply-side data: Accommodation statistics; (c) Demand-side data: Participation in tourism, tourism trips, and visitors, including same-day visits; (d) Tourism expenditure data, (e) Employment in the tourism industries, (f) Tourism Satellite Account; (g) International data dissemination practices and (h) International sustainable tourism indicators. The survey was conducted between mid-December 2021 and the end of January 2022, targeting statistical agencies across all WB6 economies. The collected responses were synthesized and analyzed based on the segments outlined above, providing a comprehensive evaluation of the region's current state and development level of tourism statistics. Bearing that this research focuses on the Republic of Serbia, only the answers from the Statistical Office of the Republic of Serbia are presented with an update in August 2024.

5.2. Results

Basic Tourism Statistical Concepts – The Ministry for Tourism and Youth of the Republic of Serbia and the Statistical Office of the Republic of Serbia serve as the central authority responsible for collecting, processing, and disseminating official tourism statistics in the country. While ongoing efforts have improved the scope and quality of data coverage, significant challenges remain in fully aligning Serbia's statistical systems with the European Union acquis, particularly regarding internal tourism statistics. Serbia has made strides in collecting and transmitting critical internal tourism data, such as tourist accommodation establishments' capacity and occupancy rates. However, the existing statistical framework has yet to fully incorporate critical elements like same-day visits and outbound tourism data. These gaps highlight areas that require further development and enhancement to fully comply with international standards, thereby ensuring a more comprehensive and accurate representation of tourism activities.

Supply Side: Accommodation Statistics - Serbia has established a relatively robust system for collecting data on the capacity and occupancy of tourist accommodation establishments, encompassing essential variables such as the number of establishments, bed places, and bedrooms. The statistical coverage for these variables is reasonably comprehensive, aligning with the basic requirements outlined in the European Union's Methodological Manual for Tourism Statistics. Despite this progress, significant room remains for improvement, particularly in capturing data related to non-rented accommodation, which continues to be underreported. Moreover, while compliance with EU standards regarding the classification of accommodation establishments is generally high, the data collection process could be further refined. Expanding the classification categories to include more detailed distinctions, such as facilities that cater to persons with reduced mobility, would enhance the granularity and usefulness of the collected data.

Demand Side: Participation in Tourism, Tourism Trips, and Visitors, Including Same-Day Visits - Serbia's national statistics on tourism demand provide coverage of essential variables, including the number of residents participating in tourism, the primary purposes of trips, and the means of transport and accommodation utilized. However, the current framework lacks detailed breakdowns for same-day visits, expenditure categories, and socio-demographic variables, which are crucial for a more nuanced understanding of tourism demand. Integrating these additional variables into Serbia's data collection processes would significantly enhance the comprehensiveness and depth of tourism demand statistics, providing more valuable insights for policymakers and industry stakeholders.

Employment in the Tourism Industries - Employment statistics within Serbia's tourism sector are currently limited in scope, with the primary focus on permanent and temporary employment figures expressed in terms of the number of jobs and hours worked. Other critical variables, such as employment distribution by age group, educational attainment, and the type of establishment, are not yet fully incorporated into the statistical system. Serbia needs to broaden its data collection framework to include these additional variables to improve the reliability, depth, and utility of employment statistics within the tourism sector. Aligning with international best practices and guidelines will ensure that the employment data collected is comprehensive and reflects the sector's dynamics.

Tourism Satellite Account - Initial efforts to develop a TSA in Serbia were undertaken with a survey on domestic visitor consumption conducted in 2009. However, despite these efforts, the TSA has not yet been fully integrated into the country's official statistical system. Establishing a fully operational TSA is crucial for Serbia to more accurately measure the economic impact of tourism, offering a detailed framework for assessing tourism's contributions to GDP, employment, and other key macroeconomic indicators. The planned survey on tourism demand-side data in 2023 marks a positive advancement towards this goal. However, sustained efforts will be necessary to embed TSA as a regular and integral component of Serbia's national statistics, thereby enabling a more holistic understanding of the tourism sector's economic significance.

International Data Dissemination - Serbia has been actively submitting tourism data to several key international organizations, including Eurostat, the United Nations World Tourism Organization (UNWTO), and the World Travel & Tourism Council (WTTC). However, to further enhance the visibility and comparability of Serbia's tourism statistics on a global scale, there is a need to expand the dissemination of data to additional international bodies and platforms. Additionally, greater emphasis should be placed on improving compliance with Eurostat's metadata quality assessment and reporting methodologies. Ensuring that Serbia's tourism data meets these stringent international standards will enhance the country's published data's consistency, reliability, and global credibility.

6. CONCLUSION

The assessment of Serbia's national tourism statistical system highlights notable achievements and areas requiring further enhancement. Significant progress has been made in aligning tourism statistics with international standards, especially regarding data collection for accommodation statistics and participation in tourism. However, challenges persist in fully integrating comprehensive demand-side data, such as same-day visits and outbound tourism, into the statistical framework. The absence of this data limits the ability to capture a complete understanding of tourism activities and their economic impacts.

Developing a TSA remains crucial for enhancing Serbia's tourism statistics. Initial efforts, such as the 2009 survey on domestic visitor consumption, laid the groundwork, but TSA is not yet fully embedded within the national statistical system. Establishing a TSA would enable a more accurate measurement of tourism's contributions to the national economy, including impacts on GDP, employment, and other macroeconomic indicators. Such a framework is essential for informed decision-making and strategic planning, both critical for sustainable tourism development.

Serbia has also shown commendable efforts in international data dissemination, regularly submitting data to organizations like Eurostat and UNWTO. To improve global visibility and comparability

of tourism statistics further expansion of dissemination efforts and enhanced compliance with Eurostat's metadata quality assessments and reporting methodologies are recommended. Ensuring accuracy, reliability, and consistency with international standards will significantly benefit the country's tourism data.

It is also essential to highlight the issue encountered by the Statistical Office of the Republic of Serbia regarding data input by caterers on the *eTurista* platform. The quality control revealed that caterers frequently input data mechanically, lacking awareness of its significance, by selecting the first choice presented in the guest registration questionnaire. To address this issue, investing effort in training and enhancing caterers' awareness regarding the need for precise input is essential.

In conclusion, Serbia's national tourism statistical system has demonstrated substantial progress, particularly in aligning accommodation statistics and participation data with international standards. However, to fully achieve best practices, further actions are required. Key priorities should include fully integrating a TSA for precise measurement of tourism's economic impact, expanding demand-side data collection to encompass same-day visits and outbound tourism, and enhancing the quality and consistency of international data dissemination. Addressing challenges such as the mechanical data input on the *eTurista* platform through targeted training and awareness initiatives will also be crucial for improving data reliability. Advancing these areas will elevate the overall quality and utility of Serbia's tourism statistics, enabling more effective policy-making, better resource allocation, and the sustainable growth of the tourism sector. These efforts will help position Serbia as a competitive and informed player in the global tourism market. Continuous refinement of the statistical framework is essential to harness the full potential of the country's diverse tourism resources.

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Does Islamic financing matter for Halal tourism?

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Abstract: *The halal travel industry is growing thanks to solvent Muslims, who want to travel and explore the world without violating Islamic principles. Given the wealth of the Arabic world, this demand could prove to be a profitable market if they are actually compliant with Sharia principles. On the other hand, as also Islamic finance continues to grow and new players enter the market, the opportunities for innovation and collaboration in the Muslim-friendly travel space are limitless. With a shared commitment to inclusivity and ethical practices, these industries are well-positioned to drive growth and create lasting economic impact in the years to come. Businesses in the tourism sector have to explore the synergies between these industries and consider how Islamic finance can help them grow and innovate. The intersection of Islamic finance and Muslim-friendly travel presents a unique opportunity for growth, innovation, and inclusivity and can create an ecosystem that benefits travelers, businesses, and communities alike.*

1. INTRODUCTION

Tourism is constantly looking for a new customer base. On the other hand, the sharp increase in the Muslim population is causing the tourism sector to turn its attention to this customer segment (Battour et al., 2017; Gabdrakhmanov et al., 2016). The rapid growth of Muslims around the world is one of the critical reasons for the interest among practitioners over the past decades (El-Gohary, 2016). That is why it is imperative to carefully analyze them, court them, and attract them to European latitudes. But first, their distinctive characteristics, their norms and beliefs, preferences, and limitations must be examined in depth (Stephenson, 2014).

Halal travelling or Halal Tourism is highly appreciated in Islam because every Muslim should travel for various reasons, according to Islamic beliefs (El-Gohary, 2016). This kind of tourism includes amenities, attractions, and accessibilities whose main objective is delivering and fulfilling Muslim traveler's experiences, needs, and wants (Sutono, 2019, p. 2). There were 11 criteria based on Global Muslim Travel Index (GMTI) as follows: 1) Muslim Friendly Destination; 2) Muslim Travelers & General Safety; 3) Muslim visitor arrivals; 4) Dining options and Halal Assurance; 5) Access to Prayers places; 6) Accommodation Options; 7) Airport Facilities; 8) Muslim Traveller Needs Awareness & Outreach; 9) Easy of Communication; 10) Air Connectivity, and 11) Visa Requirements.

Future Market Insights estimates a 4% annual growth for halal tourism in the global market during the period 2022-2032. The global halal tourism market is estimated to have a revenue of US$ 255 billion in 2022 and is expected to reach US$ 365 billion by the end of 2032 (FMI, 2022). Muslim visitor arrivals are expected to reach 230 million by 2028, at an estimated spend of USD 225 billion (Master Card-Crescent Rating, 2022).

Halal tourism is often mistakenly identified only with food or what is permissible to consume according to Islam. Although important, the perception of halal is much more extensive than just

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food. The term itself is not clearly defined and is not understood even by many Muslim traders. Understanding the overall concept of Islamic tourism would lead to the discovery of new opportunities in the Halal tourism sector (Jafari & Scott, 2014).

As the Muslim presence tends to grow in Europe, it is expected that Halal products and services will grow, too (Gunduz, 2023). From the marketing point of view, this will provide a lot of opportunities for various businesses from different economic sectors like food producers, travel companies, finance and insurance institutions.

Europe has had a long history of Islamic rule, as well as a rich Islamic heritage, making the region a favorite destination for Muslim visitors according to several European Tourism Organizations[2] (Prayag, 2020). Muslim tourists spend USD 220 billion annually and will increase to USD 300 billion by 2026. Abrori and Hadi (2020) stated that halal tourism is an attraction for various non-muslim countries in the world and several countries in Europe also are developing halal tourism" (Widodo et al., 2022).

The halal tourism market had an estimated market share worth US$ 266.3 billion in 2023, and it is predicted to reach a global market valuation of US$ 417.6 billion by 2034, growing at a CAGR of 3.6% from 2024 to 2034. In Europe, luxurious halal experiences accelerate demand in the United Kingdom. Its halal tourism market is expected to expand with a 4.1% CAGR through 2034. Also, gourmet halal food options to enhance market growth in France. It is likely to evolve with a 3.9% CAGR during the forecast period.

The European Halal tourism market is a rapidly growing industry, because more and more Muslims, thanks to globalization, are striving "to break out of their shells" and get acquainted with new worlds – but worlds that respect and care about their religious, cultural norms (Doğan, 2019). The factors of this remarkable growth are the following:

1. The increasing Muslim population in Europe, leads to increased demand for Halal tourism.
2. Rising levels of income: With larger disposable income Muslims can spend a larger portion of their income on travel
3. The growing supply of Halal-certified hotels, restaurants, and other travel services in Europe.
4. The popularity of Europe as a destination for Muslim travelers, who are looking for different cultural experiences in countries offering Halal-friendly attractions and facilities
5. The development of the aviation industry increases direct flights between Europe and the Middle East and Southeast Asia.

European countries` players have begun to act and respond to the increased demand - some are already quite popular among Muslims such as the United Kingdom, France, Germany, and the Netherlands, because they offer Halal-certified products and services, while others are just entering this promising market such as Italy, Spain, and Portugal (Halal Booking, 2023).

2. HALAL TRAVEL AND SUSTAINABLE TOURISM

Sustainability principles refer to the environmental, economic, and socio-cultural aspects of tourism development, and a suitable balance must be established between these three dimensions to

[2] Syracuse (Italian National Tourism Agency), Montenegro National Tourism Organization, Serbian National Tourism Organization, Bulgarian Ministry of Economy, Energy and Tourism, Albanian National Tourism Board, UNESCO, National Tourism Organization of Greece (GNTO), that Europe is promoting Islamic Heritage Tourists.

guarantee its long-term sustainability. Tourism is now one of the major sectors of markets where sustainability is becoming highly significant. According to the United Nations, "Sustainable tourism development requires the informed participation of all relevant stakeholders." Therefore, visitors from different backgrounds must be aware of which airline they are flying with, how socially responsible the hotel they are staying in, and what products they are consuming. All of this is directly related to sensitive Muslim tourists and Halal tourism - a relatively new and challenging concept in the tourism sector with high potential for European countries (Battour & Salahaldeen, 2021, p. 8).

The sources of Islamic teachings support the concept of sustainability in Halal tourism (Battour & Salahaldeen, 2021, p. 8). In fact, by getting to know in detail the Sharia principles (avoiding unnecessary waste of scarce resources and thrift, the principles of cooperation and brotherhood, helping the needy, and avoiding risky activities) it is seen that they are in line with the environmental concerns of sustainable development. Halal Tourism might contribute to climate change mitigation, pollution reduction, renewable energy use and waste disposal.

Looking at it from the other side, the greater participation of the Muslim population in European countries is in line with one of the social principles of sustainability for equality and "inclusion" of different communities. By empowering underserved communities and promoting equal access to tourism opportunities, inclusion catalyzes sustainability development. In these terms, designing a Halal tourism subsector that respects Islamic cultural values, civilization and rules, should contribute to long-term sustainability. The more we invest in areas that are suitable for halal travel the more inclusive we make the world.

Halal tourism addresses a few of the seventeen sustainable development goals (SDGs) and can have a significant contribution towards sustainability (Azam et al., 2019). However, the concept of 'Halal' does not refer to Muslim consumers only. The limit of halal tourism could be increased from 2.8 billion Muslim consumers to non-Muslim consumers all around the world. Halal travel goes beyond religious and personal preferences. It is welcomed by non-Muslim consumers whose personal values are in terms of Shariah principles. Halal tourism develops relationships between regions, leaders and countries and thereby contributes to the achievement of sustainability development goals.

Halal travel isn't only about travel. Many of us travel with different purposes and expectations. Therefore, one of the most important tasks is to holistically serve all the needs of travelers starting with religious customs such as access to places of prayer, food preferences, assurance of halal-certified products, and ending with the question of what activities the tourism company invests in and how socially responsible it is. Because if it is ethical towards the environment, it will also be reliable towards its customers.

Separately, Muslims are highly conscious of the environment, and all creatures of Allah, and for them sustainability is one of the concepts unconsciously „coded" in their principles. Therefore, they pursue this consciousness in all sectors - even in tourism and in all aspects of their lives - even while traveling. Halal tourism will develop as the desires of socially responsible European companies, ready to expand beyond regional borders, merge with the desires of Muslim and non-Muslim tourists who pursue certain norms by offering them, for example, suitable tourist packages. The growth in the market also means that there are opportunities for investors to indulge in socially responsible and ethical investments in the tourism and hospitality sectors.

According to Hussain (2023), the key components of halal travel include the following:

1. Halal package deals: The entire value chain of the offer must be examined. The tourism company must not invest in gharar activities, be ethical and not contradict Sharia principles.
2. Accommodation: halal hotels are a very important component of the entire trip - they should be able to provide facilities for praying, maybe hammam, and offer oriental foods without pork and alcohol. Their entertainment should also be measured without a lot of dancing and decent clothes.
3. Muslim-friendly destination: the travel agency must offer tours or trips to some Muslim-friendly country, taking into account the historical background. Some halal travel operators go further and offer trips that offer Islamic and spiritual enlightenment.
4. Islamic travel insurance: takaful, also known as Islamic insurance, is now an integral part of halal tourism, as it offers the option of obtaining insurance coverage that is Sharia-compliant. Offering innovative insurance products tailored to the religious beliefs of the Islamic world will benefit not only Muslim tourists and their tour operators but also society as a whole. There is no doubt that the introduction of travel insurance into the lives of these people will have an additional ripple effect on the economic development of the tourism market (Kirov, 2019).

3. HALAL TRAVEL AND ISLAMIC BANKING

The word halal comes from the Arabic language, „halla, yahillu, hillan, wahalalan“ which has the meaning justified or allowed by sharia law. Has a meaning as something that is allowed or permitted by Allah (Qardhawi, 1994). The word is a major source that is not only related to food or food products but also enters all aspects of life, such as banking and finance, cosmetics, work, tourism, and others (Widodo et al., 2022).

In fact, in recent years, the progress of halal tourism has been observed. But this progress would not have been so easy if it were not for the support of the financial sector. The synergy between the tourism, financial and insurance sectors has led to a more complete satisfaction of Muslim tourists. Islamic finance and banks provide special tools for halal tourism companies that follow Sharia principles. Moreover, they subsequently monitor the spending of these funds so that they are not in gharar and risky activities. The presence of Islamic financial institutions is one of the prerequisite materials that a Halal tourism destination should provide. The amount of Islamic banks financing in the tourism sector such as restaurant and tourism businesses has contributed to an increase in the number of halal tourists and the growth of the locally generated income (Muhammad, 2019).

The development and growth of halal tourism should be driven by the Islamic finance industry. Islamic finance must provide the halal travel industry with access to Sharia-compliant business and finance options. The components of Islamic finance play a key role in shaping and supporting the halal travel industry through funding. But this is not only about providing suitable Islamic financial products but also about how they manage the whole financial infrastructure by issuing proper policies, supporting halal travel companies, providing cash and capital or innovative traveling checks, and cards and even investing in their growth.

The Halal industry and Islamic Finance (IF) have developed in parallel, especially since the 1960s and the 1970s, respectively (Martín et al., 2020). Muhamed and Ramli point out that the majority of Malaysian academics support Halal integration. Wilson activates the Islamic banks towards the Halal industry. Better integration is necessary to achieve economies of scale and scope. This means firstly development of an adequate regulatory framework, the establishment of regional/global agreements and the harmonization of Halal certifications. That is why authorities`s support

is considered crucial. But one is certain - there is consensus on the need to explore and exploit potential synergies between both sectors.

At the 4th World Islamic Tourism Conference (WITC), a compelling panel discussion titled "Islamic Finance and the Economic Opportunities for Muslim-Friendly Travel" explored the potential synergies between the rapidly growing Islamic finance sector and the expanding Muslim-friendly travel market (Hafiz, 2024). With a focus on how Islamic finance can fuel the growth of halal tourism and create new economic opportunities, the panel brought together industry leaders to discuss the future of these intertwined sectors.

Islamic finance and halal tourism are both driven by ethical, inclusive, and value-based frameworks. These industries share common principles, and the growth of one directly impacts the other. Islamic finance has the potential to unlock significant opportunities for Muslim-friendly travel by providing tailored financial products and services that cater to the needs of both travelers and businesses operating in the halal tourism sector. From Shariah-compliant investment products to Islamic travel financing, there are numerous ways Islamic finance can empower the growth of Muslim-friendly travel. Collaboration between these two sectors can pave the way for innovative solutions that make Muslim-friendly travel more accessible and affordable for consumers while also driving business growth.

Islamic finance is about ethical and inclusive financial services. This aligns perfectly with the goals of Muslim-friendly tourism, which seeks to provide inclusive, value-based travel experiences. Sustainability is a key concern for modern travelers, and Islamic finance can provide the necessary funding for green tourism projects that align with Islamic principles. This not only meets the needs of environmentally conscious travelers but also contributes to the long-term sustainability of the industry.

Although the a limited number of research on the relationship between Islamic Finance and Halal tourism, they show positive linkage between them. Muslim tourists would have a positive attitude to tourism companies that work with Islamic banks. The presence of Islamic financial institutions is one of the "must haves" that Halal tourism destinations should consider. Islamic Financial Institutions could provide different financing solutions, develop a good tourist infrastructure, and in the end improve the overall quality of Halal Tourism (Martín et al., 2020).

In the halal business, a tie between Islamic banks and halal tourism develops. These two sectors are interconnected and complement one another to create the ideal ecosystem for Sharia-compliant tourism. Islamic banking institutions offer funds to companies from lodging, transportation, food, and other industries supporting the adoption of halal tourism. However, Islamic banks require these initiatives as collaborators in financing, funding, and services (Ahmad, 1994).

Akyol and Kilinç (2014) associate the term Muslim friendly with Halal tourism, which provides faith-based services consisting of Halal hotels, Halal transport (Halal airlines), Halal restaurants, tourist packages, and Halal finance. Therefore, Halal tourism includes several sectors that are connected (Biancone et al., 2019). The financial resources of the hotel, restaurant, travel agency and the airlines have to fit with Islamic principles. In general, Islamic finance requires participation in sharing the profit and loss among all parties who are involved in this financial enterprise. Islamic finance also prohibits interest.

The financial sector is not left behind. All financial flows of these companies included in the halal package must comply with Islamic financial principles - such as the prohibition of interest, the

principle of sharing profit and loss, etc. Halal tourism does not only emphasize final halal products but requires an appropriate comprehensive system, including banking institutions - but not only. The support of the state with its appropriate legal and regulatory frameworks is also needed. There is a great potential synergistic effect from the interaction of the financial sector with the other sectors included in the halal chain, supported and guided by Sharia law (Rahmayati, 2018).

The tourism ecosystem includes elements such as the government, society, business people, and all related industries (Nugroho, 2018). The halal tourism ecosystem comprises products and services, government support, human resources, and infrastructure (Rahtomo, 2018). In this context, Islamic banks and financial institutions are also from this ecosystem as financing institutions, places to deposit funds from halal tourism, providers of convenient services for Mulim tourists related like ATMs and other financial cash or card services, guarantees, checks, etc.

The presence of Islamic banking and finance is of high-level importance for countries like Malaysia, and UAE and medium-level importance for the UK according to the study by Biancone et al. (2019). The paper of Martín et al. (2020) aimed to analyze empirically whether Islamic Finance (IF) can be seen as a catalyst for the development of Halal Tourism (HT). Focusing on the leading role of the Islamic Finance for Halal Tourism they advise using IF sources for starting an integrated Halal business. This process can also be helped by FinTech companies that provide a wide range of innovative products and services in the growing Halal niche market. Ismanto et al. (2022) showed that Islamic banks are an essential part of regional halal tourism, which acts as a supporting facility in the form of institutions.

The beginnings of halal tourism are observed even in Russia, which is not a popular Muslim destination. Tourist intentions are perhaps the last reason for Muslims travelling to Russia, mainly due to the so-called lack of halal infrastructure (Gabdrakhmanov et al., 2016). Russia is not a fan of attracting foreign capital. However, since April 2016 Tatarstan, where more than half of the population is Muslim, together with the Central Bank of Russia began to actively work on the introduction of Islamic banking in Russia. What is more, they luckily have the government support, too. The Russian Central Bank and the government of Tatarstan have even started the implementation process of Islamic banking in Russia.

Financial Constraints are pointed out as one of the challenges of Halal tourism development by the Organisation Of Islamic Cooperation Statistical Economic And Social Research And Training Centre For Islamic Countries (SESRIC, 2015): As a new emerging segment of the global tourism industry, Islamic tourism has not received enough financial resources, perhaps, with growing number of success stories investors will give due attention to this niche segment by considering its potential and growing market size.

Analyzing the characteristics of Islamic or halal tourism, Biancone and Secinaro (2021) suggest analysis from the perspective of globalization. The rules of halal tourism, which is part of the wider system of ethical-religious tourism, can globalize Islamic concepts, particularly to the knowledge and applicability of Islamic finance.

Ismanto et al. (2022) showed that Islamic banks are an essential part of regional halal tourism, which has a main supporting role. Existing Islamic financial institutions have played an indirect role in the halal tourism business. According to the author, Islamic banks are part of the halal tourism ecosystem. This kind of tourism would not develop unless it is supported by Islamic banks that play a significant role in its implementation.

The study of Takhim et al. (2023) revealed: "synergy and development patterns between Islamic banks and Muslim-friendly tourism should be carried out simultaneously". He focused on six aspects to consider - establishing partnership cooperation, intensifying education and literacy of the halal industry, improving ACES (access, communication, environmental, and service infrastructure), innovating technology, optimizing the role of Islamic banks and Muslim-friendly tourism and conducting clusters for the halal industry development.

"Sharia Banks" act as a communication tool because they can influence people's viewpoints and preferences in determining alternative capital financing for tourism business development. If related to the main role of Sharia banks in reviewing various aspects, Sharia banks play a role as economic enablers of the people because they aim to channel funds so that tourism industry players can develop and be empowered to increase their economic welfare (Amiruddin et al., 2024).

4. CHALLENGES AND OPPORTUNITIES FOR THE HALAL TOURISM AND ISLAMIC FINANCE COLLABORATION

Islamic finance, a rapidly growing sector with assets projected to reach $3.69 trillion by 2024, has become a key player in the global financial landscape. As more online platforms and fintech companies emerge in the Islamic finance space, the question arises: how can these financial innovations support the Muslim-friendly travel industry, a market that is also witnessing exponential growth?

It is highlighted several key areas where Islamic finance can support the halal tourism industry (Hafiz, 2024):

1. Islamic Travel Financing: With the growing demand for Muslim-friendly travel services, Islamic finance institutions can offer tailored financing solutions for Muslim travelers. Shariah-compliant travel loans and financing options can make it easier for consumers to book halal-friendly vacation packages, accommodations, and tours without compromising their religious values.
2. Investment in Halal Tourism Infrastructure: Islamic financial institutions can play a pivotal role in funding the development of Muslim-friendly tourism infrastructure, such as halal-certified hotels, restaurants, and entertainment venues. By investing in halal tourism projects, Islamic finance can support the expansion of the industry and create new destinations that cater to the needs of Muslim travelers.
3. Halal Crowdfunding Platforms: The rise of Islamic fintech platforms, such as halal crowdfunding, that can be used to fund halal tourism startups and small businesses. Crowdfunding provides an excellent opportunity for Muslim entrepreneurs in the travel sector to raise capital and grow their businesses.
4. Islamic Credit Cards and Payment Solutions: Islamic fintech companies are increasingly offering Shariah-compliant payment solutions that cater to Muslim travelers. These financial products, including halal credit cards and digital wallets, provide convenient and ethical payment methods that align with the religious values of Muslim consumers. Islamic finance and fintech offer a wealth of opportunities for innovation in the Muslim-friendly travel space. By working together, these industries can create a more inclusive and dynamic tourism ecosystem.

As the Muslim-friendly travel market continues to grow, with Muslim travelers expected to spend $300 billion annually by 2026, the discussion emphasized the role Islamic finance can play in driving growth. Thus, financial institutions have a unique opportunity to tap into the halal tourism market by offering products and services that support the specific needs of Muslim travelers and tourism businesses.

While the opportunities for collaboration between Islamic finance and halal tourism are vast, some challenges need to be addressed. One of the primary challenges is the lack of awareness and understanding of Islamic finance among tourism businesses and consumers. Many businesses in the travel industry are not familiar with Islamic finance, and as a result, they are missing out on opportunities to leverage Shariah-compliant financial solutions. It must be focused on raising awareness and educating both businesses and travelers about the benefits of Islamic finance.

The regulatory frameworks and market accessibility can sometimes hinder the growth of Islamic finance in certain regions. To fully realize the potential of Islamic finance in the travel sector, there is a lot of work on improving regulatory support and expanding market access, particularly in non-Muslim-majority countries.

5. CONCLUSION

The increase in Muslim tourists is a coin with two sides. Halal tourism is a challenge and simultaneously an opportunity for the tourism sector. Both Muslim and non-Muslim countries are trying to develop halal tourism. Admittedly, there are a few countries that have started to put in place a legal framework and standardize the rules for this type of clientele, but this is not the case for the majority of other countries.

In the context of halal tourism, Islamic banks are part of the halal tourism ecosystem that must be increased in their role. For this reason, local governments must bridge between entrepreneurs and Islamic banks to establish profitable cooperation to support halal tourism development. On the other hand, if Islamic banks can finance the halal tourism business, then the institution will also be able to develop properly.

This paper aims to analyse whether Islamic Finance can play an active role in developing Halal Tourism. Without hesitation, it can be concluded that it is not only Islamic finance that influences halal tourism, but that the two sectors are interrelated and complementary because of their common principles and target groups. The presented statistics, on the other hand, support an increase in the activity of Islamic banks in the Halal tourism sector, offering a wide variety of financial instruments perhaps through Islamic Fintech companies nowadays. Moreover, the collaboration between them would contribute to sustainable development too.

The paper emphasized also that halal tourism will be a new competitive field for the countries in the European market. The European Halal tourism market is rapidly growing and provides an opportunity for countries to diversify their tourism offerings and attract Muslim travelers. With the growing demand for Halal tourism worldwide, this industry will continue to provide significant economic benefits to countries that can provide a comprehensive Halal tourism experience.

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Opportunities and Challenges for Tourism Enterprises in Relation to Tourist Spending

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Abstract: *The focus of the study is on tourism expenditure. The distribution and spending of funds by tourists are studied with a view to making appropriate decisions in general and financial management, and especially in the marketing management of tourism enterprises, more specifically in segmenting the market and choosing suitable target segments of tourists, developing relevant products and pricing strategies and selection of proper communication and sales channels. The article presents some models and trends of variation in the amount of funds spent by tourists, both from some world markets in general and in Bulgaria in particular in recent years. Some reasons for these changes are given, and challenges and opportunities facing tourism business managers are outlined. The level of tourism expenditure changes over time and depends on the nationality of the tourists, the type of tourist trip, and the tourist services used. The results of the current research reveal a significant drop in tourism spending due to the crisis in 2020 and rapid growth in the following years. Managers of tourism enterprises should consider these trends, especially when choosing tourist target markets, to realize positive financial results for the tourism enterprise.*

1. INTRODUCTION

The level of funds spent by tourists is one of the main factors for positive financial results and, accordingly, for the success of tourism enterprises. The financial success of tourism enterprises contributes to the positive economic development of the regions where they are located. To achieve positive financial results tourism enterprise managers should explore the model of tourist spending, the changes in the amount of expenditure, and their distribution by types of goods and services. Considering tourist expenditure in the regions where tourism enterprises sell trips or provide products and serve tourists as customers is a significant part of their management, specifically when preparing general management, marketing, and financial strategies and plans, for maximum positive financial results to be achieved. The purpose of the study is to analyze patterns and trends of changes in tourist spending and to outline opportunities and challenges that tourism enterprise managers should resolve. First, the spending by the residents of the leading countries in terms of tourism expenditure in recent years has been examined. Managers and marketing specialists of tourism enterprises should consider this expenditure when selecting target segments of tourists from prospective markets. Next, an analysis of trends and patterns in spending by tourists from a specific region of the world, namely - tourists from Bulgaria, has been made. This is important for tourism enterprises that have focused on providing products to tourists from the country.

2. THE SETTING OF THE STUDY

Tourism expenditure can be defined as the money that visitors spend before, during, or after a trip (Burger & Labuschagne, 2016). International tourism expenditures are spending by international outbound visitors in other countries (Kyrylov et al., 2020). Among the most important items of tourist

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expenditures in the destination are accommodation, food and drinks, internal transport and fuel, excursions, entertainment, shopping, etc. (Korol & Skutar, 2018). The importance of tourism expenditure is widely recognized, both by the private sector and by local authorities and destination marketing organizations (Aparicio et al., 2022). The enterprise managers seek tourists who spend money on their products while the community planners consider the range of tourists to augment local economic development. In both cases, understanding expenditure patterns and related economic values are vital issues (Fredman, 2008). In terms of managerial implications, expenditure is an essential factor that helps to understand the consumption behavior of tourists (Kruger et al., 2010). The identification of the allocation of expenditures across different categories of services would help local enterprises to adapt their supply to tourists' preferences (Banos-Pino & Boto-Garcia, 2023). Understanding the expenditure patterns is a key factor in the strategic planning and packaging of accommodation facilities and attractions (Brida et al., 2013). Tourism expenditures can help tourist product providers market their products and generate income for their business (Tamene & Wondirad, 2019). As a result of the study of tourism expenditure, plans can be formulated in terms of the development of promotional strategies to increase the number of tourists and, hence their expenditure (Amir et al., 2015). Tourist expenditures increase demand in the domestic economy, providing opportunities for local companies to expand their activities and increase employment (Mikulic et al., 2023). The volume and composition of spending by international visitors in destinations catch the attention of researchers primarily because of the impact of such expenditure on domestic economic activity (Olaleye & Oluwaye, 2022). Estimates of visitors' expenditures in countries, regions, cities, and other areas are essential for producing comprehensive forecasts of tourism's economic benefits in an area (Frechtling, 2006). Visitor expenditure is the main factor for income change and thus is a crucial element in understanding local economic growth (Felsenstein & Fleischer, 2003). The results of some studies show that there is a positive relationship between spending on tourism and economic growth (Garza-Rodriguez, 2019). It was found that tourism spending has an influence on countries' productivity (Gavurova et al., 2020). Tourism spendings have a positive impact on employment (Scarlett, 2021). They provide economic benefits to destinations, promoting infrastructure development and investments (Dogru et al., 2021). In periods of crisis, tourists' spending decreases, which is confirmed by some studies. The broad implementation of travel restrictions during the Covid-19 crises resulted in a decrease in visitor spending in 2020 (Orindaru et al., 2021). The COVID-19 crisis resulted in a decline in tourism arrivals transmitted to tourist spending (Skare et al., 2021). Studies found that it is essential to observe differences between individual countries while researching tourism spending because tourism spending differs in individual countries (Gavurova et al., 2020). Results of studies reveal that spending shows differences between tourists of different nationalities (Oklevik et al., 2019). A study's results showed that there were spatial variations of tourism expenditure declines in 2021 compared to 2019, as some countries exhibited smaller declines than others. Central European countries exhibited smaller reductions in tourism spending. Central and Southern European countries experienced relatively smaller declines in expenditure on accommodation, transport, and food compared to their counterparts in Northern and Western Europe (Korinth, 2023). During the COVID-19 crisis, more than 60% of Bulgarians have limited their financial expenses. A large proportion of people (74%) have limited their visits to restaurants, and 54% of them have reduced their spending on travel and vacations (Bozhinova et al., 2022). During the period of the crisis, more than 60% of the Bulgarians limited their spending, and 54% reduced their spending on travel and leisure in the first quarter of 2020 compared with the same period of 2019 (Marinov & Todorova, 2020). A study indicates that the total income from visitors to Bulgaria in the period from 2019 to October 2020 decreased by more than two-thirds. However, the statistics for domestic tourism reveal a different optimistic picture – in June, July, and August, the income from Bulgarian tourists increased by over 20% on average, and their share equals that of receipts from foreigners, who traditionally form over two-thirds of all tourism revenues (Petranova, 2021). During the COVID-19 crisis, Bulgarians spent more on domestic travel than on travel abroad.

3 METHODOLOGY OF THE STUDY

The methodology of the study is based on the model presented in Figure 1. An analysis has been performed of both the spending of tourists from leading markets in terms of tourism expenditure and the spending of tourists from a specific national market, Bulgaria. Based on the analysis, recommendations have been given to tourism managers regarding the selection of target markets of tourists from leading countries in terms of tourism expenditure, as well as the creation of specific products for tourists from specific national markets to realize more revenue, income, and positive financial results for tourism enterprises, including under different states of the economy - crisis, growth, stability, and decline.

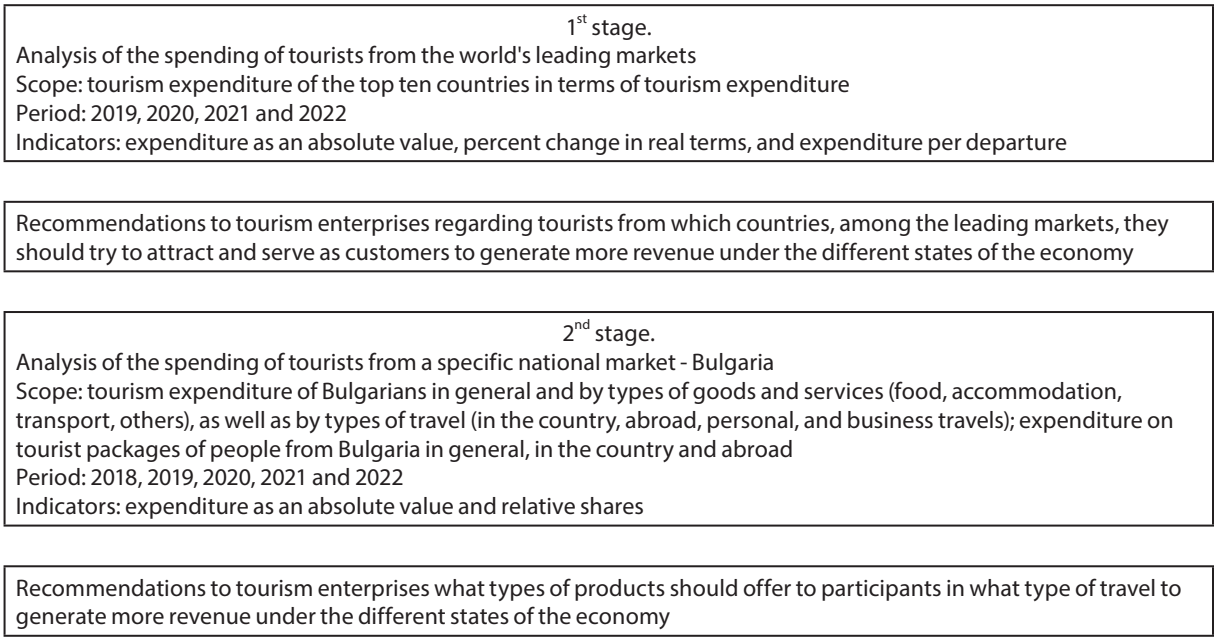

Figure 1. Model of the study

Source: Own research

Analysis was performed based on secondary data - statistical information. Analyzed is information from international and national statistics. The approach was chosen to analyze statistical information that is both objective (the data is collected based on many cases) and easily accessible to tourism enterprise managers. For the present study statistical data for the period of the last few years - 2018/2019-2022 – was used. The used data is up-to-date and therefore is expected to be beneficial for tourism enterprise managers. The studied period is characterized by different states of the world and national economies – stability, instability, crisis and growth. Indicators related to tourist spending were selected, as they are directly related to revenues and, accordingly, to the profits of tourism enterprises. The selected indicators are expenditure in absolute value, change in expenditure, expenditure per departure, total expenditure, expenditure by type of travel and by type of services, etc.

4. RESULTS OF THE STUDY

Table 1 presents the ten leading countries in terms of tourism expenditure over the past four years, from 2019 to 2022. In 2019, the economy was relatively stable, and tourist spending was significant. The leading country in terms of tourism expenditure was China, with 254.6 billion USD, followed by the USA (132.3 billion USD). In the following year 2020, there was a significant drop in tourism

expenditure due to the COVID-19 crisis. The leading country in terms of tourism expenditure was China (with 131.1 billion USD), followed by Germany (with 38.9 billion USD). In 2021, the leading country in terms of tourism expenditure was China (with 109.4 billion USD), followed by the United States (56.9 billion USD) and Germany (51.0 billion USD). In 2022, countries were recovering from the COVID-19 crisis, but war broke out in Ukraine. The United States took first place (with 114.9 billion USD). China was second (with 114.8 billion USD), and Germany - third (with 89.4 billion USD).

Table 1. The ten leading countries in terms of tourism expenditure in 2019-2022

2019 Country	Expenditure (USD billion)	Percent change in real terms	Expenditure per departure (USD)	2020 Country	Expenditure (USD billion)	Percent change in real terms	Expenditure per departure (USD)
China	254.6	-8%	1647	China	131.1	-49%	6445
United States	132.3	5%	1326	Germany	38.9	-58%	
Germany	93.2	-2%	937	United States	34.2	-74%	1020
United Kingdon	70.6	-0%	759	France	27.8	-45%	2327
France	50.5	2%	1662	United Kingdon	21.7	-69%	910
Russian Federation	36.2	5%	798	Korea (RoK)	16.1	-51%	3763
Canada	35.3	2%	1328	United Arab Emirates	15.9	-52%	2531
Australia	35.3	-6%	3037	Belgium	12.9	-31%	1821
United Arab Emirates	33.4	-49%	1815	India	12.6	-45%	1767
Korea (RoK)	32.7	-7%	1140	Canada	12.1	-66%	2394
2021 Country	**Expenditure (USD billion)**	**Percent change in real terms**	**Expenditure per departure (USD)**	**2022 Country**	**Expenditure (USD billion)**	**Percent change in real terms**	
China	109.4	-57%		United States	114.9	-13%	
United States	56.9	-57%		China	114.8	-55%	
Germany	51.0	-45%		Germany	89.4	-4%	
France	34.8	-31%	2543	France	47.7	-6%	
United Kingdon	24.3	-66%	1269	Italy	26.3	-13%	
United Arab Emirates	21.8	-35%	3001	Canada	24.4	-31%	
Korea (RoK)	17.8	-46%	14578	Spain	21.4	-23%	
Italy	15.0	-51%	1211	Russian Federation	20.3	-44%	
Belgium	14.7	-21%	1707	Korea (RoK)	19.9	-39%	
India	14.3	-38%	1701	Ukraine	19.8	133%	

Source: UN Tourism (n.d.)

On the one hand, tourism enterprise managers could target tourists from the leading countries in terms of tourism expenditure as an absolute number, and considering their characteristics, they can select appropriate communication tools and create suitable products. On the other hand, tourism enterprises can target prospective markets that record growth in terms of tourism expenditure. In 2019, among the leading countries in terms of tourism expenditure were the United States (which recorded a growth of 5%) and the Russian Federation (with a growth of 5%), followed by France (an increase of 2%) and

Canada (growth of 2%). The rest of the leading countries recorded a decline in terms of the value of the indicator during the year. In 2020, all the leading countries in terms of the tourism expenditure indicator as an absolute number recorded a significant decline in this expenditure compared to the previous year due to the COVID-19 crisis. The biggest drop was recorded by the United States (-74%). In 2021, all leading countries again recorded a significant decline in tourism expenditure compared to the previous year. The most significant reduction was recorded by the United Kingdom (-66%). In 2022, most leading countries reported a decrease compared to the previous year. The likely reason is that the countries have not yet fully recovered from the effects of the COVID-19 crisis, as well as the war between Russia and Ukraine. Significant growth was recorded in terms of expenditure of the tourists from Ukraine (133%), who probably travel more often outside the country due to the war with Russia. Expenditure of tourists from the rest of the leading countries has declined. The smallest decline was recorded by Germany (-4%) and France (-6%). The highest and most significant decline was recorded by China (-55%). Tourism enterprise managers can choose target markets among the countries that record significant expenditures per departure. In 2019, among the leading countries in terms of tourism expenditure, significant expenditure per departure was recorded by Australia (3037 USD), followed by the United Arab Emirates (1815), France (1662), and China (1647). In 2020, among the leading countries in terms of tourism expenditure, the most significant spending per departure was recorded by China (6445 USD). Significant expenditure per departure was recorded by Korea (RoK) (3763 USD), the United Arab Emirates (2531 USD), Canada (2394 USD) and France (2327 USD). In 2021, the highest expenditure per departure was recorded by Korea (RoK) (14578 USD). Relatively high expenditure per departure was recorded by the United Arab Emirates (3001 USD), followed by France (2543 USD). It is an opportunity for tourism enterprise managers to focus on attracting and serving tourists from some of the leading countries in terms of indicators related to tourism spending. They can choose the tourists from some of these countries as target markets. The managers can develop appropriate communication campaigns in these countries to attract tourists and generate revenue. Thus, they will realize significant income, which they can use to improve their activity. As is shown in Table 1, in the last few years among the leading countries in terms of tourism expenditure are the United States, China, Germany, France, etc. Tourism enterprise managers may choose target markets in terms of indicators related to tourism expenditure by considering the general state of the world economy that they expect to be realized. When the economic situation in the world is characterized by relative stability and growth, they can target countries that record the highest tourism expenditure under these conditions. That was typical of the state of the world economy before the COVID-19 crisis in 2019, when the leading countries in terms of tourism expenditure were China, the United States, Germany, the United Kingdom, France, etc. If economic crisis, recession, and instability are expected, tourism enterprise managers might focus on countries that maintain their position as leaders in terms of tourism expenditure under such economic conditions. Such an economic situation is characteristic of 2020 and 2021, when a significant decline marks travel and tourism due to the COVID-19 crisis. In the period studied, leading countries in terms of tourism expenditure were China, the United States, France, Germany, the United Kingdom, etc. A challenge for tourism enterprises would be to develop appropriate communication campaigns to attract tourists from these countries, which, in general, spend significantly less on tourism. Tourism enterprises would have the opportunity to develop proper products to meet the needs and requirements of the tourists from these countries. If economic recovery and growth are expected, tourism enterprises might aim to serve tourists from the leading countries in the relevant economic situation. Such, for example, were the leaders in terms of tourism expenditure in 2022 - USA, China, Germany, France, Italy, etc. It can be concluded that, to a significant extent, the same countries remain the leaders in terms of tourism expenditure in the last four years from, 2019 to 2022, which enables tourism enterprises to choose these countries as target markets in order to realize positive financial results. A challenge for tourism enterprises would be to prepare financial plans and forecasts in line with the expenditure of tourists from the leading

target markets in terms of the indicators related to tourism expenditure. To create realistic financial plans and projections, tourism enterprise managers should consider the significant changes in the spending of tourists from target markets. Thus, they would have the opportunity to plan better the production of goods and services and the volume of their activity, optimize costs, increase revenues, realize positive financial results, and improve tourism enterprises.

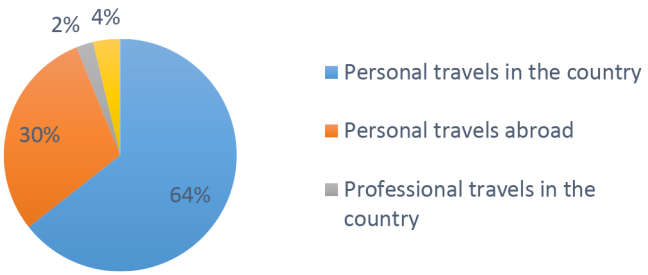

Figure 2a. Expenditure by type of travel (without tourist package) in 2022 for travel and tourism of people from Bulgaria

Source: National Statistical Institute (n.d.)

When tourism enterprise managers decide to start serving tourists from a particular national market, they should study in more detail the question of tourism expenditure and especially the distribution of expenses by types of travel and goods and services. Figures 2a and 2b present Bulgarians' expenditures for travel and tourism in 2022. The information is useful for tourism managers who intend to focus on attracting and serving tourists from Bulgaria. In 2022, Bulgarians spent the largest part of their tourism expenditure on food – over a third or 36.18%. In the next place, more than a quarter was the share of tourism expenditure on accommodation - 25.52%, and a little less - the spending on transport - 23.36%. Therefore, tourism enterprise managers who intend to serve tourists from Bulgaria should pay particular attention to the provision of the primary tourist services of food, accommodation, and transport. From the general trend, deviate travels abroad, personal travels abroad, professional travels, professional travels in the country, and professional travels abroad. For travels abroad, personal travels abroad, and travels in the country, although again most expenditures were allocated on food (31.01%, 31.82%, and 36.10% respectively), more expenditures were allocated to transport than to accommodation (28.57% vs. 22.89%; 27.95% vs. 22.07% and 33.09% vs. 20.66%). For professional travels and professional travels abroad, most of the expenditures were allocated to transport (33.32% and 33.47% respectively), secondly, for professional travels, expenditures were allocated to food (29.09%), and thirdly - to accommodation (25.97%), while for professional travels abroad, secondly, expenditure was allocated to accommodation services (29.31%), and thirdly - to food (24.67%). The managers of tourism enterprises should consider these variations in spending and allocation of expenditure when making decisions about selecting services for target segments of tourists. In the same year, 2022, Bulgarians allocated significantly more funds for personal travels (93.86%) than for professional ones (6.14%). Therefore, tourism enterprises can focus on organizing and offering services that are used in personal travels. In 2022, travel in the country significantly prevailed (66.77%) over travel abroad (33.23%). It follows that tourism enterprises could offer a greater number and variety of services for travelers in the country. To generate more revenue, tourism enterprise managers may choose such target markets or participants in that type of travel, who allocate a significant part of their expenditure to purchase the relevant service that the tourism enterprise offers. Tourism enterprises that offer food services to tourists should pay special attention to the participants in the types of travel that have larger shares of tourism expenditure on food than the average for all trips (36.18%), namely travels in the country (38.75%), personal travels (36.64%) and especially personal travels in the country (38.85%), to attract them successfully and provide

them with appropriate service according to their requirements. To generate much revenue tourism enterprise managers who offer accommodation services could focus on attracting and serving participants in travels with larger shares of tourism expenditure on accommodation than the average (25.52%), namely travels in the country (26.82%), personal travels in the country (27.05%), professional travels (25.97%) and professional travels abroad (29.31%). Tourism enterprises that offer transport services could focus on attracting and serving participants in the travels with larger shares of tourism expenditure on transport than the average (23.36%), which expectedly are traveled abroad (28.57%), including personal travels abroad (27.95%), professional travels (33.32%), professional travels in the country (33.09%) and professional travels abroad (33.47%).

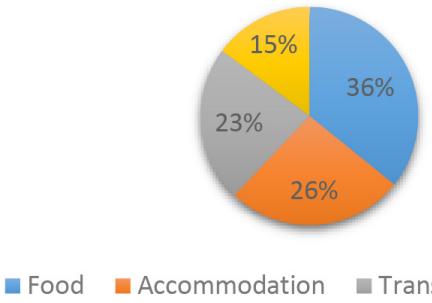

Figure 2b. Expenditure by type of services (without tourist package) in 2022 for travel and tourism of people from Bulgaria

Source: National Statistical Institute (n.d.)

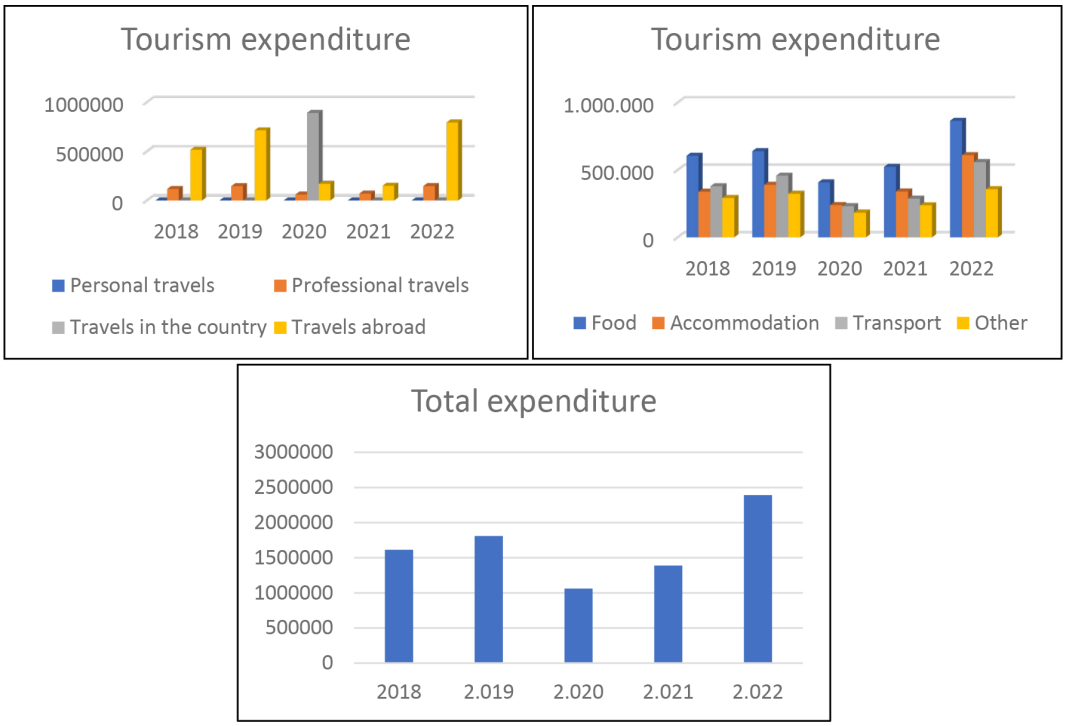

Figure 3. Total expenditure and expenditure by type (without tourist package) for travel and tourism of people from Bulgaria during the period 2018-2022, thousand BGN

Source: National Statistical Institute (n.d.)

Figure 3 presents the changes in Bulgarian tourism expenditures for the period 2018-2022. In 2022 compared to 2018, a growth of the total tourism expenditures of Bulgarians of 48.01% was recorded. The highest increase was recorded in the last year, 2022, compared to the previous year, 2021, at

72.24%, due to the recovery from the COVID-19 crisis. Only in 2020, compared to 2019, a significant decline in expenditure was recorded - by 41.37%, due to the COVID-19 crisis. In 2022, compared to 2018, a significantly higher growth than the average total for all tourism expenditure (48.01%) was recorded for expenditure on accommodation (80.27%), and a relatively smaller one - for expenditure on professional travel (25.41%).

The data in Table 2 shows that in 2022, Bulgarians' expenditure on tourist packages is 12.87% of their total tourism expenditure. The share of these expenditures is significantly higher for travel abroad (23.86%) than for travel in the country (6.14%). Bulgarians spend substantially more on travel packages abroad (70.46%) than on packages in the country (29.54%). Therefore, tourism enterprises could offer more tourist packages abroad.

Table 2. Expenditures on tourist packages of people from Bulgaria in 2022

Types of expenditure	Total expenditure (thousands BGN)	Including, travel packages (thousands BGN)	Share, %	Expenditure on travel packages of total expenditure, %
Total	2 742 950	353 147	100%	12.87%
In the country	1 700 006	104 315	29.54%	6.14%
Abroad	1 042 944	248 832	70.46%	23.86%

Source: National Statistical Institute (n.d.)

Table 3 reveals that, like tourism expenditure, spending on package travel has grown significantly for the period from 2018 to 2022– by 54.91%. The growth in travel abroad (60.20%) was considerably higher than the growth in travel in the country (43.60%). The most immense growth was recorded in the last year, 2022, compared to the previous year, 2021 (280.56%), with the growth of packages abroad being exceptionally high (829.45%), and the growth of packages in the country being lower than the average (58.00%). In periods of stability expenditure on tourist packages abroad exceeds that on packages in the country and tourism enterprises may offer more packages abroad. In the periods of crisis expenditure on tourist packages in the country exceeds those on packages abroad.

Table 3. Expenditures on tourist packages of Bulgarians for the period 2018-2022

Period/ expenditure	Total (thousands BGN)	In the country (thousands BGN)	Abroad (thousands BGN)
2018	227 967	72 643	155 324
2019	280 878	77 177	203 701
2020	96 314	83 696	12 618
2021	92 796	66 024	26 772
2022	353 147	104 315	248 832
2019/2018	23.21%	6.24%	31.15%
2020/2019	-65.71%	8.45%	-93.81%
2021/2020	-3.65%	-21.11%	112.17%
2022/2021	280.56%	58.00%	829.45%
2022/2018	54.91%	43.60%	60.20%

Source: National Statistical Institute (n.d.)

5. FUTURE RESEARCH DIRECTIONS

In the future, tourist expenditure in other countries of the world should be studied in detail. The trends in the variations in tourism expenditure should be studied for a longer period. The results of the present study could be compared with the results of similar future studies.

6. CONCLUSION

When making managerial decisions regarding the selection of tourist target markets, tourism enterprise managers should examine the expenditures of tourists from individual national markets. Thus, tourism enterprise managers would be able to attract and serve prospective tourist markets to generate more revenue. Tourism expenditure is an important economic factor that influences management plans, actions, techniques, and approaches of tourism enterprises. In turn, tourism expenditure is influenced by other economic factors. Among them, the general economic situation in the world and in the regions where tourism enterprises provide trips or services to tourists is of primary importance, which is expressed in growth, decline, crisis, or stability. Various studies have highlighted the effect of the world economic instability, recession, and stagnation on the spending behaviors of tourists from different continents on both national and international levels (Mehran & Olya, 2018). Such a condition of the economy was evident during the COVID-19 crisis. Understanding the changes in travel patterns induced by the COVID-19 pandemic would help in the development of policy responses to resume the tourism industry (Banos-Pino & Boto-Garcia, 2023). Before the pandemic, tourism was one of the world's largest sectors. In 2019, international tourism spending amounted to USD 1.8 billion. Global tourism recovery was supported more by the rise in the expenditure of domestic visitors than revenues from international visitors (WTTC, 2022). The present study confirms these results. During the period of the COVID-19 crisis, there was a decline in expenditures of tourists from the leading countries. Tourism expenditure of Bulgarians decreased in 2020 compared to 2019.

The results of the current study show that the leading countries in terms of tourism expenditure in the last few years, 2019-2022, were the USA, China, Germany, France, etc. Tourism enterprise managers might choose tourists from these countries as target markets. As these tourists spend more, tourism enterprises would increase their revenue and gain more financial resources that could be used for expanding operations and improving management. Tourism enterprises that intend to serve tourists from Bulgaria should consider the fact that Bulgarians spend more on travel in the country than on travel abroad. They spend more on personal travels than on professional travels. During their travels, tourists from Bulgaria spend most funds on food, accommodation, and transport. Tourism enterprise managers should take this into account when developing and offering services for tourists from Bulgaria to realize more revenue. In general, the spending of Bulgarians on tourism trips and products has been increasing for the period of the last few years, 2019-2022, which is why they could be considered an attractive prospective market for tourism businesses.

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Improving Tourism Development Through Planned Employee Training

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Abstract: *The paper represents a problem statement and an invitation to start a research project presented as a draft and is focused on ways to increase the effectiveness of the educational process for training human resources in tourism. Stimulating tourism is now key to achieving effective economic development internationally, nationally, and locally. The authors propose an invitation to research focused on developing human resources in tourist host areas. Well-trained staff are key to maximizing tourist program efficiency. The research project will develop a training program intended for undergraduate and graduate levels, as initial training, and for continuing adults' training. The graduates of the proposed training programs should show the covering of the needs of an effective tourism activity in each of the areas involved, being trained according to the local specificity. They have to show achieving those main competencies which help to work on a wider touristic area, after only short continuing training sessions.*

1. INTRODUCTION

Tourism is one of the fastest and largest growing industries in the world, with Europe being the world's leading tourist destination. Before the pandemic, the sector accounted for 10% of both global GDP (USD 9.2 billion – EUR 7.87 billion) and EU GDP, while employing approximately 10% of the global workforce (European Commission, 2021).

Tourism's rapid growth makes it a key driver of employment and a major contributor to the global economy. On a global scale, tourism stands out as a dynamic and influential industry, making significant contributions to the economic, cultural, and social landscapes of organizations worldwide.

Moreover, the tourism industry boasts many advantages, like job creation, regional growth, and the preservation of cultural heritage. By fostering economic growth and promoting cultural exchange, tourism allows people to discover new places and enjoy leisure.

Tourism is an almost universal phenomenon, except in areas devastated by war or political instability, tourism in a certain form and, to a certain extent, occurs everywhere. Even war zones attract visitors such as journalists, writers, or those who want to experience thrills (Robinson et al., 2020).

Tourism currently offers a wide range of choices for travellers. Cultural tourism, business travel, ecotourism, adventure tourism, and medical tourism are just a few examples of different types of tourism.

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Economic, demographic, social, and political forces have driven the global growth of international tourism. Technological advancements in transportation, making travel easier and faster, along with the desire to experience other cultures, are key reasons for the importance of international tourism in this context.

According to Matosevic (2021, p. 177), tourism is clearly an experience-driven sector because tourism products and services are specifically designed to enhance the tourist's experience.

"Tourism" and "tourist" are widely recognised international terms, describing travel and travellers for leisure in most modern languages. A tourist, as defined by Yu et al. (2012), is someone who travels away from home for under a year, primarily for reasons other than paid work in the destination.

Leisure, business, education, culture, and entertainment are just some of the ways tourism impacts our lives. With travel becoming a favourite pastime globally, the tourism sector is experiencing rapid growth in the world economy (Vești, 2018).

Economic, demographic, political, and social factors increasingly influenced global tourism, such as the desire to travel, cultural curiosity, and technological advancements in infrastructure (Yu et al., 2012).

Increased tourist activity in a location often results in more job prospects within the tourism industry. Paicu et al. (2013, p. 1) highlight that tourism activity generates significant economic benefits, including registered income, employment opportunities, and foreign investments.

2. DISCUSSION

As a multifaceted field, tourism acts as a bridge, combining goods and services from multiple departments. Tourism relies on licensing agencies to link suppliers and tourists by offering the services they require. Today, tourism stands out as a unique activity that plays a significant role in people's interests. As a key sector of the world economy, tourism significantly contributes to job growth and sustainable development.

Since tourism has a vast impact on the world's economy, environment, and society, it relies on sustainable development as a guiding principle, and its growth depends on the dimensions of sustainability. Sustainable development directly involves the tourism industry, which relies on natural resources and cultural heritage. Sustainable tourism development is essential for both economic and environmental reasons (European Commission, 2021).

This phenomenon boosts the economy by creating jobs, such as hotel staff, waiters, restaurant cooks, and tour guides. According to Livandovschi et al. (2018, p. 235), tourism development positively impacts diverse economic actors, such as accommodation businesses, restaurants, transportation providers, travel agencies, tour operators, taxi drivers, and other transportation services, in addition to tourist guides.

Similar to other income sources, tourist spending directly benefits local businesses by providing revenue for food, transportation, and other services, thus contributing to the local economy.

An infrastructure that draws investment can be a big advantage. Local trade's growth and scale are linked to the number of explorers involved; visitors can dine at local restaurants, promoting

local culture's authenticity, which attracts tourists seeking unique experiences and encourages spending on local goods and services.

By engaging with local residents, visitors can learn about their traditions, customs, and way of life. Tourists can gain a deeper understanding of a culture and community identity by engaging in traditional activities. Promoting local trade can boost local income, especially in areas with limited tourism, while simultaneously increasing the visibility of local businesses.

Natural beauty and rich history are the cornerstones of Romanian tourism. Besides the landscapes, the villages with people preserving traditions for centuries are also a unique feature of the country. Romania's tourist potential is highlighted by its medieval towns and castles.

Romania's tourism industry thrives on its varied landscapes, unique traditions, and rich historical heritage, significantly contributing to the country's economic well-being (Paicu et al., 2013, p. 1).

The current strategy aims to promote not only Romania's landscapes and places but also its regional gastronomy. The exploration of local cuisines reveals both the ancient, traditional culinary practices unique to each region and the modern reinterpretations of these gastronomic traditions. The present culinary landscape is marked by a drive to promote fresh creations and bring old favourites back to life (Tabunșcic, 2023, p. 207).

Culinary experiences are now essential for tourism, attracting global travellers seeking new dishes and flavours, contributing to economic growth. In Tabunșcic (2023, p. 204) view, gastronomy is a key component in enhancing tourist offerings and driving economic growth at various scales. This approach prioritizes sustainability, emphasizing territory, landscape, local products, and authenticity, which are all consistent with contemporary cultural consumption trends.

Chiriac and Grunzu (2021, p. 213) argue that cultural tourism plays a crucial role in boosting tourism and the national economy. Positively presented historical sites become more valued and significant, leading to increased efforts for their protection and preservation.

As Comendant (2019, p. 166) notes, all tourism development strategies must contribute to the preservation and enhancement of the community's sociocultural identity.

Tourism is an activity in continuous expansion, and it is becoming more and more important, with indirect causes of increased labour productivity and leisure periods, so tourism has increased the number of companies providing tourist services (Mironescu, 2012).

Tourism has become remarkably diverse and interesting in the contemporary world. From leisure to business, medical, or religious, tourism offers opportunities to discover the traditional treasures of diverse areas, such as rural, gastronomic, or cultural landscapes.

Though they are found in various parts of the world, each region, including Romania, has its own special national or local elements. Tourism has become the fourth industry in terms of contribution to GDP worldwide (after retail trade, financial services and construction) and also the fourth industry in terms of contribution to employment (after retail trade, agriculture and construction) (Cristian, 2020).

Since tourism is a key driver of the global economy, governments must prioritise its growth. This is especially true for businesses, considering the positive impact tourism has on jobs and the economy at various levels.

Universities need to focus on methods that enhance the effectiveness of training tourism human resources. As we previously discussed, fostering tourism is key to achieving sustainable economic development internationally, nationally, and locally. There is potential to create strategies for developing human resources in tourist host areas. The goal is to ensure the highest possible efficiency of tourist programs through good training of human resources. This should determine the balancing effects of the regional economy even in conditions of economic syncope determined by the dynamics of evolution within the traditional areas of activity.

The focus is on improving the efficiency of tourism, particularly in Europe and other regions witnessing interesting contemporary trends. Some tourism areas have developed in a promising way. Though these trends are global, they are shaped by unique national or local characteristics in different parts of the world.

Such initiatives are taking place all over the world, but each place shows its specific mark coming from its own culture and history. The awareness of the unity in diversity of this training efficiently represented an essential factor in training human resources in tourism.

Thus, one can find a common competence profile all over the world of each occupational status in the tourism area, completed by elements of specificity for each local/ national area.

3. RESEARCH PROJECT – TRAINING PROGRAM

Educational institutions at the European and international levels can positively affect the efficiency of national and international tourism by providing quality training for tourism professionals. Human resources training can be delivered through specialized tracks in undergraduate and master's programs.

This training program can be designed for both undergraduate and graduate students, as well as adults who are seeking initial or continuing education. Niculescu (2010, p. 198) argues that teachers and scholars should be change agents, not just passive contributors. It's essential to recognise the significance of teachers when creating a curriculum that prioritises student needs and skills strongly connected to the needs of the jobs market.

Developing competences for undergraduate and graduate as well as continuing adults' training requires a mix of formal, non-formal, and informal education. Thus, what is trained in formal contexts (schools or training non-formal institutions) should be connected to what the general background of the work and the life, the aim of training being to prove competence within the professional context, not to get a certificate.

According to Niculescu (2010, pp. 93-94), formal education is not the sole factor influencing learners' competency, as informal and non-formal learning within their communities plays a significant role, as well. Assigning competences depends on their specific qualities and their proof to satisfy particular demands in the concrete work area, whether it's to individuals, social groups, or institutions (Niculescu, 2010, p. 95).

Developing a common competencies profile for tourism workers is necessary in this context, with core competencies necessary for occupants of the same status/job no matter where in the world. These core competence profiles should be completed and nuanced for each local/ national area according to the cultural, social, religious, etc. specificity.

They become targets to be achieved for specific training programs for each type of occupation within the tourism domain. One of them needs an undergraduate training program, others a graduate training and, no doubt, each of them needs a continuing training track aiming to update the competencies according to evolving the work context needs.

The competences profile is a matrix outlining many competencies organized on ”must, should and would” levels (essential, necessary, and desirable) developed and permanently adapted for a profession/ occupation. They are described and detailed for all the domains of activity implied by a specified profession/ occupation.

At this point is important to highlight an essential observation in enough thorny issues: the concept of competence/ competency and the competence structure. The literature usually uses the term skills, which implies a focus on what is easy to see: what a professional shows to do in the work context (what the worker can do, the performance as an act). But, competence is much more than this. Any performance as an action is determined by the base and the functionality of knowledge in the area, and hugely by the values and the character features of the worker, which gives efficiency and quality to the performance. Thus, competency represents the synergic effect of three verbs: to know, to know how, and to be. It contains knowledge, capacities or abilities (implying skills) and attitudes based on values.

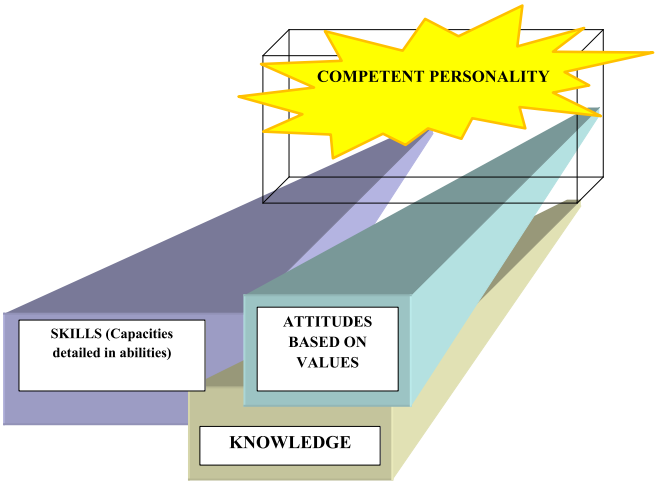

Figure 1. Competency structure
Source: Niculescu (2010)

The starting point of a curriculum design for a training program must be the competencies profile of the occupation/ profession the program is designed for. Achieving the competencies' profile structure on at least acceptable levels of performance (the must/ essential described competencies) represents the *aim* of the curriculum implementation. The items of the specifically described matrix represent the *goals* of the training program, detailed during the designing process by *objectives* connected to each sequence of learning situations. This developed *learning situations* during the curriculum design offer *learning experiences* for students/ learners along the curriculum implementation. They give the learners content aiming to provide them information for their future role as professionals, and by the way, this information and the way to interaction teacher-learner are aimed to achieve and develop components of know-how (capacities) and to be (attitudes and values). The teachers should demonstrate a real teaching art to develop all these on a high level for students/ learners.

A competence profile for a specific occupation/profession serves as a useful tool for both selection and ongoing evaluation. The selection process must focus on the ”must” (essential) competencies of each domain of activity which are compulsory. The competition is on the level of should and would competencies (necessary and desirable).

During the selection process, the mandatory *must* level competencies must be verified, with consideration given to the presence, absence, and quantity of *should* and *would* level competencies.

The employers have a profile of each employee (what the selected candidate already has in their own profile and what lack) after the selection process if it is done using this matrix. They will know what they need to guide the employee towards further training, beyond those new skills that may appear as necessary in the specific field of activity.

The focus of further development will be on mastering the competencies not covered in the selection process.

Creating a well-structured curriculum must take into consideration, as well, a correctly understood structure of a learning situation/ experience as the core concept of the curriculum concept. A curriculum consists of a suite of learning situations that generate learning experiences for learners.

The learning situations are designed by the curriculum designers and are implemented for and with the students/learners. The students/learners live learning experiences which have as outcomes elements of competencies (knowledge, capacities and attitudes) combined, with specific focuses on one or more of these.

Each learning situation as design and learning experience, from the perspective of the learners (twins' elements of curriculum concept), can be defined through *five elements.* A possible model of curriculum can be disposed as a pentagon or as a pyramid for a more complex and dynamic understanding (Niculescu, 2010).

The firstly defined elements inside of the curriculum design and implementation process must be the expected outcomes. These outcomes are: (1) the aims as general outcomes for learning situations considered at a wider level (as time connected to educational cycle, school year, sequences of a school year, or as contents/ defined subjects); (2) goals at an intermediate level as time/ complexity of the suite of learning situations (sequences of content or suite of time units sequences); (3) objectives at the level of a learning situation/ experience considered as a short unit as content and time (lesson or learning unit). They represent three levels of targets to be achieved along the learning situations designed and implemented. Finally, they must be reflected by learners' performances (achieved outcomes) expressed by the learning experience. The content selected for being taught represented the second structural element of a learning situation/ experience. This selection should be done according to the designed outcomes and to the allocated time for implementation (the third structural element).

The content delivered in a defined time aiming to achieve specified outcomes (aims, goals and objectives) is approached with specific didactic methods, which represent the fourth element of the mentioned structure of the learning situation. The teaching methods are selected according to content, the age and other particular features of the learners, and the existing didactic means available. This element must be connected wisely to the assessment method of students' achievements, the level of fulfilment of the designed outcomes. The assessment represents the fifth element. The circle is closed when the action returns to the outcomes as already achieved results as mirror of their design as expected outcomes.

4. CONCLUSION

The tourism domain needs training based on local specifics. That's why three issues should be considered. First, the curriculum design must be concerned with the core competence profile of a tourism worker. This is asked by a more and more accurate necessity determined by the wide transfer of workers worldwide in this area, as well. This core competencies profile must be the fundament for further training in case of geographical movement according to a specific competence profile that answers the needs of each region where the worker intends to practice.

Second, must exist for each occupation/ status within the tourism domain clear specific competencies profile.

Third, the responsible staff for tourism management and educational training for tourism must know the matrix of a competence profile for any status, even well defined as a structure, is a dynamic construction as content, because of the dynamic of the needs of beneficiary for the tourism.

Debating developing strategies to train tourism staff for determining a higher level of effectiveness was followed by the idea of drafting an international project aiming to improve the level of initial and continuing training of this type of professionals. The improvement could turn tourism as an alternative to balance the efficiency of economic development at the international, national and local levels.

This project is a proposal for collaboration that could bring beneficial elements to the efficiency of national and international tourism by influencing training human resources in a genuine professional way. Partners enrolled should establish the level of training necessary for each represented educational institution, according to their necessities (undergraduate, master's degree, adult continuing training). A grouping strategy may be the preparation for the next stage: designing curricula for the chosen levels.

Some goals can be stressed: (1) developing specific curricula for the chosen levels of training; (2) training a core team to implement the developed curricula; (3) developing a cascade system of training the training staff for the future of the project implementation.

These goals may be achieved if well-structured activities are designed and implemented. Workshops can be the best way to organise these activities. They should be focused on:

a) Establishing the level of training programs for each group of project's members according to their local specific needs - types of curriculums for each group (undergraduate and graduate levels, as initial training, and/or for continuing adults' training).
b) Establishing the steps of developing an effective curriculum.
c) Designing the competence profile for the beneficiaries of a specific level/type of training, as a defined outcome of each curriculum. This stage will consider how tourism activities in a specific area fulfill the needs of each region. The staff should be trained under local details.
d) Defining the core competencies to be developed for all the regions which approach the same type of curriculum, and the specific ones for each region.
e) Establishing the necessary time for curriculum implementation.
f) Designing the necessary content for each curriculum (considering the national/ local specificities, as well).
g) Designing the teaching methods according to the contents, time and the intended outcomes defined by the competence profile (carefully respecting the specificity of the culture and tradition for concrete beneficiaries, especially for the specific competencies).
h) Designing the assessment and evaluation strategies (also respecting the specificity of the culture and tradition for concrete beneficiaries, especially for the specific competencies).

A high impact could occur on local and even wider levels. Some milestones of this impact are: (1). The graduates of the proposed training programs should show the covering of the needs of effective tourism activity in each of the areas involved, being trained according to the local specificity. At the same time, they have to show achieving those main competencies which help to work on a wider touristic area, after only short continuing training sessions corresponding to each cultural context. (2). Through its very structure and implementation, the project can be a marketing and training tool for effective marketing. The idea is to develop a project with international participation to realise the unity in diversity of human resources, training in tourism as an essential factor of its efficiency. (3) The project will also open the way to prove similarities in the tourism field, underlying the existence of some core needs of effective tourism activity in each of the areas involved.

This project could have multilevel effectiveness for the educational staff as well. A professionalised approach to curriculum design, with a better understanding of its core concept, and an in-depth approach to developing the training in the tourism area is expected.

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Public Relations as a Function of Creating the Identity of a Tourist Destination

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Abstract: *This paper is in the context of identity creation as a key factor for tourist destination attractiveness. The theoretical research is supported by empirical research, that includes many respondents on several aspects of the current situation of Ohrid, thus determining just how much this most important tourist destination in North Macedonia is recognizable and attractive on the global market. Through constructive criticism and friendly advice, upon determining the strengths and weaknesses, recommendations for future actions will be given, i.e. where and in what manner should the tourist entities and related fields be motivated to implement modern PR solutions.*

The ultimate goal is building a globally better image, reputation and branding of Ohrid, which will result in creating a more quality, segmented tourist offer that will be well placed, easily accessible and valorised on the market and will have multiple positive effects on the destination, the tourist and community entities, with long-term sustainability.

1. INTRODUCTION

The main goal of this paper is to utilize the large number of elements, possibilities, forms and tools available to public relations to establish a distinctive and recognizable identity for the tourist destination, which will improve its visibility in the highly competitive global market and increase its appeal to potential tourists. The goal is aimed at profiling selected-segmented tourism, and not mass tourism, to introduce and develop responsible, long-term sustainable tourism.

Our purpose is to determine the effectiveness of public relations (PR) in the context of modern mass media, with its ever-growing and inexhaustible possibilities, in creating a recognizable and positive image, as well as to generate greater interest in the diverse natural, cultural-historical, spiritual, traditional, and other values and tourist attractions of Ohrid.

The subject of this paper is the research of the correlation - the mutual relations and influences, of public relations and the identity of Ohrid as a tourist destination, the largest and most famous tourist center in North Macedonia and beyond.

The focus is on the thorough research of the role and impact of public relations in creating, defining, and promoting Ohrid's identity as a tourist destination. This includes enhancing Ohrid's positive image and developing a recognizable brand that showcases what the destination has to offer.

The paper is realized with two methodological approaches. The elaboration of the theoretical foundations of the connection between public relations and the identity of the tourist destination

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is supported by empirical research. With survey questionnaires on the subject of the research, it was conducted with 100 foreign and domestic tourists in Ohrid, as well as 54 employees involved at different levels, branches and entities, in the tourism industry in the Ohrid tourist destination.

2. THEORETICAL BACKGROUND

The enormous competition in the modern tourism market presents numerous challenges for tourist destinations and business entities offering tourism services in determining strategies on how to maintain their competitiveness in the market. One of the strategies that is increasingly attracting attention today is the creation of a recognizable identity for the tourism product and establishing an international image as an attractive tourist destination.

According to Melucci (1965) "That identity refers to permanence in time, to the notion of unity, to the continuity of the subject and to distinguishing the subject from others to the so-called ability to recognize and be recognized".

For a tourist destination, identity is defined as a set of distinctive features that characterize it and set it apart from other destinations, giving it its unique stamp of recognition among tourists and the public. This is especially important for tourist destinations that are within the same regional framework and have similar key features, which imposes the need to create a unique, recognizable identity that will ensure diversity in relation to competing destinations.

According to Simoncheska (2020), identity unites all the resources of the destination, such as natural resources, cultural values, history, architecture, legends, myths, events and manifestations, gastronomy, and local products and services. This set of material and cultural values creates the perception of the destination as a whole.

Reading (2002) found "The purpose of the identity is to position a positive image of the product (the tourist offer – ed.) in the minds of tourists, because a positive perception is worth a million dollars in terms of realized values and achieved performances. Products with a strong positive identity generally have higher prices and much better financial results than their competitors".

According to Gregorić and Skendrović (2013), creating a distinctive, strong identity is the creation of a tourist destination brand. A destination brand includes the authentic natural and anthropogenic values of the destination, as well as defined visual elements such as the name, logo and slogan of the destination. In tourist destination branding, the name is permanent and expresses the geographical name of the destination, and the slogan must adapt to it.

O'Leary and Deegan (2005) state that "The identity and branding of a tourist destination should create an image, i.e. a positive picture of the destination and its offer. The image is a psychological construction of formed attitudes, opinions, ideas, representations, prejudices and acquired experiences of tourists regarding the tourist destination as a whole. The image is a product of the perceptual set, shaped by the influence of all external stimuli to which the tourist and potential tourist are exposed. Since the tourist product on the market cannot be presented in the form of a sample, and potential tourists cannot see and try it before deciding to buy it, promotional activities through multiple means and media are the only way to present the tourist offer to potential buyers. The primary goal of presenting the offer is to build a positive image of the destination with all its values. The intangibility of the tourist product makes the image the only tool that the potential tourist has in comparing and choosing the potential destination".

When a recognizable identity has been built, in order for it to be recognized and seen by tourists, first, through public relations as a means of communication, the image of the identity must reach tourists, attract their attention, leave an impression on them with an attractive story that is recognizable and separates itself from the competition as well as arouse a desire to visit. Therefore, public relations are intrinsically linked to identity; without positive feedback and effects, the benefits of a well-defined identity would be diminished.

According to Kotler (2001), a definition of image is "An image is a set of beliefs, ideas and impressions that a person has, which a related to a certain object. People's attitudes and activities towards a certain object a largely conditioned by the object's image".

AMA (n.d.) found that "Image is the consumer perception of a product, institution, brand, business or person, which or may not correspond with reality".

According to Zolak (2024) "The issue of image, personal, organizational, brand, destination, is one of the most important issues that attracts the attention of the social, business and scientific public. This paper draws attention to the need for a comprehensive treatment of the image, the mechanisms of its formation, and especially to the difficulties of considering the image phenomenon in isolation, separated from its basis - identity. Numerous studies of the image of tourist destinations in the past decades, mostly of an empirical nature, remain on the surface of this phenomenon. Their results do not contribute to a deeper understanding of this phenomenon, primarily due to the absence of an appropriate conceptualization and theoretical framework. Regarding the image of the destination, the most important thing is, of course, its result, but the analysis of the image phenomenon, the separation of one into its constituent factors, different, opposite and contradictory, reveals levers whose shaping and use can influence the result - the image. The role of mass media in this process, especially in the digital era, is very significant, but not decisive".

In the digital, internet era, public relations, with the help of numerous instruments, forms and tools, such as social media, search engines and internet platforms, very quickly and at quite low costs, reach millions of potential tourists. Thus, a good combination of identity and public relations, built with knowledge, professionalism, experience, honesty, dedication and love, will certainly have positive effects on the recognition of the tourist destination, valorization of its values and advantages and the realization of a series of benefits for tourists, as well as for the tourism industry. From the above, the essential role and importance of public relations, along with their correlation and functional connection to identity, become clear.

3. EMPIRICAL RESEARCH AND RESULTS

In order to understand the attitudes and opinions of the entities in the tourism market (supply and demand) regarding the identity and communication of the tourist destination Ohrid, we conducted empirical research by surveying tourists on the one hand, and tourism operators, on the other. The survey included 100 tourists, of which 70 are foreign, reflecting the research's focus, which is geared towards the international tourist market, and 30 are domestic guests from North Macedonia. The questions are largely the same, tailored to suit the respective target group of respondents.

For both foreign and domestic tourists, we focused on the age group from 25 to 70 years, 50% of the respondents are women, 50% are men. According to the educational structure, 65% of the respondents have higher education, while 35% have secondary education. The survey for foreign tourists includes respondents from European countries: Serbia, the Netherlands, Italy, Sweden, Turkey, Great Britain, Switzerland, countries in the Middle and Far East, the USA and Australia.

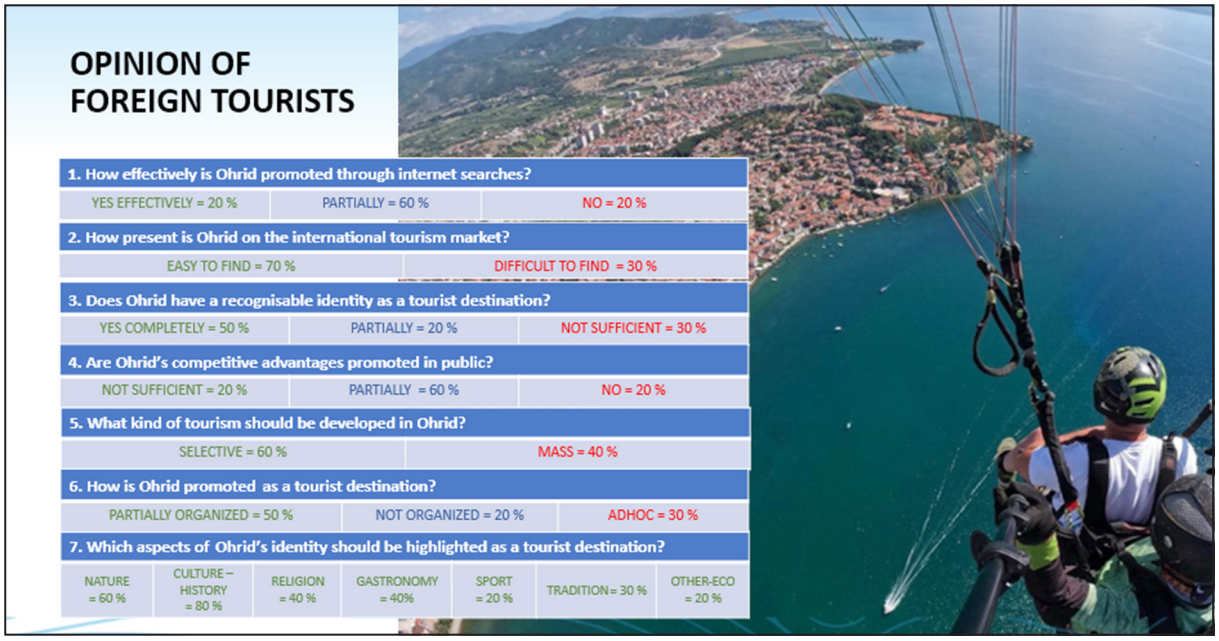

Figure 1. The results of the survey of foreign tourists
Source: Own research

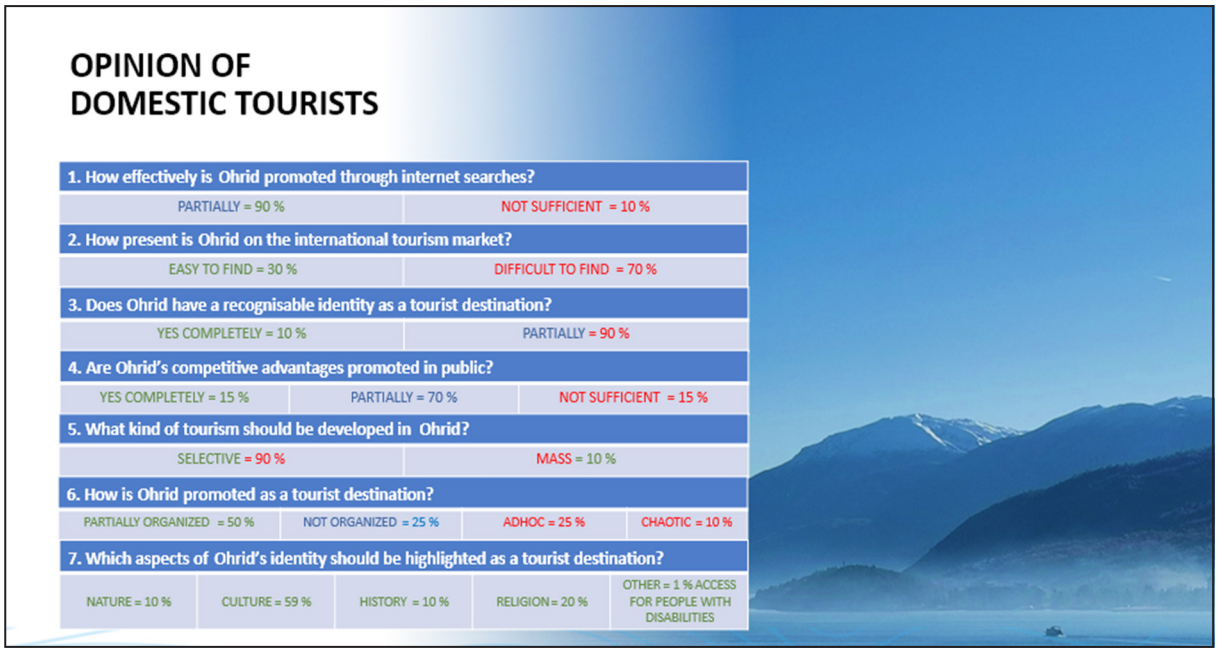

Figure 2. The results of the survey of domestic tourists
Source: Own research

The questionnaires were also answered by 30 domestic tourists, from different cities and regions in North Macedonia.

The survey was conducted with 54 providers of tourist services in Ohrid, 60% of them being owners and managers of hotels, restaurants, cafés, boat operators, souvenir shops, Ohrid pearl and jewelry shops, vacation rental owners, and tour guides, while 40% are employees in the tourism industry. Among the respondents from the tourism industry, 50% are women and 50% are men, with 60% having higher education and 40% having secondary education. The questions were tailored to suit the target group.

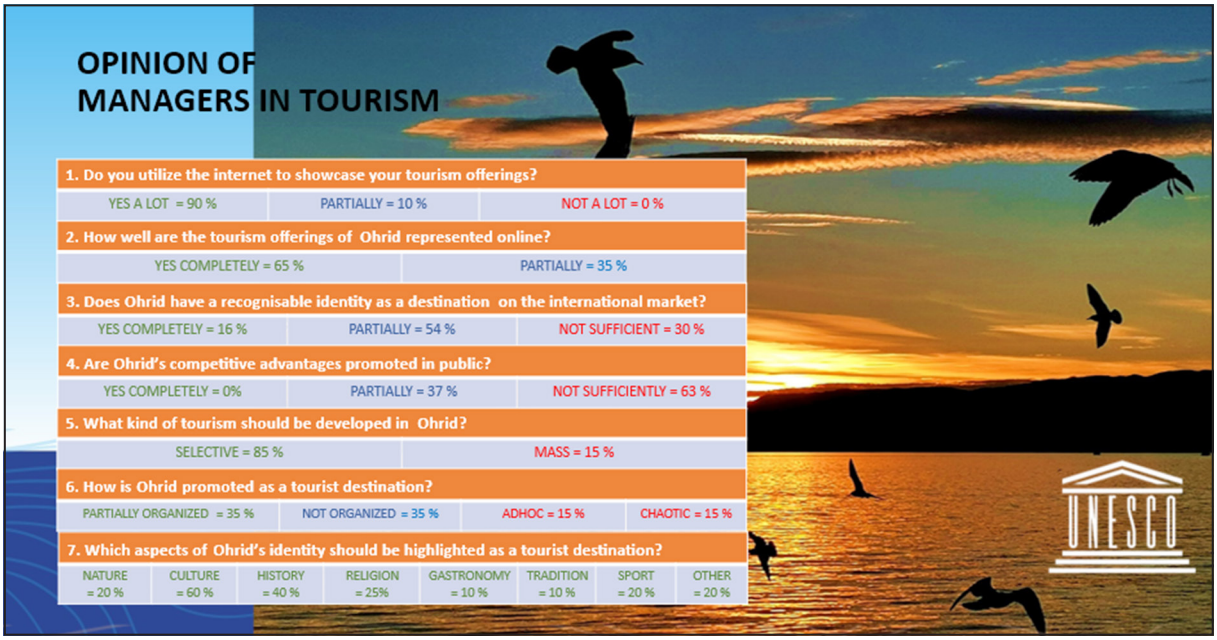

Figure 3. The views of the surveyed business entities in tourism in Ohrid

Source: Own research

Figure 4. The views of the surveyed employees in the Ohrid tourism sector and other complementary activities

Source: Own research

To identify the right path for achieving this paper's goal, we conducted a SWOT analysis of Ohrid's tourist offer, detecting its strengths, weaknesses, opportunities and risks, that require thorough attention and work.

The SWOT analysis is designed to help us understand and identify factors that enable us to achieve our goal and also identify what has a detrimental impact on achieving the desired goal.

The determinants from the analysis should guide us in effectively utilizing public relations in the function of creating a recognizable identity for Ohrid as a tourist destination and enhancing the competitiveness and valorization of Ohrid's tourist offer on the international market.

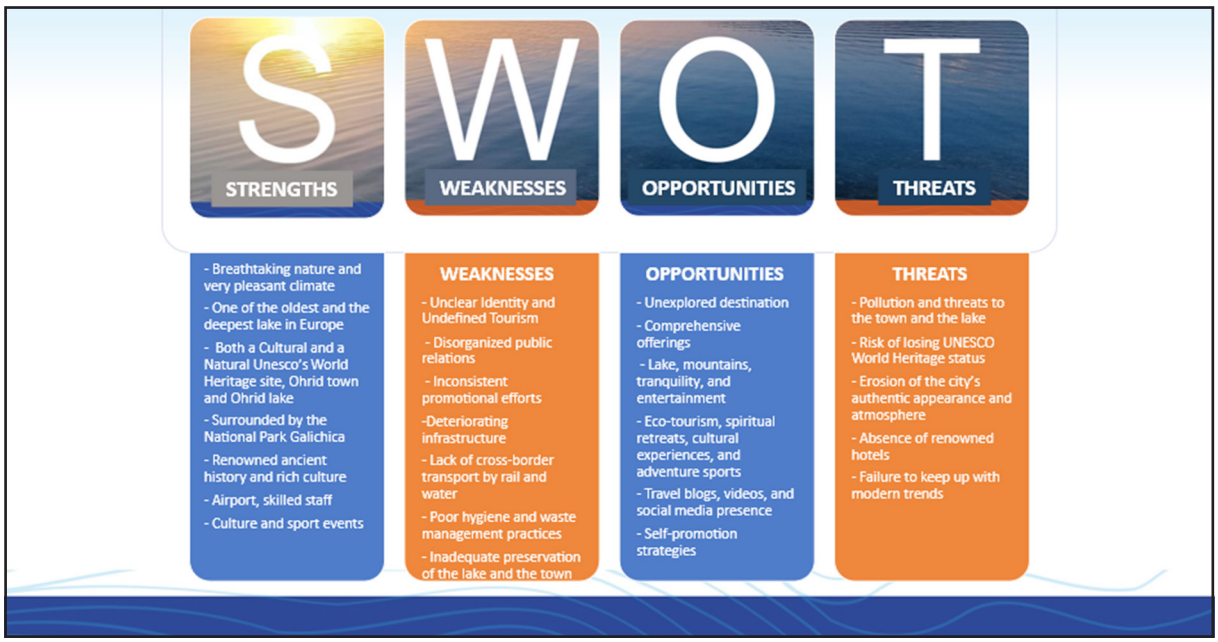

Figure 5. SWOT analysis of Ohrid's tourist offer

Source: Own research

Ohrid, as a tourist destination, boasts a long list of strengths, with its unique natural potential, rare cultural and historical heritage, UNESCO protection, the local airport, and a variety of cultural, sports, and other events ranking highest. However, it also faces weaknesses, such as an unrecognizable image and undefined tourism due to disorganized public relations and sporadic promotions, along with poor infrastructure, pollution, litter, urban encroachment, and space devastation. A large number of risks threaten the Ohrid tourist destination, but it also has many opportunities as a still "undiscovered" location on a global scale, offering "everything in one place." With well-planned and managed public relations, centered on a recognizable identity, Ohrid can become even more attractive to tourists.

4. CONCLUSION

- Public relations are of essential importance and PR is the "most powerful weapon" for creating the identity of the tourist destination.
- There is a great space and need for strategic, organized, professional management and improvement of PR in Ohrid.
- Ohrid's tourist offer is promoted partially. For some tourists, Ohrid is easily accessible, and for other tourists, it is difficult to access.
- Ohrid has a partially recognizable identity, partially promoted competitive advantages and a disorganized approach to creating public relations.
- The majority (60 to 90% of all respondents) believe that segmented-selective tourism should be developed in Ohrid, not mass tourism.
- The results of the research indicate that cultural-historical, spiritual, geographical, eco, traditional and gastronomic identity should be favored in the offer and in the promotion of Ohrid as a tourist destination.

5. RECOMMENDATIONS

- The government institutions in the Republic of North Macedonia and the local authorities in the Municipality of Ohrid, in conjunction with science and the tourism sector, should build a long-term strategy for organized, thoughtful promotion of Ohrid through modern means of public relations, on the global market.
- The focus in the PR should be on the affirmation and communication of the recognizable, unique, rare tourist potentials, values and attractions that are part of the brand identity of Ohrid as a tourist destination.
- The state and the city of Ohrid should provide the necessary, professional human resources, budgetary and technological means and institutional forms, such as the establishment of a ministry of tourism, tourist organizations and information points, for serious, interesting and modern promotion of tourism.
- An urgent focus on the improvement of infrastructure, roads, and above all, overcoming (solving) the problem of unhygienic conditions and waste management issues.
- It is necessary to ensure a stronger presence of Ohrid in the digital world, through an easily accessible, comprehensive, detailed tourist offer, with a well-packaged, attractive story and a proposal of elaborate programs for the stay of tourists, served directly, in the hands of tourists.
- With serious and dedicated efforts, implementation of recommendations and sanctioning of non-compliance, Ohrid must prevent itself from acquiring the status of an endangered area, halt the trend of negative promotion through bad news, and shift its focus toward affirmation as a region with integral protection on the UNESCO list.
- Through public relations, we should work on raising awareness among the local population, the tourism sector, local authorities, and the state. We have been blessed with a piece of paradise on Earth called Ohrid, and instead of destroying it by cutting the branch we sit on, we need to mobilize everyone in their respective fields toward a common goal. A well-defined and well-packaged narrative about Ohrid should reach and attract tourists from around the world. In this context, by maximizing the use of and enhancing public relations, we can establish a recognizable identity on Ohrid, fostering an environment that leads to satisfied guests who will spread positive energy about this tourist destination, ultimately benefiting everyone involved.

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The Presentation Role in the Study's Selection: Tourism and Environmental Protection (University of Sarajevo)

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Abstract: *The purpose of the paper is to investigate the presentation role in study selection. Presentation and promotion of studies are major issues that academic institutions focus on in order to attract students. The study included students from the University of Sarajevo's I, II, and III cycles of tourism and environmental protection. Three kinds of reference criteria and indicators were selected: attractive presentation features, promotion approach, and presentation influence on decision. The study's findings revealed that the faculty's official website and recommendations are the most influential marketing tools, that the presentation of the study influences choice and decision-making, and that the study's conception, the modernity of the educational infrastructure, field teaching, as well as the geographical aspect of tourism and environmental protection, are particularly appealing factors.*

1. INTRODUCTION AND THEORETICAL BACKGROUND

The study's presentation plays a crucial role in the decision-making process. „Decisions taken when continuing education are long-term decisions that affect future life, such as work, self-satisfaction, and subsequent social activities" (Adam & Gunarto, 2021). „In academic settings, presentations are important for sharing knowledge and ideas with students as the key factor to the success of information delivery and audience engagement" (Suwartono & Furqon, 2021). The effectiveness of an academic presentation is influenced by its content, the nature and design of the academic program, the technical and creative organization, and the modes used for its promotion. Various scholars (Adam & Gunarto, 2021; Kango et al., 2021; Suwartono & Furqon, 2021; Garner & Alley, 2013; Jusaj, 2019; Boardman & McCormick, 2019) have stated that promotion in education is a fundamental marketing component that encourages the acquisition of academic products by highlighting their benefits and providing comprehending materials, while also incorporating physical, media, and digital strategies, along with word-of-mouth endorsements that are essential for establishing the academic reputation. It includes visiting schools, installing banners, brochures and using social media, etc. The quality of promotion is also an important aspect to support the audience to comprehend the materials, thus, well-structured and instructional presentations that incorporate examples and visual illustrations are significantly more effective.

Institutions of higher education are encountering intense competition from both the public and private sectors, necessitating a more sustainable approach to academic promotion. „Students' choice and decision-making in higher education have gained superior importance since higher education has become market-oriented and very competitive (Jusaj, 2019). „Increasingly fierce competition

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from universities in getting new students requires universities to carry out marketing activities well, one of which is through promotion and formation of a good college image to influence the decisions of prospective new students in choosing a university" (Kango et al., 2021). A wide array of internal and external factors plays a crucial role in shaping a student's decision-making process and selection of academic programs: these include motivation, personal interests and abilities, educators, family, friends, environmental influences, available facilities, promotional efforts, offered programs and scholarships, financial assistance, parental expectations, and geographical proximity to home. Various modes of academic presentation have different impacts: WOM (word of mouth), as, for example, the review from alumni students, contributes to the university's image and reputation and attracts interest; promotion through digital media (internet, social media, and social networks) has an extensive reach with lower costs, accounting for videos as more effective than images; physical promotion (exhibitions, festival bazaars, or educational fairs) enables direct interaction with potential consumers to share experiences and communicate the advantages and disadvantages of the product.

In this study, key attractive elements of an academic presentation were selected—attributive features of the tourism and environmental protection academic program (University of Sarajevo): its concept and nature (curriculum and geographical aspects), availability - affability of academic staff, applicability and prosperity of the diploma, the attractiveness of the study presentation, and the study image and popularity.

2. METHODOLOGY

The research aims to investigate the role of presentation in study selection. Universities are challenged with high levels of competition today; therefore, they must recognize their assets in order to produce competitive academic presentations. The students' attitudes were critical to determining which presentation aspects influenced their decision-making. As a result, the face-to-face survey with combined (open-ended) questions and semi-formal interviews was conducted with students of the geography academic program of tourism and environmental protection (University of Sarajevo) across all three cycles. Three categories of elements were selected: the attractive aspects of the study presentation, the mode or the promotion strategy, and the overall presentation impact on the decision. The study's presentation content included the important attribution elements in terms of the study specifications, as well as an assessment of the mode and presentation effectiveness on the selection. The paper analyzes the study presentation's major strengths, which are critical for long-term promotion to attract new students.

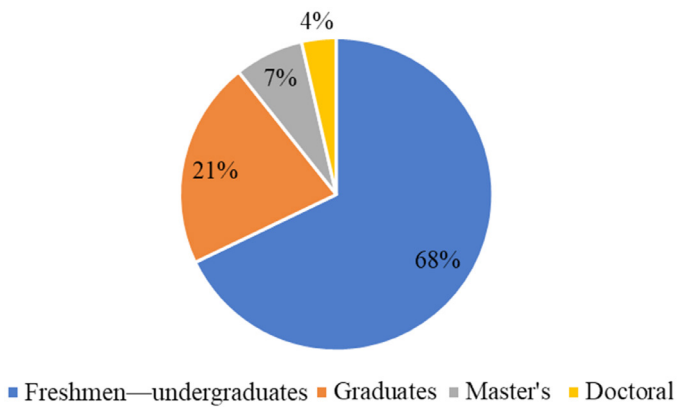

Figure 1. Respondent Profile by Year of Study
Source: Own research

3. RESULTS

Tourism and environmental protection study (University of Sarajevo) is promoted through several channels:

a) Fairs: University Fair and Sarajevo Festival of Tourism (Center Skenderija);
b) Internet: official website of the Faculty of Science, Department of Geography (University of Sarajevo), and social media promotional videos (Facebook and Instagram);
c) Cooperation with schools: academic staff conducts direct promotion through visits to secondary schools throughout Bosnia and Herzegovina;
d) Collaboration with the Association of Pedagogues in the Canton of Sarajevo: promotion of the study presentation on class community meetings across the pedagogues program (area: professional orientation with high school students), 2020-2022;
e) Word of mouth: reviews and recommendations from students and acquaintances directly (first-hand) and indirectly (via internet forums, etc.)

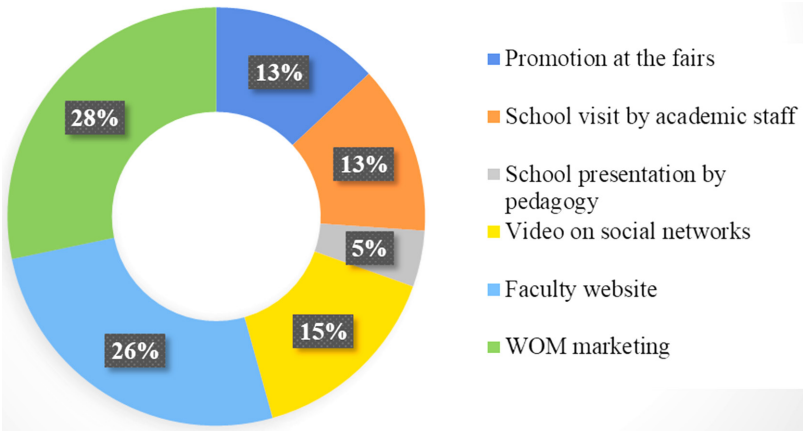

Figure 2. Modes of the study presentation promotion
Source: Own research

According to Figure 2, the most powerful modes of study presentation are ranked as follows:

a) Oral recommendation (28%);
b) Presentation on the official study/faculty portal (26%);
c) Social media promotion (Instagram, Facebook, etc.) (15%);
d) Promotion at fairs and school visits by academic staff (13%);
e) Study presentation by a school pedagogue (2%).

The findings indicate that *positive word-of-mouth (WOM)* serves as the leading mode for promoting the study and stands as the most powerful marketing tool in this context, thus also supports the conclusions drawn by Kango et al. (2021), which assert that word-of-mouth, alongside customer experience, offers the most effective promotion in shaping college selection decisions. The choice of study and decision-making process are greatly influenced by the experiences of students or alumni, the viewpoint of close friends, family, or other acquaintances whose counsel is valued, as well as their accomplishments with the earned diploma (employment in the profession, etc.). However, recommendations do not always have to come from persons who have completed that study (they do not have to be users of the academic product), such as the advice of a well-meaning friend who would be helpful with finding work in that field, etc. A positive assessment and a commendable image of the study attract new students while maintaining the study's engaging components (Figure 4).

The study presentation on the official university portal (academic promotion via digital media—the Internet) is the most relevant/ representative source, which allows the individual to become more familiar with the study concept by providing transparent curricula and syllabuses, as well as promoting interesting study activities. This information are always available and allows for comparisons with different study programs. Faculties promote major academic events through relevant stories, gallery of photos and videos, as well as the opportunity to communicate with interested clients. The internet presentation of tourism and environmental protection studies put in the foreground the following components: the organization at the faculty; the concept of study in all three cycles; international cooperation; a bulletin board with useful information for students and advertisements; scientific research work; publishing activities; specific events: field classes throughout Bosnia and Herzegovina; practical work in cooperation with the economy, tourism, and ecological sectors; programmers activities in the GIS center; modern laboratories and IT centers, etc. Furthermore, a supplement to the diploma was provided, along with guidance on how to apply it in the labor market.

Promotional videos on social networks require financial investments due to the certain costs of advertising; yet, this form of presentation ranks third in terms of impact on decision-making. However, students stated that there are too many commercials on social media, resulting in their saturation and a lack of time and that everyone will only view video content in which they are already interested, which supports the Kango et al. (2021) allegation that the drawback of this promotion is that digital media has many competitors. Young people are generally aware of their ambitions and opportunities, and they will be willing to pay attention to anything that interests them rather than study that they have no desire for. Promotional video covers typically include the faculty's title, which can be a barrier to entry if the individual has no interest in that field (how to create and impose a video should apply some marketing strategies that are rarely used in academic settings).

Promotion at fairs and high school visits by academic staff have similar effects because both provide a visual demonstration and access to promotional materials (brochures, PPTs, video presentations, etc.), as well as the opportunity for direct communication with academic representatives and the exchange of information and experiences.

The study promotion in the pedagogy classes during the implementation of professional orientation program with high school pupils (2020-2022), where pedagogies were required to present our studies to their graduates, had the smallest impact on study choice and selection. However, because pedagogues are not a qualified profession to promote various disciplines, it is reasonable that additional clarifications were lacking.

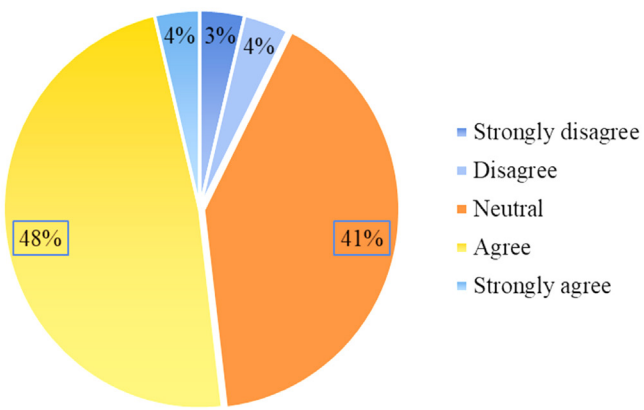

Figure 3. The presentation impact on the study selection
Source: Own research

Regarding the general impact of the presentation on the study choice, 52% of respondents are positive about it (SA: 4%, A: 48%). Young people are interested in knowing what kind of higher education they will be receiving, what courses they will be studying, what skills and knowledge they will be acquiring, what opportunities for development and employment they will have, and what the academic environment will be like. A competent study presentation delivers the majority of the information directly (by academic representatives) or indirectly (via advertising media, etc.). Nonetheless, a sizeable minority of students (41%) had a neutral opinion about the study presentation impact on their choice. According to this category, studies are frequently promoted in a more favorable light than they deserve, making media and web presentations less credible as indicators. Recommendations and experiences of people who have completed certain higher educational programs are considered more important. Their attitude additionally highlights the effectiveness of word-of-mouth marketing.

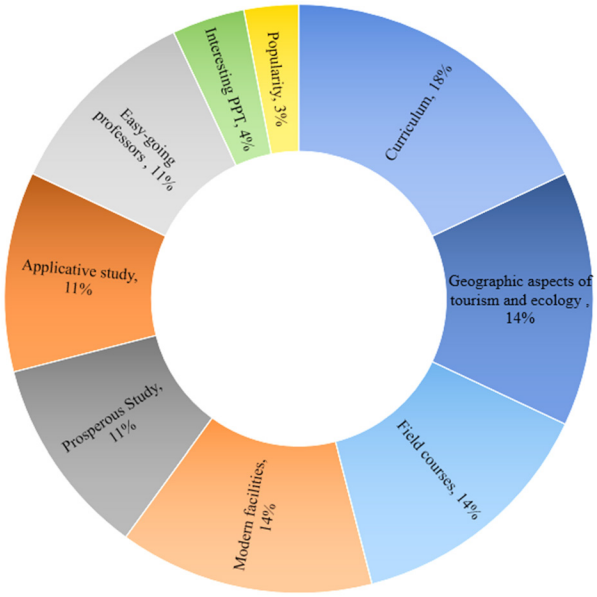

Figure 4. Attractive features of the study presentation
Source: Own research

The most attractive elements of the study presentation are ranked as follows:

a) Study conception: curriculum (18%);
b) Geographical aspects of tourism and (geo)ecology, field teaching, and modern faculty's environment (14%);
c) Accessible professors, applicable and prosperous studies (11%);
d) Interesting PPT or video presentation—concise, informative, and innovative (4%);
e) Popularity of studies in terms of numerous enrolled students.

The study conception, which takes into account both the specific subject matter and the disciplines that will be studied, is a key determinant in the decision-making process for students. This gives the student a better understanding of the type of study program and how to apply the knowledge and skills he has accomplished. Course modules provide objectives, teaching units, criteria, standards, and outcomes through acquired competencies, skills, and knowledge. Aware young people want to achieve applied and competitive knowledge, which will provide them with multiple job prospects. Geographic aspects of tourism and environmental protection has been a unique study in Bosnia and Herzegovina (University of Sarajevo) that integrates two exceptionally appealing scientific fields, even though they will be independent study programs beginning in 2024/25 (Innovated plans and programs). Geographical approaches to tourism and (geo)ecology

are a relatively new trend in Europe and the rest of the world (since tourism has traditionally been dealt with by economists and ecology by biologists), and in Bosnia and Herzegovina, the study of tourism and environmental protection was established in 2005 (University of Sarajevo, Natural Faculty of Mathematics, Department of Geography; Bologna Reform) and has grown in popularity.

Among the most appealing aspects of tourism and environmental protection studies, aside from the geographically diverse study concept, are *the modern faculty environment* and *field teaching.* The study takes place in the modern tall building with gardens of the Faculty of Science (University of Sarajevo) in the capital urban area near the center, which has air-conditioned classrooms, modernly equipped IT centers and laboratories, and a pleasant environment. Route-stationary field teaching is an integral part of the curriculum for undergraduate studies from the first to the fourth year. It's held every spring in Bosnia and Herzegovina, but also in neighboring countries (Croatia, Serbia, and Montenegro). Expert teams (often 3-5 university professors and assistants) plan, organizing, and conduct field teaching in collaboration with faculty management and agreed tour operators while adhering to the curriculum features as well as the students' requirements. The field image and video collection is impressive because it promotes both the application of professional skills in the open environment and the country's most popular tourist and eco-sites.

Figure 5. Study of Tourism & Env. Protection (in a modern skyscraper), Dep. of Geography, Faculty of Science (including both – tall and short pinky objects), University of Sarajevo
Source: Faculty of Science Sarajevo (2022)

One of the things that draws young people in is the *professor's inherent reputation—accessibility*, which they have heard about from current or former students. Though they are a genuine minority in the explored study, rigid academics do not negatively impact the positive reputation that presently exists on this side. Effective interaction between students and professors fosters a pleasant environment that students are proud to tell their peers about, which in turn stimulates potential interest.

When selecting a study, other appealing aspects include its *applicability and prosperity* in terms of job prospects. In Bosnia and Herzegovina as well as other parts of the world, tourism and protecting the environment are strategic sectors. Because the tourism industry offers far better employment prospects than the environmental protection industry due to its wider range of occupations and the country's continuous expansion in tourism, diploma in this sector is particularly in high demand.

Figure 6. Field teaching with graduate students included visiting the Museum of Sarajevo 1878-1918 as an internationally popular site in Bosnia and Herzegovina—Prince Ferdinand ft. Sofia (Austro-Hungarian rule in Bosnia)

Source: Own photo

Video and PowerPoint presentations are one of the three most important aspects in study selection, and they are promoted through all channels, including social media, the faculty's official website, educational fairs, and the cabinet. The advantages of social media include information technology accessibility and packaged content that highlights the most appealing aspects of the study in a compressed time. Nonetheless, they cannot replace much more precise information, overview tables of the study plan and program, and a plethora of other exhaustive resources available on the faculty's website, but they do constitute a bright complement to well-organised university portal content.

The *study's popularity* in terms of student numbers is the least effective component of its presentation because most young people, despite seeking socialisation, prefer a more serious clientele ("nice guys") at university. Professors are more accessible and dedicated to their students in a less congested environment, which is beneficial for young people.

4. FUTURE RESEARCH DIRECTIONS

The study of tourism and environmental protection has grown in popularity during the last two decades. It's one of the leading programs at the University of Sarajevo's Faculty of Science and Mathematics and the most demanded in the Department of Geography. It's mostly the first choice among applicants, accounting for the majority of students enrolled in geography. Since tourism and environmental protection studies are separate and innovative study programs beginning in the academic year 2024/2025, effective monitoring and innovative study presentations will be required. Some of the numerous academic challenges lie ahead, with mandatory monitoring of numerous elements: interest and demand structure; number of enrolled students; evaluation of student perceptions and satisfaction (reviews); evaluation of academic staff teaching performance, especially in relation to new courses on which external collaborators are engaged; implementation of module outcomes in practice; degree of collaboration with business entities; success in the profession; feedback in terms of a successful response to labor market demands; creating more effective studies presentations based on their upcoming new-built image, etc.

5. CONCLUSION

Study presentation and promotion have a favorable impact on decision-making. The content of the study presentation, the way of promotion, and the power of its overall influence are important aspects of the study's selection. „The image of the institution is formed through practical marketing activities" (Kango et al., 2021). The crucial modes of the study presentation are: WOM, the academic web, and social networks. However, the key to a successful study presentation—number 1—is a commendable image (positive impression) of the study. „Sales have a significant effect on choosing a college, and the image of education has a significant effect on college decisions (Kango et al., 2021). The findings demonstrated that the essential pulling factor in enhancing the study's reputation and image is its human resources—academic staff. As a result, academic departments ought to make the largest investments in their staff, keeping in mind many crucial criteria for desirable academic employees: prudent hiring; enthusiasm; pedagogic skills; evaluation of their work with students; and stimulation. For academic staff to establish productive connections with students and foster good communication, pedagogical training is required. Monitoring professors' and assistants' performance through student surveys might help identify those who are highly regarded and preferred by students; additionally, those should be encouraged through management recognition or financial incentives. Another area where funding should be increased is the faculty website, where studies are presented. This is because the website more authentically reflects the nature of the studies, presenting noteworthy accomplishments and current events alongside tangible teaching materials. A well-maintained faculty website that provides up-to-date and clear information fosters interest and confidence when selecting a degree or study. Social media promotion is also crucial, but it comes after word-of-mouth and academic web presentations. While Facebook and Instagram are the most popular social media platforms worldwide, young people in Bosnia and Herzegovina prefer to use TikTok, Badoo, and other networks. For this reason, it should be more deliberate about which social media platforms to use to promote the study of tourism and environmental protection. A sustainable presentation of the studies should sublimate its most attractive components, which in the given example are: the structural concept, field teaching, and modern environment, then the professor's accessibility and the prosperity of the study, and so on. In order to reconcile "pleasant with useful," modern students demand learning, practice, and enjoyment from their studies, as well as a sense of belonging to a higher education community. Such an experience is provided by the study of tourism and environmental protection, sublimating its geographically popular conception, a modern env. with GIS and labs, practical classes in economic and administrative centers, field classes in top nation's touristic and eco-sites, friendly academic staff, and a successful diploma with numerous employment opportunities.

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Geospatial Analysis of Airbnb Data: Understanding Distribution Patterns, User Satisfaction, and Economic Impacts in Major Global Cities

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Abstract: *This study considers the geospatial dynamics of Airbnb listings across nine major cities globally, considering the impact of location, amenities, and host status on user satisfaction and economic outcomes. Using a mixed-method approach that combines mostly quantitative geospatial analysis with qualitative insights, this study reveals the distribution patterns of Airbnb listings, factors that affect user satisfaction, and the economic implications of short-term rentals. Results from this study clearly show the importance of amenities and host interaction in enhancing the experience and bringing out clustering of listings around central urban areas, while it also shows the varying impact of Airbnb on local economies and housing markets. The current research fills this gap by providing a comprehensive geospatial view for hosts, urban planners, and policymakers making efforts for the sustainable growth of short-term rentals.*

1. INTRODUCTION

The rise of the sharing economy has reshaped industries, with Airbnb becoming a key player in the short-term rental (STR) market (Robertson et al., 2023). Since its launch in 2008, Airbnb has disrupted traditional hospitality by enabling property owners to rent directly to travelers, democratizing tourism. However, its rapid growth has sparked debates about its economic, social, and urban impacts (Zervas et al., 2017). Airbnb's effects are multifaceted, influencing local economies, housing markets, and communities. While praised for promoting tourism and providing income to hosts (Anwar, 2023), it has also been criticized for inflating property prices and altering neighborhood dynamics (Barker, 2021). These contrasting impacts highlight the need for a deeper understanding of its geospatial and economic dynamics.

Despite growing research, gaps remain in comprehensive geospatial analyses that account for diverse factors influencing Airbnb's effects. Existing studies often focus narrowly on economic outcomes or user satisfaction, overlooking spatial patterns critical to understanding urban impacts. This study addresses these gaps by analyzing Airbnb data in nine global cities: Dubai, Los Angeles, London, Miami, New York City, San Francisco, Sydney, Tokyo, and Toronto. Using a mixed-method approach, this research combines geospatial tools, such as spatial regression and heat maps, with statistical analysis to explore listing patterns, user satisfaction, and pricing implications. The findings aim to inform policymakers, urban planners, and industry stakeholders about Airbnb's urban footprint and consumer behavior, offering strategies to enhance user experience while mitigating negative effects.

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The study is structured as follows: A comprehensive review of existing studies on Airbnb is presented in the Literature Review, highlighting key findings to identify gaps in the literature. The Methodology section will describe in detail the data source, the analysis method used, and the research design. The Results section presents and interprets the findings, integrating quantitative and qualitative insights. Lastly, the section of Conclusion and Limitations sums up the key findings, discusses their implications, and outlines the limitations and directions for future research.

2. LITERATURE REVIEW

The following literature review examines existing research on airbnb's operations and impacts, focusing on user experience, geospatial distribution, economic and social effects, and regulatory implications. This review highlights key findings, identifies knowledge gaps, and sets the foundation for further geospatial and economic analysis.

2.1. User Experience and Preferences

User experience (UX) is central to Airbnb's success, shaping customer satisfaction and retention. Cheng and Jin (2019) identify key UX components, including location, amenities, and host interaction, with personalized service often surpassing price considerations. Similarly, Zhang and Chen (2019) highlight how proximity to attractions and housing characteristics influence guest preferences in cities like New York, Los Angeles, and Chicago. Behavioral studies, such as Lee and Chang's (2019) analysis of Airbnb in Los Angeles, show how listing features affect tourist patterns, offering insights for tourism management. Aversa and Rice (2023) explore how data informs urban economic development, while Hong and Yoo (2020) emphasize the spatial variation in pricing determinants, reinforcing the need for geographically nuanced strategies.

2.2. Geospatial distribution and patterns

Airbnb listings often cluster near central urban locations and attractions, impacting housing availability and urban planning. Gutiérrez et al. (2017) and Zhang and Fu (2022) reveal clustering patterns in cities like Los Angeles and Barcelona, influenced by population density, income levels, and proximity to attractions. Similarly, Ki and Lee (2019) find that listings in Seoul are concentrated near universities and transport hubs, contributing to housing shortages. Temporal and spatial analyses, such as those by Sarkar et al. (2023) in San Francisco and Moreno-Izquierdo et al. (2023) in Madrid, underscore the role of demographic and socioeconomic factors in shaping Airbnb's spatial footprint. These findings highlight the need for localized urban management strategies to balance tourism benefits and housing challenges.

2.3. Economic and Social Impacts

The economic and social effects of Airbnb are widely documented. Deboosere et al. (2019) show that neighborhood characteristics, such as access to employment, influence revenues and drive gentrification. Rabiei-Dastjerdi and McArdle (2020) apply ai to analyze Airbnb's impact on Dublin's housing market, identifying shifts in housing dynamics and neighborhood transformations. Moreno-Izquierdo et al. (2023) examine pandemic-related impacts on Airbnb in Madrid, noting variations in occupancy rates across neighborhoods, emphasizing the need for area-specific policies. Sarkar et al. (2023) link host participation to demographic factors, revealing socioeconomic inequalities that influence str activity and urban development.

2.4. Regulation and Policy Implications

Localized regulation is critical for managing Airbnb's varied impacts. Thackway et al. (2022) highlight the spatial variability of Airbnb's influence on housing prices in Sydney, advocating for area-specific policies. Jiao and Bai (2020) and Lagonigro et al. (2020) stress the importance of integrating socioeconomic and spatial data into regulatory frameworks to balance the interests of residents, hosts, and tourists.

3. DATA AND METHODOLOGY

The study in this section highlights the methodologies used for the analysis of Airbnb listings across multiple cities to uncover the impact of various amenities and other factors on user satisfaction metrics, such as overall ratings and communication ratings. It includes the spatial distribution, correlation, and regression analysis among the different variables, visualized by heatmaps and correlation matrices.

3.1. Data Preprocessing and Dataset Characteristics

Secondary data for this analysis was sourced from the Kaggle dataset Airbnb Data: Listings Scraped Global Top 10 Cities (2024), which includes information from nine major cities across different continents: Dubai, Los Angeles, London, Miami, New York City, San Francisco, Sydney, Tokyo, and Toronto. The datasets were merged and cleaned to ensure consistency and facilitate analysis.

Python was used for data processing, employing the `pandas` library for tasks such as merging datasets with the `concat()` function and adding a "City" variable to distinguish entries. Redundant columns (e.g., 'picture_url', 'License') and rows with missing or invalid data (e.g., non-positive bedroom values) were removed. The 'Bedrooms' column was converted to numeric format to enable numerical analysis. Functions like `drop_duplicates()`, `str.strip()`, and `fillna()` were applied to refine the dataset for accurate analysis. After the data preprocessing, these are the following variables in the dataset, some of which were used or others considered to be used for the data analysis:

- **Listing Information:** Listing Title, Property Type, Listing Type, Created Date, Last Scraped Date, Country, City, Latitude, Longitude, Exact Location, Listing URL, Airbnb Property ID, Airbnb Host ID, Host Listing Count
- **Financial Information:** Currency Native, Cleaning Fee (USD), Cleaning Fee (Native), Extra People Fee (USD), Extra People Fee (Native), Average Daily Rate (USD), Average Daily Rate (Native), Annual Revenue LTM (USD), Annual Revenue LTM (Native)
- **Booking and Review Metrics:** Number of Reviews, Overall Rating, Airbnb Communication Rating, Airbnb Accuracy Rating, Airbnb Cleanliness Rating, Airbnb Checkin Rating, Airbnb Location Rating, Airbnb Value Rating, Number of Bookings LTM, Number of Bookings LTM - Number of observed months, Count Available Days LTM, Count Blocked Days LTM, Count Reservation Days LTM, Occupancy Rate LTM
- **Property Details:** Bedrooms, Bathrooms, Max Guests, Amenities, instant_bookable, Pets Allowed
- **Booking Policies:** Airbnb Superhost, Cancellation Policy, Check-in Time, Checkout Time, Minimum Stay

3.2. Regression Analysis

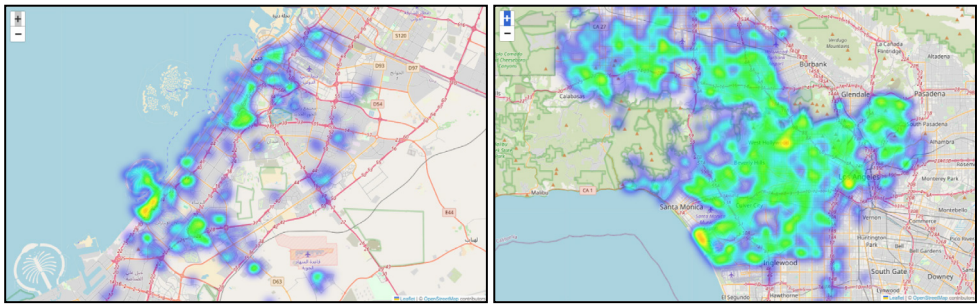
A multiple regression analysis using an Ordinary Least Squares (OLS) model was performed to assess the impact of variables such as the number of bedrooms, bathrooms, maximum guests, and minimum stay on the average daily rate (ADR) in USD. The model identified significant factors influencing ADR. The dataset was also analyzed by amenities to examine their effect on user satisfaction. Listings were grouped based on the presence or absence of specific amenities, and user satisfaction metrics (overall and communication ratings) were calculated to determine how amenities influenced ratings. A correlation matrix was created to identify relationships between variables like ADR, latitude, longitude, and listing features. Visualized through a heatmap, this analysis revealed key correlations that could impact listing performance and user satisfaction. Heatmaps were used to visualize the spatial distribution of listings across the cities, highlighting density and identifying hotspots where listings are concentrated, using the 'Folium' library. Finally, boxplots compared the overall ratings and occupancy rates between Superhost and non-Superhost listings. This analysis revealed the influence of Superhost status on user ratings and booking patterns.

4. RESULTS AND DISCUSSION

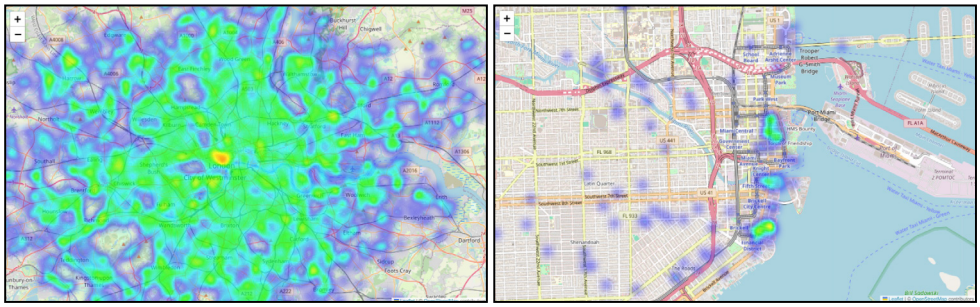
This study investigates various factors influencing Airbnb listings across nine cities, focusing on the relationship between property characteristics and average daily rate (ADR), the impact of amenities on user satisfaction, and the distribution of listings relative to tourist hotspots. The analysis also explores the role of *Superhost* status in influencing ratings and occupancy rates.

The ordinary least squares (OLS) regression analysis was conducted to explore the relationship between ADR in USD and four key property variables: number of bedrooms, bathrooms, maximum guests, and minimum stay. The regression model demonstrated a moderate explanatory power, with an r-squared value of 0.314, suggesting that these variables account for 31.4% of the variance in ADR. While the model indicates statistical significance, as evidenced by the f-statistic of 6189 and a p-value of 0.00, other unmeasured factors likely contribute to the variance in ADR. The regression analysis revealed that each additional bedroom is associated with an increase in the Average Daily Rate (ADR) by $54.69. Similarly, the presence of an additional bathroom increases ADR by $65.48, while each additional guest corresponds to a $23.38 increase in ADR. In contrast, an increase of one night in the minimum stay requirement results in a slight reduction in ADR by $0.33. All predictor variables were found to be statistically significant, with a p-value of less than 0.05. Specifically, the number of bedrooms, bathrooms, and the maximum number of guests were positively correlated with higher ADR, while the minimum stay had a minimal negative impact on the rate. These results suggest that properties with more bedrooms, bathrooms, and greater capacity for guests are generally priced higher. However, the effect of the minimum stay length on ADR is relatively minor when compared to the influence of the physical attributes of the property.

The correlation analysis revealed moderate positive correlations between ADR and the number of bedrooms (0.52), bathrooms (0.46), and maximum guests (0.50), supporting the conclusion that larger properties are generally priced higher. A very weak negative correlation (-0.05) between minimum stay and ADR indicates a minor decrease in ADR as the minimum stay length increases. Additionally, there were strong positive correlations between the number of bedrooms and bathrooms, as well as between bedrooms and maximum guests (0.82), suggesting that properties with more rooms and higher guest capacity tend to be priced higher. Minimum stay showed weak negative correlations with other variables, suggesting that its effect on ADR is less pronounced than the physical characteristics of the property.



(a) Dubai (b) Los Angeles



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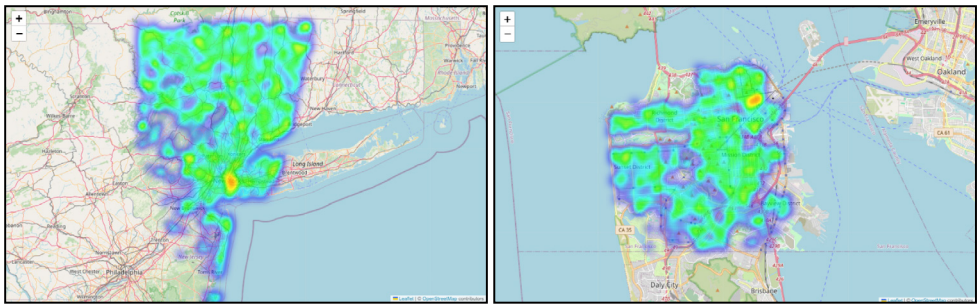

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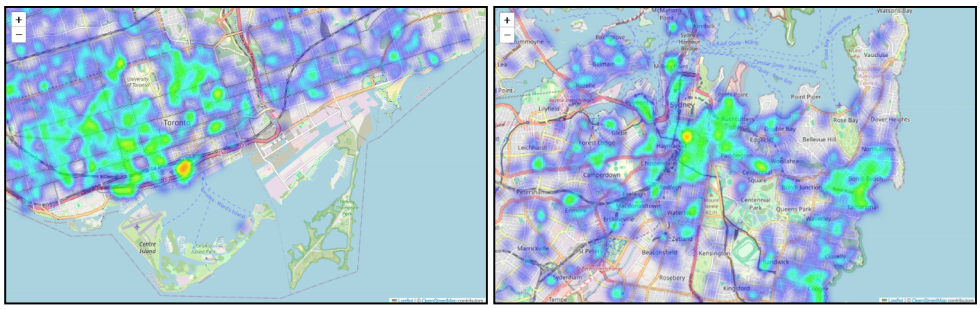

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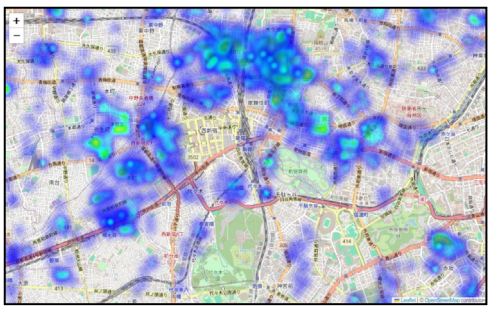

(i) Tokyo

Figure 1. Airbnb listings heatmap across the world

Source: Own processing

4.1. Impact of Amenities on User Satisfaction

The analysis of the impact of amenities on user satisfaction revealed notable trends across various cities. In Dubai, listings without air conditioning received higher ratings for both overall satisfaction (4.67) and communication (9.50), suggesting that air conditioning may not be a critical factor in this city. Other amenities such as iron, essentials, and wi-fi were found to positively influence ratings, while the lack of a tv slightly improved them. In London, heating and essentials were strongly linked to higher ratings (both with an overall rating of 4.74), confirming their importance for guest satisfaction. Similarly, in Miami, listings with essentials, wi-fi, air conditioning, and hangers received higher ratings, highlighting the significance of these amenities. In New York city, properties with heating, essentials, smoke alarms, and hangers were rated higher than those without, indicating that these features are highly valued by guests. The presence of air conditioning showed a smaller, though positive, effect on ratings. Sydney and San Francisco exhibited similar trends, where amenities like essentials, smoke alarms, and hangers were associated with higher user satisfaction. In Tokyo, basic cooking amenities, air conditioning, and essentials such as hangers had a significant positive impact on ratings, with dishes and silverware showing the most pronounced effect. In Toronto, heating, smoke alarms, essentials, and safety features such as carbon monoxide alarms contributed to higher ratings for both overall satisfaction and communication. The presence of hangers also improved satisfaction, albeit to a lesser extent. In los angeles, similar patterns emerged, with safety features and essential amenities leading to higher satisfaction ratings. However, the impact of hangers was more nuanced, showing a higher communication rating but slightly reducing the overall rating.

4.2. Geospatial Distribution of Airbnb listings

Geospatial analysis of Airbnb listings revealed notable concentration patterns in proximity to popular tourist destinations across the nine cities. In Dubai, listings clustered around areas like Jumeirah and the palm, home to iconic landmarks such as the Burj al Arab. Los Angeles exhibited three major hotspots in Santa Monica, west Hollywood, and Beverly hills, all of which are renowned for their tourist appeal. Similarly, in London, clusters appeared around landmarks like Buckingham palace, Big Ben, and Camden town. Other cities like New York, Miami, and San Francisco also showed a clear pattern of listings concentrated in and around central, well-known tourist areas, emphasizing the strong influence of location on Airbnb listing distribution.

4.3. Impact of Superhost Status on Ratings and Occupancy Rates

The analysis of superhost status revealed its significant impact on both user ratings and occupancy rates. Superhosts consistently received higher ratings, with a median rating close to 5.0, compared to non-superhosts, whose median rating was slightly below 4.5. This suggests that superhosts are more successful in maintaining high and consistent guest satisfaction levels. Additionally, superhosts tended to have higher occupancy rates, with a median rate of around 70%, compared to non-superhosts, who had a median occupancy rate of about 60%. The narrower interquartile range (iqr) for superhosts indicates less variability in booking rates, suggesting that superhosts are more reliable in maintaining high occupancy.

The results indicate that property characteristics, particularly the number of bedrooms, bathrooms, and maximum guests, significantly influence ADR, with larger properties commanding higher rates. Amenities such as heating, smoke alarms, essentials, and safety features are strongly linked to higher user satisfaction, though the specific preferences may vary by city. Geospatial analysis

confirms that Airbnb listings are primarily located near tourist hotspots, and superhost status is associated with higher ratings and more consistent occupancy. These findings provide valuable insights for Airbnb hosts, especially in terms of optimizing their listings by offering desirable amenities and maintaining a strong superhost profile.

5. CONCLUSION

This study provides a comprehensive geospatial analysis of Airbnb data, examining how listing characteristics, amenities, and host status influence user satisfaction and occupancy rates. The statistical findings demonstrate that amenities, particularly Wi-Fi, kitchens, and air conditioning, significantly affect the Average Daily Rate (ADR), supporting the notion that travelers are willing to pay a premium for enhanced comfort. The regression analysis highlights that the provision of quality amenities is crucial for improving guest satisfaction, in line with theories of service quality and consumer choice (Zhang & Fu, 2022; Gutiérrez et al., 2017). Additionally, the spatial analysis confirms that Airbnb listings are clustered around tourist attractions and city centers, underscoring the importance of location for both hosts and guests, consistent with urban economic theories and agglomeration economies (Zhang & Fu, 2022). The Superhost analysis indicates that Superhosts consistently achieve higher ratings and occupancy rates, reflecting the value of reputation and trust in the digital marketplace (Sarkar et al., 2019).

However, this study has several limitations. First, reliance on public Airbnb data means that not all relevant variables may be captured, and data accuracy may be affected by outdated or incomplete information. Second, the focus on urban areas limits the generalizability of the findings to rural or less dense regions. The cross-sectional nature of the data also means that temporal factors, such as seasonal fluctuations or economic changes, were not accounted for. Additionally, while correlations were observed, the study cannot establish causality between the identified factors and outcomes. Local regulations, which significantly impact Airbnb listings, were not considered, nor was the diversity of Airbnb users in terms of demographics or travel purposes. Future research should address these gaps, explore rural areas, and incorporate longitudinal data to capture dynamic market changes.

In conclusion, the study contributes valuable insights into the factors shaping Airbnb user satisfaction and economic outcomes, but further research is needed to address the limitations and expand the understanding of the short-term rental market.

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Journey in the Heart of the Vineyards in the Sunniest Land of Romania, Dealu Mare

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Abstract: *The Dealul Mare wine-growing area is one of the most valuable wine-growing areas in Romania. On a surface area of approximately 15,000 hectares, there are numerous wineries and vineyards. This is due to the geographical location offering favorable conditions for the development of vines (positioning at 45 degrees northern latitude). The conditions are similar to the regions of Bordeaux (France) or Tuscany (Italy), famous for their wines. The area enjoys many sunny days compared to the rest of the country. This adds to the taste and aromas of the grapes.*

The Dealu Mare vineyard is known for its red wines. The best known is Feteasca Neagra, also called the "ambassador of Romanian wines". Cabernet Sauvignon or Pinot Noir, as well as white wines: Feteasca Alba, Muscat Ottonel, or Chardonnay, take pride of place.

1. INTRODUCTION AND HISTORICAL CONTEXT OF VITICULTURE IN ROMANIA

Wine is a historical beverage. The history of vine cultivation and wine consumption in Romania dates back to before the cultivation of wheat, according to archaeological evidence. The Geto-Dacians, the inhabitants of ancient Dacia, valued this drink - wine in particular, and the grapevine was considered the most important of their wealth. Dacians drink wine poured into ox horns, jugs, or even gourds.

History A.D. Xenopol, taking the information from Homer, in his work - History of the Romans from Dacia Traiana - that "men and women drink wine after the Scythian fashion, unmixed with water, using, instead of glasses or cups, large stag horns or of oxen, which passed from hand to hand". The historian Diodorus of Sicily (1st century BC) tells about the feast given by Dromicheites, the leader of a powerful union of Geto-Dacian tribes, in honor of his prisoner, the Macedonian general Lysimachus, defeated in 292 BC, at which the guests were served wine in gold and silver goblets, while the hosts drank from wooden vessels and cattle horns, to demonstrate the simplicity and sobriety of the locals.

The first written mention of vineyard cultivation in Dacia comes from the Greek geographer Strabo (66 BC), considered the father of geography. It referred to the measure adopted by King Burebista (82-44 BC), concerning the deforestation of vineyards. The decision taken by Burebista, by following the advice of the high priest Deceneu, aimed not so much at making the population stop consuming wine in excess, but above all at making the temptation that the vineyards of Dacia had on the foreign populations from the east that came, attracted by vineyards. The Dacians knew the technology of freezing wine, thus being able to consume wine throughout the year. It is undeniable that the culture of wine consumption in various ceremonies and rituals was inherited from the Dacians.

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The notion of bread and wine represents "total food", in a variant of the medieval legend about - Baba Dochia -, who asks God for food, by which bread and wine are implied - defining elements of human food since ancient times.

After the conquest of Dacia by the Romans, under their influence, grapevine cultivation developed through the advanced viticultural techniques brought by them. The Romanians come with new varieties of vineyards, and techniques for care its and growth. On the territory of Dacia, Romans found coins on which images of bunches of grapes were inscribed, a sign of the respect offered to this occupation. There follows a period in which viticulture knows a very complex development. Viticulture remained thriving even after the Aurelian retreat of AD 207 and even during Ottoman rule.

The botanist A. Griesbach, studying botanical and climatic elements, claims that "the homeland of the vine must be sought in the wooded lands, rich in vines of Pontus and Thrace, up to beyond the Danube". Starting from the 2nd millennium BC (the Bronze Age was discovered from archaeological evidence), the cultivation of vines and the production of wines became the basic occupations of the ancestors of the Dacians, from the current Romanian space.

After 1972, the communist regime decided to cut down large areas of vineyards cultivated with varieties of foreign origin, the cultivated area was 300,000 ha. Starting with the year 1990, the cultivated area began to decrease drastically, so that in 2004 it was 193,000 hectares.

Romanian viticulture is currently going through great transformations. The production of wines is a business that leads winegrowers to ensure the technical means necessary to produce wine at the highest possible quality level. Viticulture and winemaking are adapting to new conditions, new cultivation and plantation maintenance technologies so that each producer can obtain the best and most appreciated wines.

According to the National Institute of Statistics, in 2019 Romania had around 180,000 ha of fruit vineyards, occupying the 5th place in Europe (after Spain, France, Italy, and Portugal). Approximately 5 million hectoliters are produced annually.

Table 1 presents the statistical data provided by the National Institute of Statistics for the period between 2012–2023 for the amount of wine obtained in Romania without taking into account the geographical area where the grapes were harvested for wine production.

Table 1. Amount of wine obtained in Prahova and Buzau counties (in hectolitres per year)

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
5462954	5113232	3749862	3627609	3266669	4264144	5088202	3808430	3959703	4451149	3787502

Source: National Institute of Statistics (n.d.)

From the analysis it can be seen that the largest amount of wine obtained during the studied period was 5462954 Hl in 2012, also the smallest amount of wine was obtained in the year 2016, 3266669 Hl. The amount of wine obtained in 2012 is since this year was one of the warmest years, a fact that positively influenced the amount of grapes for wine obtained. The year 2016 was a year considered very warm and without precipitation in the spring months, according to the National Institute of Meteorology, which led to the modification of the quantities of grapes for wine and implicitly to obtaining a low quantity of wine. There is also a tendency to decrease the amount of wine in 2022 as well.

2. THE WINE ROAD: A JOURNEY THROUGH THE VINEYARDS OF PRAHOVA AND BUZAU COUNTIES

The Wine Road is a spectacular tourist route that includes wineries and vineyards in Buzau and Prahova counties. The area has been known for over 400 years for the exceptional quality of the wines produced here. The secret of this area is its ideal geographical positioning, which allows it to enjoy the direct rays of the sun for 14 days longer than any other wine-growing area in Romania. Constant investments in viticulture and wine tourism attract 300,000 tourists, Romanians and foreigners, annually (Anisi et al., 2015; Hedley, 2015).

Prahova County has a temperate-continental climate, with big differences between the mountain and plain units. The maximum thermal amplitude is 77.4°C, resulting from the accumulation of extreme thermal values. The climate is characterized by hot (sometimes dry) summers and cold winters. The area of the sub-carpathian hills and depressions has intermediate climatic characteristics compared to the two neighboring areas.

Figure 1. The Wine Road in Prahova country

Source: Own research

The wine route - Wine Road is a project initiated in 2004 covering the counties of Prahova and Buzau. The route covers 15,000 ha planted with vines, with a length of 65 kilometres. The route goes through the localities of Filipeştii de Pădure, Băicoi, Boldeşti, Bucov, Pleaşa, Valea Călugăreasc㠹 Iordăcheanu, Urlaţi, Ceptura, Fântânele, Tohani and Gura Vadului. Wineries from Urlaţi, Valea Călugărească and Tohani were recently included in this circuit. The Dealul Mare wine area is famous for the native variety of Fetească Neagră and other red varieties, the modern approaches of the winemakers on this route offer an incredible variety of tastes and aromas (Oşlobeanu et al., 1991; Virgin Wines, n.d.).

One of the oldest and most reputable wineries is the Tohani Winery. The Tohani winery was established in the 1930s on the royal estates. The Tohani commercial company was founded on January 1, 1959, on an area of 856 hectares. Currently, the company manages approximately 1300 hectares of vines cultivated by 15 grape varieties. From Fetească Neagră and Sangiovesse, to Tămăioasa Românească and Fetească Regală, the Winery offers a variety of wines for every enthusiast. The only wine cellar in the area is conserved within the winery, keeping over 100,000 bottles of collection wines.

The Budureasca vineyards represent another famous area of the Dealu Mare wine region. The area occupied by Domeniile Budureasca is approximately 275 hectares. Of this surface, 250 hectares were replanted with new vines, and 25 hectares were preserved with old vines. In 2013, the new winery was inaugurated, with an area of over 2,500 square meters. The winery preserves the architecture of the area. The building has three buried sides, keeping a constant temperature for the wines throughout the year. In addition to tastings, tourists can take a tour of the vineyard, a tour of the winery, with access to the tank room and the barrel room.

The next winery on the Wine Road is Domeniile Urlati. The winery is located at the same latitude as the famous wine-growing areas of Tuscany and Bordeaux. The quality of the wines is superior in this region, the famous varieties are Fetească Albă, Sauvignon Blanc, Fetească Neagra and Cabernet Sauvignon. The area of 110 hectares of the company's heritage, divided between Urlați and Ceptura, has the advantage of total exposure to the south. Exposure to the south ensures maximum insolation throughout the growing season. In 2007, the company Domeniile Dealu Mare Urlați restored the brilliance of the area and promoted the famous Pelin de Urlaţi for wine enthusiasts.

In Urlati we discover the Bazilescu Winery. With a tradition of over a century in wine production, the winery has built its impeccable reputation since the beginning. The winery and mansion reopened in 2008, and through the remarkable wines obtained, they have established themselves on the Wine Road map (and on the oenological map in general). Basilescu Winery currently owns 60 hectares of vineyards. It has mixed plantations of Fetească Neagra, Cabernet Sauvignon, Merlot, Burgund Mare, Pinot Noir, Sauvignon Blanc, Chardonnay and Fetească. The oldest wines in the cellar are from 2013. Here are the top wines Golem, Angels from Little Paris, Eclipse and Autentique.

The first wine centre in Romania that offered tourists the opportunity to visit a functional winery is Conacul Urlățeanu. It was built on top of a hill in 1922, in the town of Urlaţi. It was taken over at the end of the 90s by Halewood Wineries. The restoration of the mansion and the cellar ended in 1999. The purpose of the restoration was to provide a location for events that tell about the wealth and history of the place. In the cellars there is the room for maturing the wines in oak barrels, being the place where wine tastings take place. Sommeliers tell about how their grapes end up being one of the most appreciated Romanian wines.

Rotenberg wineries are recognized for their exceptional wines and care for the environment. The wines are obtained by the traditional method, manually, without mechanized equipment. The winery was completely restored in 2007, having two overlapping cellars. This allows a gravity flow technology, where the wine does not go through pumps. From the area of 18 hectares cultivated with vines, predominantly Merlot between the communes of Ceptura and Fântânele, exceptional artisanal wines are produced annually, 100% handmade.

In the commune of Ceptura is the SERVE Winery, founded in 1990 by Count Guy de Poix. The first Romanian dry red wine and the first Romanian Cuvée were vinified in this winery. Arriving tourists have the opportunity to visit the vineyard and the winery and can participate in tasting sessions of the noble wines produced here. The specialists of this winery on the Wine Road will take you through most of the top ranges, Vinul Cavalerului, Terra Romana and Cuvée. The oldest wine that can be found in the winery was produced in 1999.

The wine-growing route is part of the CII wine-growing area, according to Order 645/2005 on the approval of the Romanian wine-growing regions that are part of the wine-growing areas of

the European Union. The wines produced in this area have specific characteristics only for this area The grapes come from the geographical area 100%. The implementation of oenological practices and treatments according to the legislation in force. The wine produced in this area has a real alcohol content of at least 11% vol, depending on the quality of the grapes in the ripening phenophase given by the sugar content (Oşlobeanu et al., 1991; Wadsworth, 1999).

Tables 2 and 3 show the productions obtained in Buzau and Prahova counties, according to the statistical data provided online by the National Institute of Statistics. The analyzed period is between 2016 – 2023.

Table 2. Areas occupied by vineyards in Prahova and Buzau counties

Vineyards	Ownership forms	Counties	Years							
			2016	2017	2018	2019	2020	2021	2022	2023
			Hectares							
			Ha	Ha	Ha	Ha	Ha	Ha	Ha	Ha
Total vineyards	Total	Buzau	14466	14223	13880	13781	13101	14012	13841	14545
-	-	Prahova	7324	7405	7254	7218	7169	6834	6813	6873
-	Private sector	Buzau	14303	14065	13722	13623	12954	13785	13614	14306
-	-	Prahova	7324	7293	7121	7179	7130	6725	6768	6833
-	of which: Individual farms	Buzau	13233	12646	12600	12600	11601	12734	12719	12709
-	-	Prahova	5551	5556	5391	5392	5391	4871	4913	4906
Grafted vineyards on the fruit	Total	Buzau	9172	8829	8570	8488	7578	8575	8515	9142
-	-	Prahova	6261	6342	6269	6226	6176	5855	5841	5898
-	Private sector	Buzau	9014	8671	8412	8330	7431	8348	8288	8904
-	-	Prahova	6261	6230	6136	6187	6137	5746	5796	5858
-	of which: Individual farms	Buzau	7983	7395	7318	7319	6319	7455	7445	7444
-	-	Prahova	4488	4493	4406	4407	4406	3892	3941	3935
Hybrid winwyards per fruit	Total	Buzau	5294	5394	5311	5292	5523	5437	5326	5403
-	-	Prahova	1063	1063	985	992	993	979	972	975
-	Private sector	Buzau	5289	5394	5311	5292	5523	5437	5326	5403
-	-	Prahova	1063	1063	985	992	993	979	972	975
-	of which: Individual farms	Buzau	5250	5251	5282	5281	5282	5279	5274	5265

Source: National Institute of Statistics (n.d.)

From Table 2, for the county of Buzau, the year 2022 has the smallest area cultivated with vines, 13101 ha. The private sector owned an important area of 12954 ha, individual farms owned 11601 ha, Prahova County had the smallest area cultivated with vines in 2022, 6813 ha, and the private sector occupies 4913 ha.

Fruit vine plantations, in Buzau county in 2016 had 9172 ha, the largest area. In 2017, Prahova has 6269 ha. In the case of individual farms, Buzau County in 2016 with an area of 7983 ha, and

Prahova in 2017 - 4493 ha. Hybrid vineyards per fruit, the largest area is in Buzau in 2022 - 5403 ha, in Prahova in 2018 - 985 ha.

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Table 3 shows the production of grapes from the two counties of Prahova and Buzau, for consumption and for obtaining wine. The quantities obtained from the private sector are analysed in which Buzau county, due to the favourable climatic conditions, obtained 2018 a record quantity of 93125 tons. The private sector obtained the largest amount in 2021, 96356 tons. From individual farms, the largest amount was in 2013, 77574 tons. Prahova County obtained a quantity of 45,717 tons in 2018, of which 45,555 tons are from the private sector. Individual farms obtained the highest production in 2013, 34,563 tons, and in 2016, the lowest production, 17,286 tons.

Table 3. Production of grapes from the two counties of Prahova and Buzau

Vineyards categories	Ownership forms	Counties	Years										
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
			Tons										
Wine grapes	Total	Buzau	83047	65829	70694	64462	81613	93125	81815	81410	98626	76069	75551
-	-	Prahova	43661	30771	34716	27838	44488	45717	33369	40335	44708	32861	33508
-	Private sector	Buzau	81511	64434	69249	63486	80507	91861	80551	80386	96356	73595	73658
-	-	Prahova	43090	30593	34385	27838	44411	45555	33346	40260	44574	32788	33386
-	of which: Individual farms	Buzau	77574	57633	63291	58347	69395	83447	75465	71834	89847	68410	63440
-	-	Prahova	34563	23088	21757	17289	30244	30864	26959	26860	27897	21688	17510

Source: National Institute of Statistics (n.d.)

3. CONCLUSION

In the world, wine tourism is a priority in travelers' vacation options. France, Italy, Spain, and the USA, countries with wine traditions excel in this tourism. In Romania, there is an increase in interest in this type of tourism. However, growth opportunities depend on accommodation, dining, and leisure options at wineries and in the surrounding area.

The wines produced in these wineries frequently win world medals and are the result of investments of millions of euros by specialists who want to regain the image of Romanian wine in the world through quality. The bet of the investors in the vineyard was won, by returning to the pure varieties and consecrated assortments of wines from the Dealu Mare – Big Hill area.

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Exploring the Growth and Challenges of Agritourism in Sibiu County, Romania

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Abstract: *Agritourism has become a significant component of Romania's tourism sector, contributing to rural development, cultural preservation, and economic diversification. This research paper focuses on developing agritourism in Sibiu County, a region with rich cultural heritage and picturesque landscapes. The paper analyzes agritourism's current state and potential growth in Sibiu County, identifying key factors that influence its success. Statistical data from the Romanian National Institute of Statistics were analyzed to identify trends and patterns in agritourism in Sibiu County, providing insights into the challenges and opportunities within the agritourism sector. The results highlight the significant role of agritourism in promoting sustainable rural development in Sibiu County and underline that targeted policies and investments are essential to support the growth of agritourism, ensuring its long-term viability and positive impact on the community.*

1. INTRODUCTION

Agritourism, a dynamic blend of agriculture and tourism, has become an integral part of Romania's tourism landscape, playing a pivotal role in enhancing rural development, preserving cultural heritage, and diversifying the economy. In recent years, the sector has gained significant traction, especially in regions rich in cultural and natural resources. Sibiu County is one such area, famous for its stunning scenery and rich cultural history. This region serves as an ideal case study for understanding the growth and challenges of agritourism in Romania.

Sibiu County, with its rolling hills, traditional villages, and historical landmarks, represents one of the regions of great tourist attraction in Romania with plenty of natural and anthropogenic factors for the development of agritourism. The county's rural charm, coupled with its agricultural practices, presents numerous opportunities for agritourism activities, from farm stays and local food experiences to cultural events and outdoor adventures. However, the path to realizing these opportunities is fraught with challenges that need to be addressed to ensure sustainable growth.

This research paper intends to explore the particularities of agritourism in Sibiu County, examining both its growth potential and the obstacles that impede its development. By considering statistical data collected by the Romanian National Institute of Statistics, this study seeks to identify trends and patterns in agritourism within the county, offering insights into the sector's dynamics. The analysis will highlight key factors influencing the success of agritourism ventures, such as market demand, infrastructure, policy frameworks, and stakeholder engagement.

Ultimately, this paper underscores the importance of targeted policies and investments in bolstering the agritourism sector. It advocates for a strategic approach to developing agritourism that leverages the county's unique attributes while addressing the inherent challenges. By doing so, agritourism can become a catalyst for sustainable rural development in Sibiu County, contributing to its economic resilience and cultural vitality.

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2. LITERATURE REVIEW

Agritourism has emerged as a significant component of Romania's tourism sector, contributing to rural development, cultural preservation, and economic diversification. This literature review explores the growth and challenges of agritourism in Sibiu County, Romania, by examining various research studies and their findings.

In the paper "An Extensive Study on the Sustainable Exploitation of Sibiu County's Agritourism Potential", Balcu et al. (2023). investigate "the sustainable exploitation of agritourism potential in Sibiu County, focusing on rural development, economic sustainability, environmental impact, and cultural heritage preservation". The research highlights "the mechanisms through which agritourism generates employment opportunities, stimulates local production, and fosters a sense of pride and identity among residents" (Balcu et al., 2023).

Mihăilean et al. (2023) analyze the agritourism potential of Sibiu County, considering indicators regarding "the number of accommodation units, accommodation capacity, tourist arrivals, and overnight stays". This research identifies key resources that constitute the agritourism potential of the region and "emphasizes the importance of involving local communities" (Mihăilean et al., 2023) in the tourism sector.

A paper worthy of consideration is that of Adamov and Iancu (2023) which focuses on the role of tour operators in the logistics of agritourism, examining how they impact an increased evolution of rural tourism. The conclusions suggest that tour operators have an essential role in differentiating the social structure of rural areas, promoting local crafts, and supporting economic diversification.

The book of Bran et al. (1997) provides an overview of rural tourism in Europe, with a focus on the European model and its applicability to Romanian rural areas. The authors discuss the potential of rural tourism to solve urban-rural imbalances and promote cultural values, offering insights into the development of agritourism in Romania.

Glăvan (1995) in "Agroturismul-Factor Determinant în Dezvoltarea Economico-Socială a Satului Românesc" examines the role of agritourism as one of the primary agents in both economic and social development of Romanian villages. In this study, the author highlights the increasing importance of agritourism on rural communities by showing its positive effects, including increased income, employment opportunities, and cultural preservation.

Cărătuș Stanciu (2017) discusses the development of agritourism in Sibiu County highlighting its role in sustainable development. It is based on a sociological survey conducted in 70 rural pensions across 15 localities between 2015 and 2016, utilizing data from the Romanian Tourism Ministry and the Sibiu Association of Tourism and concludes that rural tourism and agrotourism are vital for promoting Romania internationally, enhancing the quality of life, and contributing to economic growth through sustainable practices (Cărătuș Stanciu, 2017).

Another research paper published in the Cactus Tourism Journal (Ana, 2017) explores the growing significance of ecotourism, agri-tourism, and rural tourism within the European Union, particularly focusing on the New Member States. It highlights the evolution of these tourism forms as responses to changing lifestyles, tourist behaviors, and increasing environmental concerns, which have led to a demand for sustainable tourism practices.

The study by Stanciu et al. (2023) provides a comprehensive analysis of the state of research in rural tourism, agritourism, and ecotourism in Romania. The authors conducted a bibliometric analysis using

VOS Viewer software to evaluate the literature from 1990 to January 2023, highlighting the importance of sustainability, job creation, and digital transformation.

An in-depth analysis of the tourism sector in Romania's Central Region could be found in the research of Iancu and Hurmuzache Tabita (2014), which considers the counties of Alba, Brașov, Covasna, Harghita, Mureș, and Sibiu. The authors highlight the significance of tourism as a dynamic economic force that has evolved from a primarily social activity to a crucial economic contributor.

The paper titled "ETIS in Sibiu County" by Iștoc et al. (2022) analyzes the implementation of the European Tourism Indicators System (ETIS) in Sibiu County, Romania. The ETIS is part of the EU's Sustainable Development Strategy aimed at promoting sustainable tourism through economic growth, social equity, and environmental protection.

3. PARTICULARITIES OF AGRITOURISM IN SIBIU COUNTY, ROMANIA

As an emerging trend in tourism, agritourism merges agriculture with travel, allowing visitors to immerse themselves in rural life, engage in farming activities, and savor local products. The present research is focused on Sibiu County in Romania, as the current state of this type of tourism in this region has seen a steady increase, with a notable rise in the number of agritourism guesthouses and farms offering various experiences.

With reference to the evolution of accommodation structures in Sibiu County, there has been a notable increase in the number of accommodation structures over the years. From 2005 to 2018, there was an increase of 165.76% in the number of accommodation units. Specifically, for agritourism guesthouses, the increase was 168.29%. However, in recent years, there has been a slight reduction in the number of agritourism guesthouses. The existing accommodation capacity in Sibiu County includes a variety of types, such as hotels, guesthouses, and agritourism units. The county offers a mix of cultural, health, and wellness tourism options, although these forms are currently underexploited. The accommodation capacity in operation in Sibiu County is characterized by a mix of traditional and modern facilities. The county has seen investments in modernizing existing units and developing new ones to cater to the growing tourism demand.

About the evolution of the number of overnight stays in Sibiu County, the number of overnight stays in Sibiu County has been increasing over the years, reflecting the growing popularity of the region as a tourist destination. This trend is supported by the county's rich natural and cultural heritage, which attracts both domestic and international tourists.

According to the data from the Tourism Activity series of documents corresponding to the years 2020 and 2023, in Sibiu County, the number of accommodation places offered to tourists by type of tourist reception structures are represented in Table 1.

The number of seats in inns has remained constant, indicating a stable demand and no significant changes in this type of accommodation. A modest increase in tourist villa seats reflects a slight growth in demand for more private and luxurious accommodation options. The significant rise in tourist cabins indicates an increasing enthusiasm for nature-focused and rural tourism experiences. The decrease in tourist guesthouse seats indicates a possible shift in tourist preferences or a reduction in the availability of such accommodations. The increase in agritourism guesthouse seats highlights the growing popularity of agritourism and the demand for authentic rural experiences. The introduction of campsite seats suggests a new or emerging trend in outdoor and adventure tourism. The overall trend in the data suggests a dynamic growth in tourism accommodation structures in Sibiu County, particularly in agritourism

guesthouses also highlights the growing appeal of rural and farm-based tourism experiences. On the other hand, the decrease in tourist guesthouses may reflect changing tourist preferences or challenges faced by this segment.

Table 1. The number of accommodation places offered to tourists by type of tourist reception structures in Sibiu County

	Number of places		
Type of tourism reception structures	**2023**	**2020**	**Variation**
Hotels	3,387	3,000	13%
Hostels	69	16	331%
Motels	127	122	4%
Inns	38	38	0%
Tourist Villas	624	590	6%
Tourist Cabins	408	343	19%
Tourist Guesthouses	1,177	1,368	-14%
Agritourism Guesthouses	1,624	1,458	11%
Campsites	75	0	No data
Tourist Stops	14	0	No data
Holiday Villages	0	0	No data
Bungalows	40	0	No data
School and preschool Camps	330	24	1275%
Apartments for rent	894	314	185%

Source: National Institute of Statistics (2020, 2023), Own calculations

According to the data from the document you provided, in Sibiu County, in December 2023, the accommodation capacity in operation by type of tourist reception structures is as follows:

Table 2. The accommodation capacity in operation by type of tourist reception structures in Sibiu County

	Accommodation capacity (places-days)		
Type of tourism reception structures	**2023**	**2020**	**Variation**
Hotels	1,290,414	898,412	44%
Hostels	25,185	19,156	31%
Motels	54,008	44,359	22%
Inns	13,870	10,602	31%
Tourist Villas	242,926	159,212	53%
Tourist Cabins	148,920	93,286	60%
Tourist Guesthouses	488,175	424,091	15%
Agritourism Guesthouses	583,477	420,777	39%
Campsites	57,215	9,460	No data
Tourist Stops	5,110	0	No data
Holiday Villages	0	0	No data
Bungalows	16,430	9,876	No data
School and preschool Camps	121,222	60,012	102%
Apartments for rent	296,776	No data	

Source: National Institute of Statistics (2020, 2023), Own calculations

As future trends of potential growth of agritourism in Sibiu County, considering the year 2024 as a base year, one should underline the following: engaging in sustainable practices as agritourism plays a key role in promoting environmental conservation and local biodiversity; preserving cultural heritage by practicing and showcasing traditional activities, local cuisine, and crafts; and determining an economic impact as agritourism is expected to contribute significantly to the local economy by creating jobs, stimulating local production, and generating additional income for rural residents.

In Romania, the key factors to bring success in agritourism are represented by the investment in infrastructure (e.g.: developing new highways and improvement of existing roads, amplifying the accommodation facilities, and advertising tourist attractions can enhance the agritourism experience), the marketing and promotion, and also the community involvement by active participation of local communities in agritourism activities that can foster a sense of pride and identity.

4. CHALLENGES OF AGRITOURISM IN SIBIU COUNTY IN 2024

A series of factors was challenging and continue to challenge the development of agritourism not only in Sibiu County but in Romania as a whole. The most significant for the author are:

- Sustainable Development: Ensuring that agritourism development aligns with sustainable practices is a significant challenge. Balancing economic growth with environmental preservation requires careful planning and implementation of eco-friendly practices.
- Infrastructure: The lack of adequate infrastructure, such as roads, internet connectivity, and modern facilities for utilities, can hinder the growth of agritourism. Inadequate infrastructure, such as poor road conditions and limited access to technology, can hinder the growth of agritourism. Improving infrastructure is essential to attract more tourists and provide them with a comfortable experience.
- Marketing and Promotion: Effectively marketing agritourism destinations and promoting them to a wider audience is crucial. Many agritourism businesses in Sibiu County struggle with limited marketing resources and knowledge, which affects their visibility and competitiveness.
- Training and Education: There is a need for continuous training and education for agritourism operators to enhance their skills and knowledge. This includes understanding customer service, sustainable practices, and effective business management.
- Seasonality: Agritourism is often seasonal, with peaks during certain times of the year. Managing the fluctuations in tourist numbers and income can be challenging for agritourism businesses, requiring them to diversify their offerings and find ways to attract visitors year-round.
- Regulatory Issues: For agritourism operators, navigating and complying with local, regional, and national regulations can be intricate and time-intensive, particularly when aligning with EU policies for sustainable rural development. Simplifying and streamlining the regulatory process can help alleviate this challenge.
- Community Involvement: Engaging the local community in agritourism initiatives is essential for long-term success. Building strong relationships with local residents and involving them in tourism activities can enhance the authenticity and appeal of agritourism experiences.
- Depopulation and Aging Population: Many rural areas in Romania are experiencing depopulation and an aging population, which can limit the availability of labor and reduce the number of potential visitors.
- Economic Decline: Rural communities often struggle with economic decline, making it difficult to invest in infrastructure and services needed to attract tourists.
- Lack of Unified Framework: There is a lack of a unified framework for agritourism in Romania, which can lead to inconsistencies in standards and practices.
- Globalization and Market Pressures: The pressures of globalization and EU market demands can make it challenging for rural areas to maintain their cultural heritage while adapting to modern tourism trends.
- Climate Change: Climate change can impact agricultural productivity and the natural beauty of rural areas, affecting their appeal to tourists.
- Cultural Preservation: Balancing economic development with the preservation of cultural heritage is a delicate task that requires careful planning and community involvement.

A different kind of challenges for agritourism in Romania, particularly in Sibiu County, in 2024 and beyond, are represented by financial difficulties such as:

- Economic Slowdown: Romania's GDP growth in 2024 is expected to be sluggish, barely exceeding 1%, which is significantly lower than earlier projections. This economic slowdown can impact tourism and agritourism by reducing disposable incomes and limiting travel budgets.
- High Interest Rates: The high interest rates in Romania can make borrowing more expensive for tourism and agritourism businesses, affecting their ability to invest in infrastructure, marketing, and expansion.
- Fiscal Adjustments: Necessary fiscal corrections to address budget and external deficits may lead to tax increases and public spending adjustments. These changes can create uncertainties and financial strain for tourism businesses.
- Seasonality: Agritourism is highly seasonal, with peaks during certain times of the year. Managing fluctuations in tourist numbers and income can be challenging, requiring businesses to diversify their offerings and find ways to attract visitors year-round.
- Access to Financing: Financial needs in the agriculture and agri-food sectors, including agritourism, are significant. There is a gap between the supply and demand for financing, with many businesses struggling to access the necessary funds for growth and development.

Overcoming these challenges necessitates a unified effort from stakeholders, such as government agencies, local communities, and agritourism operators, to promote sustainable agritourism development. By working together, they can create a sustainable and thriving agritourism sector in Romania and, particularly, in Sibiu County.

5. CONCLUSION

In conclusion, this paper has explored the growth and challenges of agritourism in Sibiu County, Romania, highlighting its significant role in promoting sustainable rural development.

Agritourism in Sibiu County has shown substantial growth, as proven by the analysis of statistical data from the Romanian National Institute of Statistics, showing insights into the trends and patterns in agritourism, emphasizing the sector's potential for further development.

The paper identifies various challenges that need to be addressed to ensure sustainable growth in agritourism. These challenges include inadequate infrastructure, limited marketing resources, regulatory issues, and the need for continuous training and education for agritourism operators.

Agritourism contributes significantly to the local economy by creating jobs, stimulating local production, and generating additional income for rural residents. In that regard, the paper underlines the importance of financial incentives in order to develop and diversify agritourism activities that leverage the county's unique attributes.

Overall, the paper concludes that agritourism has the potential to become a catalyst for sustainable rural development in Sibiu County, contributing to its economic resilience and cultural vitality. By addressing the identified challenges and leveraging the opportunities, agritourism can ensure its long-term success and positive impact on the community.

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The Impact of Artificial Intelligence on Tourism, with Particular Attention to Deepfake

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Abstract: *Modern technology is having a significant impact on tourism. This is particularly true for tourism companies, as nowadays, almost everything from transport to hotels to program management is done digitally. Concurrently, the role of traditional travel agencies is diminishing. This trend has many positive effects, but its potential dangers should not be overlooked. While the development of technology has made services available from anywhere in the world, and it is easy to compare prices and the quality of services, it is also essential to avoid over-reliance on online content. While the importance of online consumer reviews is growing, consumers can be easily misled by false positive reviews. Moreover, the explosion in these fake reviews can, in many cases, be attributed to the use of artificial intelligence. The use of deepfake videos and images to generate interest is rising. Some deepfake methods are morphing (identifying patterns between two photos and dynamically transforming one image into another), and others are warping (digitally altering the shape of a part of the image for creative purposes). However, artificial intelligence and machine learning techniques also play a significant role. As a result, there is a loss of trust in media content published online. Deepfake technology also raises significant privacy concerns. Deepfake can, therefore, play a dual role. Besides the dangers outlined here, it should not be forgotten that it allows for much more information than before. Deepfake can be used to make tourism programs more visually attractive, and there are many untapped areas for virtual reality in addition to its existing uses (e.g., 3D presentations of hotels, virtualization, and interactivity of museums). Following a general introduction to deepfake technology, this paper will describe its application in tourism, highlighting the benefits and potential threats.*

1. INTRODUCTION

The study mainly reviews literature and case studies to analyze the effects of artificial intelligence, especially deepfake technology, on the tourism sector. The research discusses various issues raised by artificial intelligence and deepfake technology, such as fake tourism promotions, deceptive accommodation, manipulated online reviews, and social destabilization factors. Based on previous literature, the analysis presents the possible consequences of each problem area in the tourism sector, highlighting the ethical and trust challenges tourism actors face.

2. THE DANGERS OF ARTIFICIAL INTELLIGENCE

In September 2024, Spanish authorities arrested a criminal organization that defrauded two women of more than $350,000 on behalf of Brad Pitt. The fraudsters contacted the victims through a Brad Pitt fan page and made them believe that the actor was personally interested in them. During longer communications, the fraudsters pretended to be in a romantic relationship and convinced their victims that Brad Pitt offered them investment opportunities. The two women made transfers totaling more than $350,000, believing they supported the actor's investment projects.

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The Spanish police had an operation titled "Bralina" in which they caught five people and later started an investigation against another ten people due to fraud. During the investigation, they found out that the criminals created psychological profiles about the victims, exploiting their emotions of vulnerabilities. The actor's representative condemned the fraud and emphasized that Brad Pitt has no official social media profile and warned the fans to be cautious when they are found with such solicitation (People, 2024).

The deepfake technology used to commit the crime was so authentic that the fraud went unnoticed for a long time, and the victims did not notice that they were not communicating in real terms. This case draws attention to deepfake technology's risks for public figures and celebrities, as fraudsters can use their manipulated identities for financial gain. Since the credibility of deepfake content is high and often difficult to recognize, protection against deception is a challenge for both individuals and authorities.

Deepfake technology for criminals can be used against the tourism sector alongside many other areas. This can also be useful since, e.g., high-quality 3D content can be created to present a specific hotel, but it can also be hazardous (Lin et al., 2021). The purpose of this study is to present the dangers of these deepfakes after a brief overview.

3. THE CONCEPT AND MAIN CHARACTERISTICS OF DEEPFAKE

A deepfake is a video, audio, or other content (e.g., image) that is entirely or partially fabricated or created by manipulating existing, accurate content (Van der Sloot et al., 2022). As Delfino puts it, with the help of deepfake, its creators make a "false reality" (Delfino, 2023). The term is attributed to a Reddit user whose username was "deepfakes" (Meskys et al., 2020). In late 2017, "Deepfakes" swapped the faces of many famous actresses with the faces of actors in sexually explicit films (Cole, 2017) as if these famous actresses had starred in sexually explicit films. What was unique about this was not that they replaced the faces of the characters in the original films, but that it was all done extremely quickly, efficiently, and with open-source learning tools (e.g., TensorFlow) freely accessible to anyone (Goggin, 2019).

The possible advantages and disadvantages of deepfake are summarized in the following table based on the study by Chesney and Citron (2019, p. 1772):

Table 1. Advantages and Disadvantages of Deepfake Technology

Advantages	**Disadvantages**	
1. Education 2. Art 3. Autonomy 4. Other	Damage to individuals or organizations	Damage to society
	1. Exploitation 2. Sabotage	1. Distortion of democratic discourse 2. Manipulation of elections 3. Deterioration of trust in institutions 4. Aggravation of social divisions 5. Undermining public safety 6. Undermining diplomacy 7. Endangering national security 8. Undermining journalism 9. The Liar's Dividend

Source: Chesney and Citron (2019, p. 1772)

Deepfake has many advantages. For example, it provides an opportunity to use a more modern, fundamentally different teaching method from the classical education system (Chesney & Citron,

2019). Furthermore, there are also considerable possibilities in the field of art in the application of deepfake; it is enough to refer to the cases when dead performers were brought to life and created in their name more recent works. Among the advantages of deepfake, the appearance of parodies is usually mentioned if they are within the boundaries of not infringing another person's dignity (Baker, 2014). Deepfake can also help injured and sick people to achieve a better quality of life. Thus, e.g., people with certain forms of paralysis (e.g., amyotrophic lateral sclerosis (ALS), (HuffPost, 2019) In recent years, we have also seen great advances in voice technology. These developments have made it possible for people with speech disabilities (e.g. Duchenne muscular dystrophy) (Gábor, 2023) to communicate using synthetic versions of their original voices. (Moëll & Aronsson, 2025). Deepfake can also be beneficial for law enforcement, e.g., if they catch a child molester red-handed with fake child pornography.

On the other hand, deepfakes may pose many dangers as well. Some can be harmful to individuals and organizations and others to society. One of the most significant dangers of deepfakes is that, with their spread, public trust in video, image, and audio recordings (and thus indirectly in the media) will be shaken (Mráz, 2021).

4. THE DANGERS OF ARTIFICIAL INTELLIGENCE AND DEEPFAKE IN THE TOURISM SECTOR

In this chapter, we will discuss the possible dangers related to deepfakes. We would like to highlight the following risks associated with deepfakes without being exhaustive:

- fake tourism promotions,
- Deceptive accommodations,
- Fake travel regulations and information,
- Fake promotions by influencers and celebrities,
- Manipulated online reviews and testimonials,
- Social destabilization and panic-mongering,
- Falsification of travel documents.

4.1. Fake Tourism Promotions

The use of deepfake technology in the tourism sector is a new and more widespread phenomenon that can manipulate the visitor's intentions and influence the destination's reputation. These deepfake videos can show places realistically, and travelers can believe they are authentic. Using this technology in tourism promotions can significantly increase the visitor's interest, and the risk of fraud is also increasing (Kwok & Koh, 2020).

The manipulation possibilities of deepfake recordings include presenting scenes that do not correspond to reality and creating more attractive images and videos for visitors (Leung et al., 2017). This technology is particularly effective in social media, where visitors make travel decisions based on visual content. An example of this was when the Lithuanian National Tourism Agency used manipulated images during its promotional campaigns, which could hurt tourism in the long term due to the loss of credibility (BBC, 2017).

One of the negative consequences of fake promotions is that the consumer's trust will weaken, which can distort the tourism market. (Yoo et al., 2009). The misinformation spread by deepfake videos may create disappointment for the visitors when they see that reality differs from what was previously seen. Due to the development of the rich content of the media and online spaces,

tourists may believe these contents are authentic, which can result in an increased intention to visit these places; therefore, the use of deep fake technology in tourism creates significant challenges to maintaining authenticity. (Boté-Vericad & Vállez, 2022).

4.2. Deceptive Accommodations

Deepfake technology, which uses artificial intelligence and machine learning to create realistic but fake videos and images, allows hotels to share more attractive images and videos of themselves, primarily online (but also in brochures). However, these contents are often misleading, falsely presenting the facility's condition, location, or services. For example, an advertisement for accommodation may present a luxurious setting and a fantastic view, while the place is much simpler and does not offer such an experience (Tuomi, 2021).

With deepfake content, more and more authentic-looking fake videos and images are created, which can also be used in marketing to deceive. Due to the wide availability of such technology, it is a fundamental question of how well consumers can recognize these manipulated contents since deepfakes are often more visually convincing than traditional advertising materials (Sivathanu et al., 2024).

The loss of trust due to promotions made by deepfake technology can significantly impact the tourism industry. Tourists increasingly rely on online advertisements and opinions when deciding which accommodation to choose (Pestek & Sarvan, 2020). When the scenes, pictures, and videos do not describe reality, the clients will be disappointed, which can negatively influence the concrete accommodation and the whole region's reputation. Furthermore, consumers may be less inclined to trust online content, so the sector's future income will decrease (BBC, 2017).

The industry's response to the challenges posed by deepfake is increasingly based on detection technologies and regulatory initiatives. Although content created with artificial intelligence can become part of business marketing, companies operating in the hospitality industry must follow transparent and ethical practices (Kietzmann et al., 2020). Introducing verification and certification systems for the realism of images and videos on accommodation booking sites could be a potential solution (Boté-Vericad & Vállez, 2022).

The problem would be that the pictures the visitors see will not match reality, and because of this, the visitors will give negative feedback about these accommodations. Consequently, the evaluation of online accommodation does not match reality, and the reputation of these places will be breached. And lastly, due to the reasons above, guests will be unable to find adequate information about the places they intend to visit.

4.3. Fake Travel Regulations And Information

The application of deepfake technology in manipulating travel rules and information significantly impacts travelers' information and fundamentally affects trust in tourism and the credibility of destinations. Fake content created with the help of artificial intelligence makes it possible to publish manipulated travel regulations, visa requirements, quarantine measures, or even health regulations, which tourists often believe to be accurate. This false information can spread quickly and widely through social media and other online platforms, thus exerting a significant influence on travelers' decisions (Sivathanu et al., 2024).

One of the most well-known examples of fake travel information based on deepfake is when it may seem to travelers that the epidemiological regulations or other types of health requirements are in

force in each country rather than in reality. This can be particularly dangerous, as travelers may leave with a false sense of security, which may also affect the tourism of the given destination. Tourists can be misled in many ways by these deepfake videos. One example could be when a fake video shows no need for vaccination or a visa in the destination country. As a result, tourists can face many problems if they plan according to the misinformation provided by the deepfake video (Tuomi, 2021).

Another consequence of the manipulation of the rules of travel is that these fake contents can influence the reputation of the destination. Maliciously intended deepfake videos can create false security information about the place's safety, deterring tourists from a specific region. This can be particularly problematic in those regions where they heavily depend on the tourism sector as a primary source of income. As a result, in the eyes of the public, these places will be less attractive destinations in the long term (Kwok & Koh, 2020).

In addition to providing reliable sources of information, tourists must learn to look critically at the content they see and recognize manipulated information. For this, it is essential to launch media and digital literacy campaigns and prioritize authentic sources of information in the travel industry.

4.4. Fake Promotions by Influencers and Celebrities

The implementation of deepfake technology in fake promotions made in the name of influencers and celebrities has become increasingly widespread in tourism, as visually convincing, artificially generated content is an effective tool for influencing tourists (Van der Veen & Song, 2014). Deepfake technology uses artificial intelligence and machine learning algorithms to create images and videos of celebrities and influencers that appear to recommend a particular destination or accommodation. Such manipulated content is often produced with such detail and authenticity that travelers perceive them as honest opinions. Thus, they can influence their travel decisions, even if the celebrities and influencers are not involved in the campaign (Boté-Vericad & Vállez, 2022).

Including celebrities and influencers in advertising is highly effective, as their followers develop a strong attachment to them and greatly influence their decisions. Therefore, a well-known influencer or celebrity appearing in a travel ad often directly impacts the audience's intention to travel. Such deepfake content is viral on social media, where tourists come across similar recommendations daily and may be unable to distinguish between genuine and artificially generated reviews. For example, an influencer's face can be used to promote an exotic destination that will attract tourists without the influencer having ever visited the location (Sivathanu et al., 2024).

Such false promotions hurt the industry and consumer confidence in several ways. First, when tourists discover that the influencer they follow did not recommend the accommodation or destination, they will be disappointed and may lose confidence in that brand and the entire industry. Secondly, this kind of manipulated content can reduce the credibility of accommodations in the long term, as travelers find it difficult to distinguish between real and fake recommendations, which makes them more suspicious of online advertisements (Kwok & Koh, 2020).

The cost-effectiveness and easy availability of deepfake technology allow tourism companies to produce convincing but fake content quickly and in large quantities. This is often related to the media richness theory, which states that visually rich, multi-channel communication content makes a more profound impression on consumers, increasing interest in products and services. Based on this theory, deepfake content can be easily deployed in tourism, as rich visual content helps consumers believe what they see and is more likely to choose the advertised location.

4.5. Manipulated Online Reviews and Testimonials

The use of deepfake technology in manipulating online opinions and recommendations is a significant problem in tourism, especially in accommodation marketing. Deepfake fake reviews and testimonials can deceive potential guests and appear authentic despite being generated by artificial intelligence and machine learning (Ayeh et al., 2013). Such reviews are visually and contentally very similar to honest feedback, which increases their credibility and influence on consumer decision-making. These deepfake reviews and testimonials are often designed to evoke emotions and tell personal experiences, so readers tend to believe them.

Manipulated online reviews significantly impact tourism, as travelers rely heavily on online reviews and recommendations when making decisions (Akhtar et al., 2019). Opinions generated with deepfakes can present positive feedback about a specific accommodation, or they can express negative criticism of competitors, thereby manipulating the choices of potential guests. Some research has shown that guests tend to base their decisions on authentic detailed reviews, and manipulated feedback can increase trust in accommodations, even though they convey an untrue image.

Deepfake technology is a cost-effective and fast tool for hotels and tourism companies to multiply positive reviews, which can cause severe distortion in the online space. These deepfake reviews can appear in large quantities and in a short time, and thus, some accommodations can quickly achieve favorable reviews without providing a high-quality service (El-Said, 2020).

This deception can create uncertainties and mistrust among travelers to the entire tourism sector about the trustworthiness of online reviews (Cui et al., 2014). More and more manipulated reviews and recommendations will create can I have the ability problems for the sector, and it will become necessary for companies to consider implementing strict control mechanisms on online platforms to detect and remove fake AI-generated reviews; such systems can often filter out the linguistic and stylistic patterns characteristic of deepfake content, although these solutions are still under development. However, here, too, the development of consumers' media and digital literacy, which was emphasized earlier, can be significant.

4.6. Social Destabilization and Panic-Mongering

Using deepfake technology in tourism can cause social destabilization and panic, leading to a long-term loss of trust in the travel industry (Woolley, 2020). This artificial intelligence-based technology makes it possible to create images and videos that are very realistic but carry false information, easily misleading people. With the help of deepfake content, for example, manipulated news can spread about the alleged dangers of specific destinations, false safety warnings, epidemic measures, or other travel regulations. These false contents can cause serious social tensions, primarily through social media's rapid information dissemination effect (Kwok & Koh, 2020).

There are also dangers with deepfake videos spreading online on social media platforms. Occasionally, these videos can create such emotional responses in the masses, resulting in panic. For example, if there is a video talking about unreal dangers in a destination country, tourists may avoid visiting it, which can result in significant economic losses for the tourism sector in that place. This is especially problematic for countries that rely heavily on tourism revenue. Such fake content may influence travel decisions and create negative stereotypes, and even aggravated cases result in social destabilization (Tuomi, 2021).

The impact of deepfake manipulations on social stability is particularly evident in social media, where users often share such content without criticism. Fake videos appear authentic and can easily provoke an adverse reaction from the public, undermining a given destination's perception and economic stability (Fedeli, 2020). In addition, if tourists avoid a place because of fake content, it can lead to the economic decline of that area, which can create new tensions among the local population.

4.7. Falsification of Travel Documents

Deepfake technology creates new opportunities for forging travel documents such as passports and visas, which poses a significant security challenge for tourism and border security. With the help of artificial intelligence and machine learning algorithms, deepfake technology can create realistic forged documents that are difficult to recognize with traditional methods. These fake documents can be hazardous, as they can grant entry to certain countries to people who would otherwise not be allowed to. Through deepfake technology, even real passports and other identification documents can be manipulated, including biometric identification data, such as a facial image or fingerprint. This can be of particular concern at border crossings and airports where document control is crucial to maintain security (Sivathanu et al., 2024).

Fake documents created by deepfake technology provide opportunities for some criminal groups to commit illegal immigration, terrorism, and other crimes. Realistic fake passports allow travelers or criminals to bypass traditional controls and enter countries they would otherwise not be able to enter. Technological abuse can undermine trust in authorities and create significant economic and security risks, especially in tourism, where free movement across borders is essential.

Developing biometric systems in borders and recognition technology based on artificial intelligence can help decrease the risks associated with deepfakes. Such systems can help authorities check travel documents' validity more accurately and recognize documents before they impose real societal risks (Sivathanu et al., 2024).

5. CONCLUSION

In conclusion, the widespread use of deepfake technology in tourism increases accessibility and attractiveness but threatens realistic and ethical promotions. Addressing this phenomenon requires improvements in detecting fake content and increasing media and digital literacy so tourists can distinguish between manipulated and accurate content. The use of deepfake technology in accommodation marketing poses severe challenges to the tourism industry, especially regarding consumer trust and ethical issues. In the same way, the manipulation of travel rules and information poses a severe threat to both the safety of tourists and the economy and reputation of destinations.

In terms of fake promotions made in the name of influencers and celebrities, deepfakes pose a severe challenge to tourism and the hospitality industry. We should also not forget about manipulated online reviews and recommendations, which threaten the credibility of the tourism industry and the maintenance of consumer trust in the long term. Such misleading content may benefit hotels in the short term, but in the long term, it damages the reputation and credibility of the industry.

Using deepfake technology in tourism can also lead to severe social destabilization and panic if misleading content is spread on social media and other online platforms. The falsification of travel documents poses serious security and economic challenges for tourism.

Adequate regulation, technological developments, and increasing consumer awareness are essential to minimize the adverse effects of deepfake technology on tourism in the future. This is the only way to ensure that tourists make decisions based on reliable information and that accommodations can sustainably compete on the market.

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Smart Technologies Shaping the Future of the Hotel Industry in Developing Countries: A Post-Covid Review

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Abstract: *This paper aims to identify the optimal smart technologies and AI-driven solutions for the hotel industry, with a particular emphasis on their contribution to the broader digital transformation of business operations. The research examines the state of the art as of September 2024 using a mixed-methods approach, combining a systematic review and design thinking. The review spans studies from 2020 to 2024, characterized by rapid advancements in AI and smart technology, partly driven by the post-Covid digital transformation. The findings are related to a growing global demand for AI-powered smart technology solutions in the hotel industry, motivated by different reasons such as operational efficiency, customer experiences, and streamlined management processes. The adoption of these technologies in developing countries is affected by some specific economic, cultural, and regulatory factors and remains aligned with global digitalization trends. The study brings attention to continuing important concerns, such as data privacy and security, financial constraints, and cultural factors that affect technology acceptance and integration. These insights provide a foundation for examining the potential of integrating smart technologies within Albania's hotel industry landscape.*

1. INTRODUCTION

The rapid adoption of smart technologies in the global hotel industry has become a significant driver of operational efficiency and customer satisfaction Liu, H. (2024). Key technologies include AI, the Internet of Things (IoT), machine learning, and automation systems Kaur et al. (2024). The use of AI, IoT, and machine learning has revolutionized the sector, making smart hotels the new standard for service excellence Kim et al. (2020). The hospitality industry, traditionally slow in adopting new technologies, underwent rapid changes post-Covid, with smart technologies and AI becoming vital tools to enhance operational efficiency and improve customer experience Yu and Hsu (2024). Developed countries led the charge in adopting these innovations, but developing countries face unique economic, regulatory, and cultural challenges that influence the rate and manner of technology adoption Gajić et al. (2024). The pandemic has risen the demand for contactless solutions in hotels, particularly in regions where health and safety have become primary concerns. As noted by (Yu & Hsu, 2024; Pillai et al., 2021), hotels are increasingly investing in AI-powered systems that can perform tasks such as automated check-ins, room service deliveries via robots, and contactless payments, offering safer guest experiences post-pandemic (Yu & Hsu, 2024; Pillai et al., 2021). The introduction of these innovations comes along with some challenges. Hotels in developing countries have to navigate problematic issues related to data security and privacy, and the high costs associated with building, implementing and maintaining these technologies (Leko 2021; Infante-Moro et al., 2021). Despite these obstacles, the potential benefits of smart technologies for hotels in developing countries are considerable. The highlights of Negro (2022) show ways on how the smart hotels can support environmental initiatives by reducing carbon footprints and improving resource management.

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2. MATERIALS AND METHODS

This paper explores the literature through a mixed-methods approach, combining a systematic review of the existing literature with a design thinking methodology. A mixed-methods approach was employed, including a systematic literature review and design thinking workshops with stakeholders from the hotel industry. The review spans publications from 2020 to 2024 to capture recent advancements in AI and smart technology. Design thinking sessions involved experts from developing countries, allowing for a tailored analysis of their unique challenges and opportunities (Kim et al., 2020; Han et al., 2021).

The research question of the paper relates to how the current state of smart technology adoption in the hotel industry is, particularly in developing countries, and to identify both opportunities and barriers associated with implementing these technologies in resource-constrained environments.

The systematic review focuses on peer-reviewed journal articles, conference papers, and industry reports published between 2020 and 2024. This time frame was selected due to the surge in research and technological advancements following the COVID-19 pandemic, which accelerated the adoption of automated and non-contacted services in the hotel industry (Yu & Hsu, 2024; Li et al., 2021). Relevant studies were identified through searches in academic databases, including IEEE Xplore, ScienceDirect, Web of Science, and Google Scholar. The search terms included: "Smart hotels, AI in hospitality. IoT in hotels, Contactless hotel services, Blockchain in hospitality, Smart technology adoption in developing countries". The inclusion criteria were:

- **First Criteria**: Studies published between 2020 and 2024.
- **Second Criteria**: Articles focusing on the adoption of smart technologies in the hotel industry, including AI, IoT, robotics, blockchain, and other emerging technologies.
- **Third Criteria**: Research that addressed the economic, social, or operational aspects of technology adoption, especially in developing countries.

Studies were not included if they did not specifically address smart technology adoption in hotels or were not related to the post-COVID era. A total number of 90 studies were included in the review, offering a comprehensive view of the current trends, challenges, and future prospects for smart technology in the hotel sector (Leko 2021; Infante-Moro et al., 2021). Alongside the systematic review, this paper incorporates a design thinking approach to better understand the human-centered challenges of adopting smart technologies in hotels, especially in developing countries. The design thinking procedure incorporates five key stages. The first stage, empathize, involves gaining insights from existing literature about the needs and challenges faced by hotel operators and guests regarding smart technology adoption Han et al. (2021). In the second stage, define, specific barriers to adoption are identified, such as financial constraints, data privacy concerns, and cultural resistance Negro (2022). The third stage, ideate, focuses on brainstorming potential solutions, including lower-cost technology models or training programs to enhance staff and guest comfort with technology (Katartis et al., 2023; Yu & Hsu, 2024). During the fourth stage, prototype, conceptual models are developed to explore how smart technologies like AI, IoT, and robotics can be integrated into existing hotel infrastructures, particularly in developing countries (Negro 2022; Infante-Moro et al., 2021). Finally, the test stage evaluates potential solutions using insights from the literature, as no primary data collection was conducted.

The design thinking approach added a user-centered dimension to this analysis, focusing on the practical challenges and opportunities for adopting smart technologies in developing countries.

3. RESULTS AND DISCUSSION

The findings from the systematic review reveal that AI-powered systems such as chatbots, predictive maintenance, and smart room automation have streamlined guest services and reduced operational costs Yu and Hsu (2024). Hotels are increasingly using AI to provide personalized guest experiences by analyzing guest preferences and optimizing room environments (Li et al., 2021; Yu & Hsu, 2024). IoT-enabled devices allow hotels to monitor resource usage in real time and automatically adjust services based on guest preferences (Shani et al., 2023; Torre et al., 2023). This has not only enhanced guest comfort but also improved energy efficiency, contributing to sustainability initiatives Poullas and Kakoulli (2023). High initial costs for technology implementation are a significant barrier, particularly for smaller hotels that struggle with financial constraints Gajić et al. (2024). Furthermore, cultural attitudes towards technology, where certain guest populations may not fully trust or feel comfortable with AI-driven solutions, pose another obstacle Li et al. (2021). Despite these challenges, smart technologies offer significant opportunities for hotels in developing countries. IoT-based energy management systems can help reduce operating costs—particularly in regions where energy expenses are high—while maintaining guest satisfaction Ferreira (2023). AI-powered virtual technologies and customer service solutions, as evidenced by Li et al. (2021) help reduce labor downsizing by automating routine tasks.

3.1. Barriers to Adoption in Developing Countries

While the benefits of smart technologies are evident, their adoption in developing countries faces several barriers. The review identified key challenges, particularly for small- and medium-sized hotels.

The first challenge is financial constraints. Many hotels in developing regions struggle with the high costs of implementing and maintaining smart technologies. Initial investments in IoT infrastructure, AI systems, and robotics can be prohibitive for smaller hotels, and these costs are further compounded by ongoing expenses for software updates and maintenance (Infante-Moro et al., 2021; Gajić et al., 2024).

The second challenge involves data privacy and security concerns. In developing countries, these concerns have emerged as significant barriers to the adoption of IoT and AI systems. Guests are often apprehensive about how their personal data is collected, stored, and used by smart systems, further complicating trust in these technologies Leko (2021).

The third challenge is cultural resistance, particularly the reluctance to engage with automated systems due to fears of losing the human touch in hospitality services. This resistance is especially strong among older generations (Leko, 2021; Gajić et al., 2024).

Financial constraints, data privacy concerns, and regulatory issues are significant obstacles (Çeltek, 2023; Hadi Saputro et al., 2023). Additionally, cultural resistance to replacing human interaction with AI-driven systems remains a challenge in some regions Domanski (2020).

3.2. Potential Solutions for Overcoming Barriers

The application of the design thinking framework to the review provided some potential solutions for deliberating on the barriers to adopting smart technologies in developing countries. The

solutions also include affordability, building trust through education and cultural adaptation. To overcome these challenges, the literature suggests the following strategies, partnerships with local providers and government incentives and subsidies.

One of the key challenges identified was the cost of implementing smart technologies. A potential solution is to develop low-cost versions of these technologies that are specifically tailored for smaller hotels in developing countries Yu and Hsu (2024). Infante-Moro et al., (2021) argue that smaller hotels in developing regions often cannot afford the initial investment required to implement IoT or AI systems**.** The ongoing maintenance and software upgrades needed to keep these systems operational represent an addition to the financial burden according to Gajić et al. (2024)**.** Partnerships with local technology providers could also help reduce costs by offering regionally adapted solutions.

Addressing privacy and security concerns is another crucial aspect. Hotels could implement educational programs to build trust among guests regarding the use of smart technologies. These programs could focus on data security and demonstrate how guests' personal information is protected Barkel et al. (2021)**.** Leko (2021) highlights how privacy concerns can significantly impact guest trust in smart technology, particularly in regions where cybersecurity frameworks are not well developed**.** To build trust and address the data usage concerns, hotels should focus on making as more transparent the data usage. For that hotels need to be transparent about how guest data is collected, stored, and used. Clear and accessible privacy policies can help reassure guests that their personal information is being handled responsibly Ivanov et al. (2022). Hotels also need to invest in cybersecurity, so ensuring that smart systems are secure is crucial for protecting both guest information and hotel operations. Investing in cybersecurity measures can help prevent data breaches and bolster guest confidence in using smart hotel services Ivanov et al. (2022).

The literature also highlights cultural resistance as a key barrier to the adoption of smart technologies in developing countries. In many regions, guests expect a high level of personal interaction as part of the hospitality experience, which is seen as being at odds with the automated, contactless services enabled by smart technologies Gajić et al. (2024)**.** To avoid the problem of cultural resistance, hotels need to adopt a hybrid approach where technology complements human interactions rather than replacing them entirely. Therefore, AI-powered systems can be used to manage routine tasks, allowing human resources to focus on personalized guest services **(**Zhang et al., 2024; Sujood & Siddiqui, 2024)**.**

Developing partnerships with local technology providers can help reduce costs by creating region-specific solutions. These providers may be able to offer more affordable products and services that are customized to the needs of local hotels Gajić et al. (2024)**.**

Another probable solution involves government support through subsidies and tax incentives for accommodation structures that adopt sustainable technologies. By providing financial assistance, governments can help hotels offset the costs of implementing smart technologies, which in turn could foster broader adoption Yu and Hsu (2024).

One suggested solution to the challenges mentioned above is the implementation of hybrid models, where technology complements rather than replaces human interaction. Examples include AI-powered systems can handle routine tasks like check-ins or room service, allowing staff to focus on more personalized aspects of hospitality Li et al. (2021). This approach can help retain the human touch that many guests value, while also reaping the efficiency benefits of automation. Additionally,

guest education plays a crucial role in overcoming resistance to technology. By educating guests on the benefits of smart systems—such as enhanced safety, convenience, and sustainability—hotels can foster greater acceptance of these innovations Infante-Moro et al. (2021).

3.3. Sustainability Impact of Smart Technologies

One of the notable findings from the review is the potential of smart technologies to support sustainability in the hotel industry. Several studies emphasize how IoT-enabled systems and AI can support hotels reduce their environmental impact by optimizing resource use energy management and waste reduction. IoT-enabled systems, as smart thermostats and automated lighting, allow hotels to monitor and control energy. This has led to energy reductions in carbon emissions, which are critical for hotels in resource-constrained regions Ahmed El-Said et al. (2024). AI-driven predictive analytics help hotels optimize resource use such as reduce food waste by managing inventory more effectively Ahmed El-Said et al. (2024). By predicting guest behavior and preferences, hotels can guide their services toward minimizing inefficiencies in areas like housekeeping.

A key advantage of smart technologies highlighted in the review is their ability to support sustainability initiatives in the hotel industry. IoT systems that monitor and control energy consumption have been shown to reduce energy usage, making hotels more environmentally friendly Poullas and Kakoulli (2023). AI-powered analytics can also optimize resource allocation, reducing waste in areas such as food service and housekeeping, Negro (2022).

4. CONCLUSION

This paper has explored the potential of smart technologies to transform the hotel industry, particularly in developing countries. The different dimensions of analyzing technology adoption include enhancing operational efficiency, improving guest experiences, and supporting sustainability efforts. The findings show that technologies such as AI, IoT, and robotics offer important benefits, including automation of routine tasks, personalized guest services, and improved energy management (Yu & Hsu, 2024; Infante-Moro et al., 2021). These benefits are particularly valuable in resource-constrained environments, where operational efficiency and sustainability are critical (Poullas & Kakoulli 2023; Negro 2022). Despite the benefits mentioned earlier, the adoption of these technologies in developing countries faces several key barriers. Financial constraints remain a major challenge for small- and medium-sized hotels, which often lack the resources to invest in advanced technology systems Infante-Moro et al. (2021). Concerns over data privacy and cybersecurity pose significant obstacles, particularly in regions where regulatory frameworks are underdeveloped Leko (2021). Cultural resistance to the use of smart systems also complicates the adoption process, as guests in many developing countries may be reluctant to engage with automated services that replace personal interaction Gajić et al. (2024).

The application of a design thinking framework to the literature review provided several potential solutions to these challenges. These include the development of affordable, region-specific technologies, government subsidies, and guest education programs that build trust in smart systems while retaining the human element in hospitality (Leko, 2021; Yu & Hsu, 2024).

Additionally, hybrid models that combine automation with personalized service may offer a balanced approach to overcoming cultural resistance Li et al. (2021). In order to overcome the difficulties mentioned in the literature, the successful integration of smart technologies in developing countries will require tailored strategies that address local financial, cultural, and regulatory challenges.

Government incentives and public-private partnerships could play a crucial role in reducing the costs of technology adoption, while stronger data protection laws are needed to address privacy concerns. Furthermore, hotels must focus on educating both staff and guests about the benefits of smart technologies to foster greater acceptance (Leko 2021; Infante-Moro et al., 2021).

While technological innovations offer enhanced operational efficiency and customer experience, economic, cultural, and regulatory barriers must be addressed to realize their full potential. *For Albania's hotel industry, strategic adoption of these technologies could foster greater competitiveness and efficiency, provided that ongoing concerns like data privacy and financial limitations are managed effectively.*

In conclusion, smart technologies represent a powerful tool for modernizing the hotel industry in developing countries. However, their successful adoption depends on overcoming significant barriers related to cost, privacy, and cultural expectations. Future research should focus on exploring context-specific solutions that can be adapted to the requests of different hotels in these regions, while continuing to evaluate the long-term impacts of smart technologies on hotel profitability, guest satisfaction, and sustainability.

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Any use of generative AI in this manuscript adheres to ethical guidelines for use and acknowledgment of generative AI in academic research, as outlined in this manuscript. Each author has made a substantial contribution to the work, which has been thoroughly vetted for accuracy, and assumes responsibility for the integrity of their contributions (Porsdam Mann et al., 2024).

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The Evaluation of Circular Economy in the Slovak Republic Based on Selected Indicators

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Abstract: *At present, we are increasingly aware of the need to move towards a sustainable and ecologically friendly economy. An innovative approach to a sustainable and ecological economy that is gaining in importance is the concept of circular economy. The circular economy is a systemic approach to economic development and a paradigm shift from the traditional concept of the linear economy model "extraction - production - consumption - disposal - depletion". The circular economy is characterized by zero waste through resource conservation, as a changed concept of production processes design, production process and selected materials for a higher life cycle and preservation of all kinds of resources, material and/or energy recovery during all processes and at the end of the life cycle. The products could be used as an input material in a new production process in a value chain with a closed cycle of materials that improves efficiency resources, and resource productivity, benefits businesses and society, creates job opportunities and ensures environmental sustainability.*

1. INTRODUCTION

The European Commission (2023), in the communication Sustainable products as a standard of 30/03/2022 COM (2022) emphasized the need to analyse how the prosperity of citizens can be increased and the sustainable growth ensured thanks to better use of resources and materials that make up the products of daily consumption and thanks to the improvement of the products, by focusing on the production of products with less energy consumption, efficient and long-term use in consumption, and the use of recycled materials instead of primary resources and the spread of circular economy models. The circular economy is a model of production and consumption in which the lifetime of products is increased, and waste is reduced. It represents a model of a changed concept of designing production processes, the selection of resources, their material and energy valorisation in a value chain in a closed cycle, which benefits businesses and society, creates job opportunities and ensures environmental sustainability.

The paper aims to identify the links that exist between economic growth and the use of natural resources or environmental degradation and to implement circular models in such a way that they create and capture the value of products throughout the reproductive process, while at the same time helping to optimize and limit the use of resources and the creation of waste and unusable product residues. It is not just regulatory requirements that are specific to specific products, but also the right market signals for circular models to incentivize manufacturers to better design products, extend the life of products and preserve their value during and after their use.

2. RENEWABLE ENERGY SOURCES

The Slovak Republic is an open economy, the condition of which is primarily influenced by exports, mainly from the automotive sector. On the other hand, it belongs to the countries that have a high

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dependence on the import of key raw materials and energy. Slovakia has varied reserves of minerals, but only a few of them are mined. About a third of the total number of mapped deposits is actively used. From the aspect of natural conditions and current technological possibilities of the country, the Slovak Republic is not rich in terms of primary energy resources. Energy raw materials make up 7% of the total amount of reserves registered on the territory of the country. From the aspect of total extraction within Slovakia, the extraction of energy raw materials represents 6%. As of January 1, 2009, a total of 82 exclusive deposits of energy raw materials (anthracite, bituminous rocks, gasoline, brown coal, lignite, non-petroleum gases, non-paraffinic oil, semi-paraffinic oil, uranium, natural gas) in the amount of 1,147,217 kt were recorded in the territory of the Slovak Republic. The overview does not include underground natural gas reservoirs. The most important part is represented by reserves of brown coal and lignite (altogether 94% of the total reserves of energy raw materials).

In the EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources, binding targets for the year 2020 were set, in the form of a 20% share of energy from renewable sources in the total energy consumption in the EU and a 10% share of energy from renewable sources in the transport sector. In 2018, as in previous years, a high proportion of electricity produced in the Slovak Republic originated from nuclear fuel (54.7%), despite the year-on-year decrease in the production of nuclear power plants by 1.6%, as published by the Slovak Electricity Transmission System (SEPS). Fossil fuels accounted for the second largest share of electricity (21.7%) produced in 2022. Natural gas (32.6%), brown coal (26.4%) and black coal (23.2%) accounted for the largest share of electricity production from fossil fuels. According to SEPS data, green energy in Slovakia recorded a decline. As in the years 2015 to 2017, electricity from renewable energy sources in 2018 was produced predominantly from biomass (49.4%). Biogas and photovoltaic power plants continued to have a quarter share in the production of electricity from renewable sources (24.9% and 24.4%). According to Eurostat, the share of renewable energy sources (RES) in final energy consumption in the Slovak Republic has been falling for two years in a row.

Slovakia thus moved away from the EU average by 5%. For the year 2020, Slovakia has committed to increasing the use of RES in proportion to gross final energy consumption to 14%.

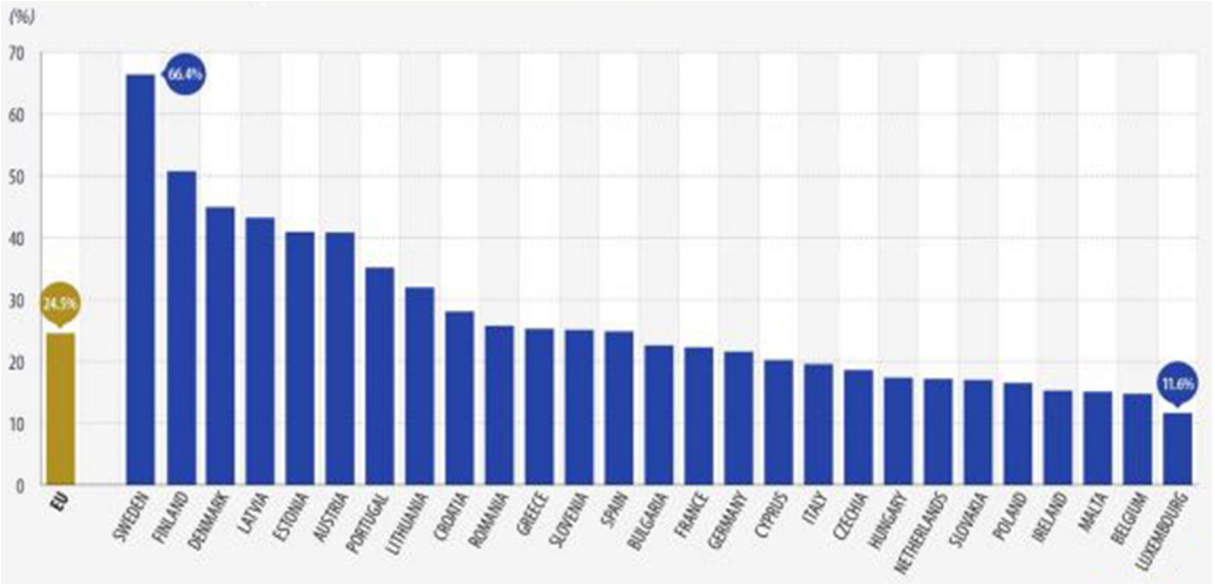


Figure 1. Overall share of energy from renewable sources in 2023

Source: Eurostat (2024)

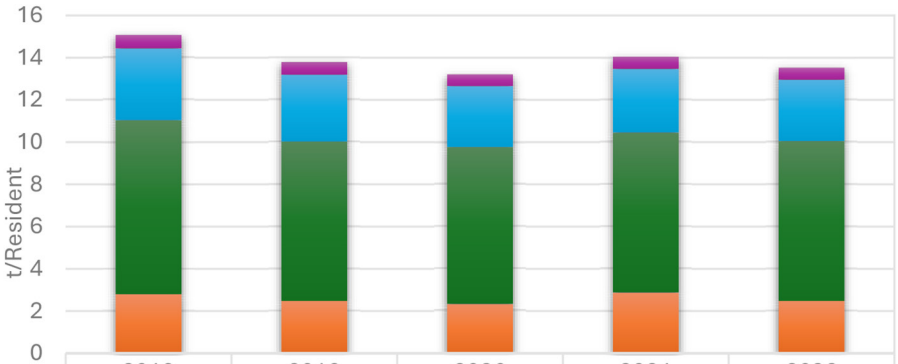
The EU has reached a 23.0% share of its gross final energy consumption from renewable energy sources in 2022, which is approximately 1.1 percentage points (pp) more than in 2021. EU countries must therefore step up their efforts to jointly meet the new goal until 2030, which requires an increase in the share of renewable energy sources in the EU's gross final energy consumption by almost 20 percentage points. Figure 1 shows the latest available data on the share of renewable energies in gross final energy consumption in 2022. Figure 1 shows the data in 2023. Among the EU countries, Sweden has achieved the leading position, as almost two-thirds (66.0%) of its gross final energy consumption in 2022 comes from renewable sources. Sweden has relied primarily on water, wind, solid and liquid biofuels, as well as heat pumps. This was followed by Finland (47.9%), which also relied on hydro, wind and solid biofuels, and Latvia (43.3%), which depended mainly on hydropower. Both Denmark (41.6 %), followed by Estonia (38.5%), obtained most of their renewable resources from wind and solid biofuels. Portugal (34.7%) relied on solid biofuels, wind, water and heat pumps, while Austria (33.8%) mainly used water and solid biofuels. Slovakia reached the value (17.5%). The lowest shares of renewable energy sources were recorded in Ireland (13.1%), Malta (13.4%), Belgium (13.8%) and Luxembourg (14.4%).

3. SECTOR INDICATORS

Sector indicators are a means of evaluating progress in the implementation of sector policies in relation to the environment and the degree of integration of environmental aspects into sector policies. Based on the analysis of indicators developed and regularly evaluated by the European Environmental Agency (EEA), the Organization for Economic Development and Economic Cooperation (OECD, 2022), and the Statistical Office of the European Community (EUROSTAT) the evaluation based on indicators in the Slovak Republic has started, after the sets of sector indicators were created for the selected six sectors - industry, energy, transport, agriculture, forestry and tourism, as indicated by the Ministry of Environment of the Slovak Republic (2022). In each sector, individual indicators are organized into three groups. The first group consists of indicators describing the trends and development of the sector significant in relation to the environment. The second group of indicators is dedicated to the sector's interactions with the environment, including both the sector's demand for resources and its impact on the environment. The third group includes indicators reflecting political, economic and social aspects such as society's reactions to mitigation, or compensation for the negative consequences of the sector on the environment respectively. A reduction in the use of non-renewable resources may indicate an increase in efficiency or a transition to a more sustainable economy. Dependence on certain materials determines the vulnerability of the economy in relation to price changes in international commodity markets. Sectoral changes in the share of materials used may indicate structural changes in the economy, as observed by the Ministry of Environment of the Slovak Republic (2022). The share of imports per DMC is an important indicator of the sensitivity of the country's economy to fluctuations in international trade. The dependence of the Slovak economy on the import of raw materials increased from 64.4% in 2018 to 71.8% in 2022, which indicates an increase in dependence on these imports. The term "material import dependency" refers to the degree to which the economy is dependent on imports to meet its material needs. This indicator expresses the ratio of imports to direct material inputs (DMI) in percentage. Dependency on material imports cannot be negative or higher than 100%.

Material Import Dependency refers to the extent to which the economy is dependent on imports to meet its material needs. This indicator expresses the ratio of imports to direct material inputs (DMI) in percentage. Dependence on material imports cannot be negative or higher than 100%.

A value of 100% means that there is no domestic production in the base year. Slovakia is an open economy with economic growth and a lack of resources. Therefore, it is very dependent on the export of raw materials from other countries. The implementation of policies aimed at improving the efficient use of resources and achieving ecological growth is of fundamental importance for sustainable growth and prosperity. The growth of material consumption has a significant impact on the environment, including climate change. However, it is not the only impact on the environment. In 2022, the energy sector accounted for 57% of total emissions. The transition of businesses, especially the energy sector, to a circular economy is key to achieving climate goals in the Slovak Republic.



	2018	2019	2020	2021	2022
waste for final processing and disposal	0	0,002	0,002	0	0
other products	0,642	0,605	0,564	0,581	0,582
fossil energy materials/carriers	3,404	3,164	2,89	3,016	2,903
non-metallic raw materials	8,238	7,549	7,432	7,576	7,57
rudy the greatnon-metallic raw materials	2,795	2,478	2,332	2,873	2,477

Figure 2. Development of direct material inputs by material groups in Slovakia
Source: Eurostat (2023a)

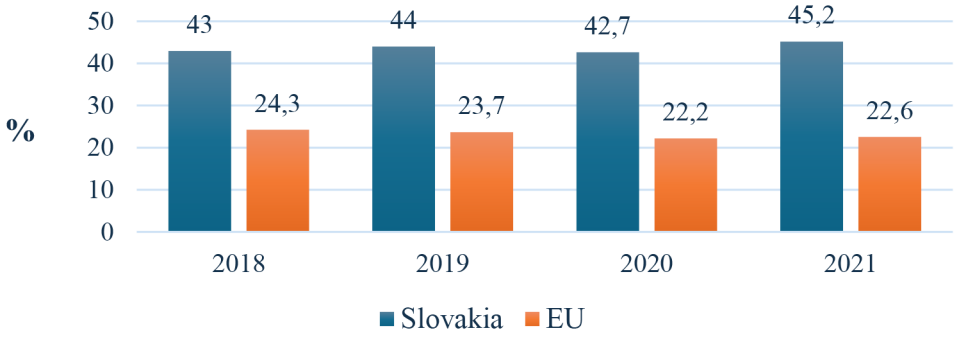


Figure 3. Dependence on material imports
Source: Eurostat (2023b)

4. ECO-INNOVATION PERFORMANCE OF SELECTED COUNTRIES

Enterprises are the carriers of change in each economy. Their innovative activities are key in achieving environmental goals. Regarding ecological innovations, information is provided by the survey on business innovation activities, which is carried out in EU member states. According to this survey, there are more innovating companies in Slovakia that have introduced an innovation with a benefit to

the environment than in the EU, the biggest difference is in the case of effects "recycling waste, water or materials for own use or sale within the company", which we can also consider as an indicator of the currently popular circular economy concept. According to Morvay (2023), this favourable situation is attributed to the high share of foreign-controlled enterprises in the corporate sphere in Slovakia.

An efficient way of using energy and materials, the selection of suitable sources of energy and materials creates economic growth, which is one of the main goals of the economic policy of the state, and business entities. Investments in research and development open new opportunities through which companies can achieve a competitive advantage. By implementing environmental measures, businesses can effectively respond to the effects of various factors with the impact of environmental disasters and environmental damage. The implemented environmental measures of legal entities in the current market economy, as well as the growth of business groups and partnerships and their decision-making regarding sustainability, as well as the fulfilment of strict standards are examples of preferring environmental solutions and sustainable products and services. The state of eco-innovation performance of various countries is indicated by the eco-innovation index, the essence of which is to measure the level and efficiency of ecological innovations in individual countries. It consists of several groups/components, which are eco-innovation inputs, activities, outputs, resource efficiency results and socio-economic results. Table 1 presents the evaluation of the ecological performance of the Slovak Republic and the EU through the eco-innovation index.

Table 1. Comparison of selected countries according to the ecological innovation index

Year	European Union	Slovak Republic	European Union	%-Increase	Slovak Republic	%-Increase
2016	106,16	82,04	95,21	104,66	30,71	47,34
2018	109,44	85,59	94,41	108,87	36,27	43,72
2019	111,05	79,08	89,46	114,25	19,40	40,50
2020	112,39	85,48	101,27	120,04	22,98	44,87
2021	115,84	88,05	96,70	126,28	29,66	49,18
2022	121,47	94,41	93,11	129,90	31,63	52,70

Source: Authors based on European Commission (n.d.)

Explanations: x = difference between the value of the eco-innovation index (2022, 2014) and the percentage growth/decrease from 2014 to 2022.

A synergistic, continuous approach to sustainability has a positive impact on the gradual growth of the European Union's eco-innovation index, which indicates that the European economy is focused on such initiatives and innovations that increase the level of environmental protection and contribute to sustainable growth. The European economy consists of the economies of the EU countries, among which there are countries with both higher and lower ecological activity. The data analysis in Table 2 presents the dynamics of changes in the eco-innovation index. Countries below the EU average are Poland (2022, 67.37), Hungary (2022, 81.15) and Slovakia (2022, 94.41). On the opposite side, there is an ecologically active country, Austria (year 2022, 173.86) with the most significant percentage growth of the index by the value of 10.58 in the period of 2021-2022. Figure 4 presents the development of Slovakia's eco-innovation index in the period 2013-2022. In the period under review, we note a gradual increase in the value of the index from 2013 (value 68.13) to 2022 (value 94.41). The exception is a decrease in value in 2019 (%-increase -7.61) and a slight stagnation in 2020 and 2021 compared to 2018.

The dynamics of changes were largely influenced by the epidemiological situation with the disease COVID-19.

Figure 4. The eco-innovation index of Slovakia in the time interval of 2013 – 2022

Source: Authors based on European Commission (n.d.)

Table 2 presents a comparison of two selected indicators, namely the indicator of government expenditures in the field of the environment and the indicator of the representation of personnel and science and research workers in the field of the environment. The data show that in the period from 2014 to 2022, all countries except Poland increased their performance in the group of eco-innovation inputs of the eco-innovation index. The only indicator that saw a decline in value during this period was government appropriations and expenditures.

Table 2. Comparison of the Slovak Republic and the EU based on 2 indicators of the group of eco-innovation inputs

Year	European Union		Slovak Republic	
	A	B	A	B
2014	95,21	104,66	30,71	47,34
2016	94,41	108,87	36,27	43,72
2018	89,46	114,25	19,40	40,50
2019	101,27	120,04	22,98	44,87
2020	96,70	126,28	29,66	49,18
2021	93,11	129,90	31,63	52,70
2022	108,59	135,43	45,46	59,79
x	14,05	29,40	48,03	26,30
y	1,25		1,32	

Explanations: A = Government appropriations and expenditure in the field of environment and energy; B = Total personnel and R&D personnel in the field of environment; x = Percentage growth/decrease from 2014 to 2022; y = Ratio between indicators B and A.

Source: Authors based on European Commission (n.d.)

The data showcases that Slovakia is the 2nd worst development of the value of eco-innovation inputs. In 2022, the value increased by 27.46% to 51.34, but in 2018 and 2019 these values were very low (28.06 and 31.97), which was deeply below the EU average (2018 and 2019: 99.64 and 108 .98). The highest percentage increase in the value of inputs during the entire interval among the selected countries was achieved by Hungary in 2018 (increase by 44.77%) and Austria in 2022 (increase by 44.62% to a well above average value of 141.89). Countries as Austria and the Czech Republic and the EU have higher values of eco-innovation inputs, and countries as Hungary, Slovak Republic and Poland have lower values. Recorded data from Slovakia point to a low level of eco-innovation inputs for both indicators. The comparison of Slovakia and the EU for the year

2022: eco-innovation inputs (SR=51.34; EU=119.61), government appropriations and expenditures (SR=45.46; EU=108.59) and total staff and research workers and development (SR=59.79; EU=135.43).

When evaluating the country's eco-innovation performance, the indicators include energy productivity and greenhouse gas emission productivity (Table 3).

Table 3. Comparison of the Slovak Republic and the EU based on two indicators of resource efficiency results in 2014, 2016 and 2018-2022

Year	European Union		Slovak Republic	
	C	D	C	D
2014	100,99	104,16	44,29	85,21
2016	109,86	120,03	51,49	100,2
2018	112,86	129,37	54,58	96,12
2019	113,97	134,47	52,32	93,64
2020	117,97	144,75	56,93	97,26
2021	123,36	161,84	59,56	112,6
2022	127,23	172,74	58,57	118,6
x	25,98	65,84	32,24	39,16

Explanations: D = Energy productivity; C = Productivity of greenhouse gas emissions; x = Percentage growth/decrease from 2014 to 2022

Source: Authors based on European Commission (n.d.)

Energy productivity represents the level of economy in the use of energy. If it is used effectively, there is a decrease in costs, less environmental impact and high competitiveness. It is a key factor for sustainable development. The highest values in the indicator - energy productivity among the selected countries were recorded by Austria (year 2022=151.02) and at the same time it is above the average in comparison with the EU (127.23). Significantly below average values were recorded by Slovakia (58.57), Hungary (52.69), Poland (52.3) and the Czech Republic (50.28). Productivity of greenhouse gas emissions represents the relationship between the produced economic value (e.g. GDP) and the generated greenhouse gas emissions. A higher value indicates higher value productivity with lower emissions. A significantly above-average value was recorded by Austria (year 2022=241.4) compared to the EU (172.4). Deeply below average values were recorded by the Czech Republic (90.86) and Poland (65.88). Slovakia recorded a value of 118.6. The positive thing is that all selected countries and the EU show a relatively high % increase.

5. FUTURE RESEARCH DIRECTIONS

Slovakia's ecological performance is not yet at the required level compared to EU countries. To reach the European level, a wider scope of involvement of public institutions, business entities and the population throughout the country is necessary. The key tasks for the near future include better information of population, the creation of regional policies emphasising citizen's interest in the environment and sustainability, reducing the environmental burdens and increasing ecological performance. Measures to support the competitiveness of the Slovak Republic and its individual regions in the eco-innovation performance are of key significance for the future development of the country. Kollár and Matúšová (2023) stated that the transition to a circular economy and the reduction of regional disparities is determined by cooperation among European countries, effective use of resources in research and development of new ecological technologies and procedures. The exchange of best practices and experiences among countries could contribute to the effective implementation of eco-innovations and policies regarding the removal of regional disparities.

Coordination measures enable creation of harmonized policies that facilitate international entrepreneurship. Equally important is a high-quality coordination institutional framework setup supporting consistent and effective management of environmental policies. According to Kollár and Matúšová (2023), it also requires better quality monitoring of indicators that point to the real state of eco-innovation performance and circulation of the country and regions.

6. CONCLUSION

Effective use of resources has a significant impact on reducing the cost of raw materials, energy and other inputs. It is important for the increase of the profitability of businesses, better availability of products and services for consumers, and the increase of competitiveness at the national and international level. Effective use of resources may promote the transition from a linear model to a circular model of the economy, to the reduction of waste and, consequently, to the reduction of the environmental burden. From the aspect of long-term sustainability, it is important that currently available resources will be available also for future generations. The quality of indicator monitoring is crucial for an accurate assessment of the eco-innovation performance and the degree of circularity in the country and regions. Objective information on the positive and/or negative advancement in the implementation of eco-innovations and the transition to a circular economy is necessary for the consistency and transparency of the monitoring, the accountability in the implementation of environmental goals, which are necessary for the long-term sustainability and competitiveness of the country. Research and development support represent the most important pillars of sustainable development, the key to strengthening the environmental industry, and creating new ecological technologies and environmentally friendly processes. Research and development must be linked to education and training in the circular economy. Investments in education and should promote awareness of recycling, waste reduction and efficient use of resources. According to Kollár and Matúšová (2023), the implementation of educational programs prepares the next generations for relevant solutions.

Acknowledgment

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The Impact of the Belt and Road Initiative on Country Indebtedness

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Fixed effects model

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Abstract: *This research investigates the impact of China's Belt and Road Initiative (BRI) on public debt levels in participating countries. Using a panel dataset covering 173 countries across various income groups and regions, we apply quantitative analysis to assess whether BRI involvement is associated with increased sovereign indebtedness. The study incorporates macroeconomic and institutional variables to capture both structural and policy-related dynamics. Our findings suggest nuanced relationships between BRI participation and debt outcomes, highlighting the importance of governance quality, economic structure, and financing terms. The results contribute to the literature on debt sustainability in the context of global infrastructure initiatives and offer evidence-based insights for policymakers considering external development financing.*

1. INTRODUCTION

The Belt and Road Initiative (BRI) is conceptualized as a strategy to stimulate economic growth by developing infrastructure, promoting trade, and enhancing economic interconnectedness. This approach corresponds with the BRI's Five Cooperation Priorities: policy coordination, infrastructure connectivity, unimpeded trade, financial integration, and people-to-people exchanges (Jenkins, 2021). The financial integration aspect implies that participating countries often depend on external funding to support large-scale infrastructure investments. As a result, the inflow of foreign loans—mainly from Chinese financial institutions—can contribute to rising public debt, posing risks to the fiscal sustainability of these nations (Zhang, 2020).

The relationship between participation in the Belt and Road Initiative (BRI) and public debt is multifaceted, involving various economic, political, and social dimensions. The BRI, launched by China, aims to enhance global trade and stimulate economic growth across Asia and beyond through extensive infrastructure investments. However, these investments often lead to significant increases in public debt for participating countries, raising concerns about debt sustainability and economic stability.

One of the primary mechanisms through which BRI participation affects public debt is the increase in infrastructure financing. As noted by Hurley et al. (2019), the BRI is associated with substantial infrastructure financing, which often involves loans to sovereign borrowers. This practice can elevate the risk of debt distress, particularly in countries that already have precarious financial situations. The

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World Bank has raised concerns about rising public and corporate debt in BRI countries, emphasizing the need to maintain debt sustainability to mitigate vulnerabilities (Zhan, 2023). Furthermore, Li et al. (2022) found that BRI participation leads to increased corporate debt due to enhanced financing sources and reduced costs for companies involved in BRI projects, which indirectly contributes to the overall public debt burden as governments often guarantee these corporate debts.

Moreover, the implications of public debt on economic growth are significant. Studies indicate that high levels of public debt can stifle economic growth and exacerbate income inequality, particularly in BRI countries where corruption may further complicate the effective utilization of borrowed funds (Mehmood et al., 2019). The relationship between public debt and economic performance is complex, as evidenced by research showing that excessive debt can lead to reduced investment and slower economic growth (Bidzo, 2018). This is particularly concerning for low-income countries participating in the BRI, where the potential for debt overload is high, and the capacity to service debt is often limited (Narins & Agnew, 2021).

The geopolitical context of the BRI also plays a crucial role in shaping the debt landscape. Countries engaging with the BRI may find themselves in a "debt trap," where the need for continued borrowing to service existing debts leads to a cycle of dependency on Chinese loans (Wong, 2020). This situation is exacerbated by the COVID-19 pandemic, which has intensified the financial pressures on BRI participants, leading to fears of a repeat of historical debt crises (Narins & Agnew, 2021). The lack of transparency and due diligence in BRI projects has raised alarms about the long-term sustainability of the debt incurred, as many projects may not yield the expected economic returns (Baltensperger & Dadush, 2019).

While the BRI presents opportunities for infrastructure development and economic growth, it also poses significant risks related to public debt. The interplay between increased borrowing for infrastructure projects and the potential for economic stagnation due to high debt levels underscores the need for careful management of debt sustainability in BRI-participating countries. Policymakers must navigate these challenges to harness the benefits of the BRI while mitigating the risks associated with rising public debt.

2. METHODOLOGY

Based on the literature reviewed and the rising popularity of China's Belt and Road Initiative (BRI), we decided to investigate whether countries experience an increase in debt after joining the Belt and Road Initiative.

We set out the following hypothesis:

- Entry into the Belt and Road Initiative leads to an increase in the gross government debt of countries.

To test the hypothesis, we conducted an R-studio analysis and used a fixed effects model. The fixed effects model (FEM) is one of the most widely used models for examining panel data. (Lukáčiková et al., 2018)

The fixed effects model allows us to examine the effects of different variables on government debt.

To conduct the study, we collected data for 173 countries (i) over the period from 2012 to 2022 (t). We collected data from all countries in the world, where at the beginning of the research we

had a sample of 217 countries, but due to the unavailability of some data we had to eliminate it to a smaller number of countries. The complete list of included countries is provided in the attachments. The data used in our analysis were obtained from the World Development Indicators (WDI) database compiled by the World Bank, which provides statistical information on a wide range of development indicators for countries around the world, and from the International Monetary Fund (IMF). The table shows the independent variables as well as the dependent variable General government gross debt.

Table 1. List of indicators used

General government gross debt	log_Gen_gov_gross_debt (IMF, 2024)
GDP (constant 2015 US$)	log_GDP (WBG, 2024)
Real efective exchange rate	Log_REER (WBG, 2024)
Exports of goods and services (% of GDP)	log_Exp_GS (WBG, 2024)
BRI	BRI Sacks in Krivosudská, Kittová a Steinhauser, 2022

Source: Own processing

For our analysis, the FEM equation takes the form:

$$\log(\text{Gen_gov_gross_debt})it = \alpha i + \beta 1 \log(\text{GDP})it + \beta 2 \log(\text{Exp_GS})it + \beta 3\ \text{BRI}it + \beta 4 \log(\text{REER})it + uit \quad (1)$$

Where:

- log(Gen_gov_gross_debt)it is the logarithm of gross government debt for country i at time t.
- αi is the individual fixed effect component for country i.
- log(GDP)it is the logarithm of gross domestic product for country i at time t.
- log(Exp_GS)it is the logarithm of exports of goods and services for country i at time t.
- BRIit is the indicator variable for participation in the Belt and Road Initiative for country i at time t.
- log(REER)it j is the logarithm of the real effective exchange rate for country i at timet.
- uit is the error term for country i at time t.

General government gross debt represents the total value of all financial liabilities that the general government has to creditors. This indicator includes all levels of government, including central, regional and local government, as well as social funds. General government gross debt includes debt instruments such as government bonds, loans and other forms of public debt. This indicator is important for assessing the fiscal stability and sustainability of a country's public finances (IMF, 2024).

GDP (constant 2015 US$) represents the total value of all goods and services produced in an economy each year, adjusted for the effect of inflation. Using constant 2015 prices allows the impact of changes in the price level over time to be eliminated, providing a more accurate picture of the actual growth or decline in economic activity. This indicator is important for the analysis of economic developments as it allows for the comparison of economic performance in different periods without inflation distortions. The resulting value is expressed in US dollars, which allows international comparison between countries (WBG, 2024).

The real effective exchange rate reflects the impact of factors such as changes in exchange rates or inflation, which promote favourable conditions for a country's exports (Plchová, 2005). Darvas

(2012) adds that the most used price and cost indicators for REER include consumer prices (CPI), producer prices (PPI), GDP deflator and unit labour costs (ULC). The use of the REER improves the modelling considerably by considering the evolution of the value of the currency and the price level. However, the inclusion of the REER in the models may reduce the number of observations as many economies do not have data available for this indicator.

Exports of goods and services (% of GDP) represent the share of the total value of all goods and services exported by a country in its gross domestic product (GDP). This indicator captures how important exports are to a country's economy and allows an assessment of the extent to which an economy is dependent on international trade (WBG, 2024).

BRI The Belt and Road Initiative (BRI) variable represents China's initiative. In the case of the BRI indicator, we created an artificial variable for each cross-sectional unit. The variables take the value of 0 or 1, where 1 represents the year of entry into the BRI and we assign 0 for years when countries were not part of the initiative.

We began our analysis by creating a database to serve as a basis for further action. A good quality database is crucial because all our further results are based on it. We created the database in Excel, where the first column, labeled "i", contains a list of all the countries used in the paper. The second column, labeled "t", represents the time data, namely the years 2012 to 2022, and the remaining columns contain the dependent (y) and independent (x) variables. We uploaded the finished database to R Studio. We used the R packages dplyr, readxl, plm, and lmtest to analyze the data and create the panel data model.

These packages provided robust tools to efficiently process, analyze, and model our panel data, contributing to the reliability and accuracy of the results.

Residuals:					
Min.	1st Qu.	Median	3rd Qu.	Max.	
-1.6967898	-0.1004275	-0.0079673	0.1144587	2.0066233	
Coefficients:					
	Estimate	Std. Error	t-value	Pr(>|t|)	
log_GDP	0.051347	0.248198	0.2069	0.836155	
log_Exp_GS	-0.482716	0.149195	-3.2355	0.001263	**
BRI	0.263741	0.055396	4.7610	2.277e-06	***
log_REER	-0.573642	0.264786	-2.1664	0.030565	*
Total Sum of Squares:		73.999			
Residual Sum of Squares:		58.993			
R-Squared:		0.20279			
Adj. R-Squared:		0.11928			
F-statistic:	52.2098 on 4 and 821 DF		p-value:	< 2.22e-16	

Figure 1. Fixed effects model analysis in R-studio
Source: Own research

3. RESULTS

The analysis including the BRI, log_GDP, log_Exp_GS and log_REER variables provided important insights into the factors influencing countries' gross government debt. The results are presented based on the statistical significance and interpretation of the coefficients of each variable:

BRI (Belt and Road Initiative):

Based on the low p-value for the BRI variable, we reject the null hypothesis of insignificance of the parameter estimate. The confidence interval does not contain a value of 0, confirming the existence of a relationship between BRI membership and the dependent variable. The coefficient suggests that countries that have joined the BRI have on average 0.26 percentage points higher gross government debt, which may be due to higher use of foreign financing and investment.

Log_GDP:

The coefficient for the log_GDP variable was not statistically significant (p-value > 0.05). Although the estimate was positive, its value was close to zero, indicating that log_GDP does not have a significant effect on gross government debt in the observed model. This result may be influenced by other factors that neutralize the effect of economic performance on government debt.

Log_Exp_GS (exports of goods and services):

This coefficient was statistically significant at the 0.01 level (p-value < 0.01), and the results showed a negative relationship between the logarithm of exports of goods and services and gross government debt. An increase in exports is associated with a decrease in gross government debt, which may be the result of an improved trade balance, higher foreign exchange reserves and less need for external financing.

Log_REER (real effective exchange rate):

The log_REER variable has a statistically significant negative effect on gross government debt. This result suggests that an improvement in the real effective exchange rate is associated with a decline in gross government debt, which may be due to higher competitiveness, economic stability and growth in export earnings. For policymakers, this result underlines the importance of promoting competitiveness and exchange rate stability in reducing government debt.

Based on the results of the regression analysis, we can conclude that participation in the Belt and Road Initiative (BRI) is associated with an increase in gross government debt. These findings support concerns that projects financed under the BRI framework may contribute to significant fiscal burdens, especially in countries with weaker debt management capacities or limited economic diversification.

To illustrate how BRI-related financing can translate into sovereign debt pressures, we reference two well-known examples from the broader public discourse. Montenegro, for instance, undertook a highway construction project between the cities of Bar and Boljare, financed by a loan from the Export-Import Bank of China amounting to one billion euros. According to Martinovic and Milovic (2022), this loan represents a substantial portion of the country's public debt. The inability to generate sufficient revenue from the highway raised concerns about repayment capacity and contributed to economic strain, increasing the country's financial dependence on China.

Similarly, Sri Lanka utilized BRI funding to construct the Hambantota port, a project whose costs far exceeded anticipated revenues. As Wignaraja et al. (2020) note, Sri Lanka was ultimately unable to service its debt, leading to the transfer of port control to a Chinese company for 99 years. This case has sparked international debate about sovereignty, debt sustainability, and the long-term implications of infrastructure-linked borrowing.

These examples serve to contextualize the quantitative findings by highlighting the real-world risks of BRI-related debt accumulation. While they are not the primary focus of this study, they underscore the importance for governments to carefully assess the economic and strategic implications of large-scale infrastructure financing through external sources.

The study reveals a strong link between participation in the Belt and Road Initiative (BRI) and rising public debt levels. Supporting this, Li et al. demonstrate that BRI engagement also correlates with higher corporate debt, especially when governments back corporate loans, further intensifying public debt burdens (Li et al., 2022). Using a difference-in-differences methodology, they show that corporate indebtedness tends to surge after BRI adoption, with a possible stabilization depending on how well debt is managed.

The economic consequences of growing public debt are complex, often undermining growth and stability. Huang (2016) argues that excessive debt can limit public investment, dampening economic performance over the medium and long term. This is particularly critical for lower-income BRI countries, where limited fiscal space hampers debt servicing and increases the likelihood of default (Cao et al., 2022). Rauf et al. further stress that unsustainable debt undermines financial stability and can negatively affect broader socio-economic outcomes in BRI nations (Rauf et al., 2018).

4. FUTURE RESEARCH DIRECTIONS

The results of this study open up several interesting directions for future research. One important area could be exploring the long-term effects of projects funded by the Belt and Road Initiative (BRI) on participating countries. For example, future studies could look into how these projects contribute to better infrastructure, job creation, and economic growth in the regions involved.

Another important question is how the increased debt from BRI projects affects the financial health of these countries in the long run. Researchers could also compare the impact of the BRI in different parts of the world, like Asia, Africa, and Eastern Europe, to see how the outcomes vary depending on regional factors.

There's also room to explore alternative ways to finance big infrastructure projects that might reduce the debt burden for countries while still allowing them to grow. Since sustainability is a growing concern, it would also be worth studying how BRI projects affect the environment and local communities and whether they align with global goals for sustainable development.

Lastly, adding more economic factors, like inflation, interest rates, or how open a country is to trade, could help create a fuller picture of what drives public debt and how initiatives like the BRI fit into that. By diving into these areas, future research could provide useful insights for countries looking to balance the benefits and risks of participating in global development projects like the BRI.

5 CONCLUSION

Our research confirmed the existence of a relationship between participation in the Belt and Road Initiative (BRI) and the increase in gross government debt of participating countries. We conclude that BRI membership is associated with a 0.26 percentage point rise in public debt. This result highlights the financial risks tied to BRI-financed projects, particularly in nations that rely heavily on foreign funding for infrastructure development.

We explain this increase in debt as a consequence of the high upfront costs and repayment obligations of large-scale infrastructure projects funded under the BRI. While these projects often promise economic benefits, such as improved connectivity and trade potential, the associated financial risks can outweigh these benefits in the absence of strong fiscal safeguards. At the same time, our analysis shows that higher export earnings and stable real effective exchange rates help reduce public debt, suggesting that a focus on boosting export capacity and maintaining currency stability can mitigate these risks.

However, it is important to point out the limitations of this research. The analysis did not account for the long-term economic benefits of BRI projects, such as increased productivity or regional integration, which may balance or even offset the short-term debt increase. Additionally, our findings are limited by the availability and quality of data, particularly for countries with incomplete economic indicators.

We therefore recommend that future research examines the broader economic, social, and environmental implications of BRI projects over a longer time horizon. Researchers should also explore alternative financing mechanisms to balance infrastructure development with fiscal sustainability. These insights can help policymakers adopt strategies that maximise the benefits of BRI projects while managing their associated risks effectively.

The relationship between BRI participation and public debt underscores the need for careful planning and robust financial frameworks. By addressing these challenges, participating countries can enhance the long-term benefits of the initiative while minimising its potential drawbacks.

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Appendix

Table 2. List of countries

Afghanistan	Djibouti	Lebanon	Samoa
Albania	Dominican Republic	Lesotho	Sao Tome and Principe
Algeria	Ecuador	Liberia	Saudi Arabia
Angola	Egypt	Lithuania	Senegal
Argentina	El Salvador	Luxembourg	Serbia
Armenia	Equatorial Guinea	Macao SAR, China	Sierra Leone
Australia	Estonia	Madagascar	Singapore
Austria	Eswatini	Malawi	Slovak Republic
Azerbaijan	Ethiopia	Malaysia	Slovenia
Bahamas, The	Fiji	Maldives	Solomon Islands
Bahrain	Finland	Mali	South Africa
Bangladesh	France	Malta	Spain
Barbados	Gabon	Mauritania	Sri Lanka
Belarus	Gambia, The	Mauritius	St. Lucia
Belgium	Georgia	Mexico	St. Vincent and the Grenadines
Belize	Germany	Moldova	Sudan
Benin	Ghana	Mongolia	Suriname
Bhutan	Greece	Montenegro	Sweden
Bolivia	Guatemala	Morocco	Switzerland
Bosnia and Herzegovina	Guinea	Mozambique	Tajikistan
Botswana	Guinea-Bissau	Myanmar	Tanzania
Brazil	Guyana	Namibia	Thailand
Brunei Darussalam	Haiti	Nepal	Timor_Leste
Bulgaria	Honduras	Netherlands	Togo
Burkina Faso	Hong Kong SAR, China	New Zealand	Tonga
Burundi	Hungary	Nicaragua	Trinidad and Tobago
Cabo Verde	Iceland	Niger	Tunisia
Cambodia	India	Nigeria	Turkey
Cameroon	Indonesia	North Macedonia	Turkmenistan
Canada	Iran, Islamic Rep.	Norway	Uganda
Central African Republic	Iraq	Oman	Ukraine
Chad	Ireland	Pakistan	United Arab Emirates
Chile	Israel	Panama	United Kingdom
China	Italy	Papua New Guinea	United States
Colombia	Jamaica	Paraguay	Uruguay
Comoros	Japan	Peru	Uzbekistan
Congo, Dem. Rep.	Jordan	Philippines	Vanuatu
Congo, Rep.	Kazakhstan	Poland	Vietnam
Costa Rica	Kenya	Portugal	West Bank and Gaza
Cote d'Ivoire	Korea, Rep.	Puerto Rico	Zambia
Croatia	Kuwait	Qatar	Zimbabwe
Cyprus	Kyrgyz Republic	Romania	
Czechia	Lao PDR	Russian Federation	
Denmark	Latvia	Rwanda	

Source: Own processing

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How Does Foreign Direct Investment Influence Albania's Economic Growth?

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Keywords:
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Abstract: *In this study, we investigate the dynamic relationship between Foreign Direct Investment (FDI) and economic growth in Albania using a Vector Autoregression (VAR) framework and Granger-causality analysis. Covering annual data from 1992 to 2022, the findings reveal a bidirectional link between FDI and GDP growth, suggesting that economic expansion not only attracts foreign investment but is also reinforced by it.*

The results highlight the importance of sustained economic growth in fostering FDI inflows, offering critical insights for policymakers seeking to enhance Albania's investment climate. Additionally, this research enriches the broader discourse on FDI-growth dynamics, providing relevant implications for emerging economies with similar structural characteristics.

1. INTRODUCTION

In the last three decades, Albania has undergone significant economic transformations, marked by the transition from a centrally planned to a market-oriented economy.

The period from 1992 to 2022 witnessed dynamic changes in Albania's FDI inflows/outflows, reflecting the country's evolving economic priorities, policy frameworks, and external dynamics. In the early years of the transition, FDI inflows were modest but steadily increased as Albania implemented reforms to improve the investment climate and attract foreign capital. Privatization of state-owned enterprises, liberalization of trade and investment regulations, and infrastructure development initiatives were key drivers of FDI inflows during this period.

Understanding the dynamics between FDI inflows and economic growth becomes paramount for policymakers, investors, and researchers alike.

The late 1990s and early 2000s saw a surge in FDI inflows as Albania intensified its efforts to integrate into regional and global markets. Many strategic sectors such as energy, telecommunications, and tourism emerged as focal points for foreign investment, supported by government incentives and investment promotion strategies.

Albania's accession to the World Trade Organization (WTO) in 2000 and the signing of bilateral investment treaties also, further bolstered investor confidence and facilitated FDI inflows.

This study aims to empirically examine the relationship between FDI inflows and economic growth in Albania, shedding light on the mechanisms through which FDI impacts the country's economic performance. FDI, characterized by the investment of foreign capital into domestic enterprises, is often perceived as a catalyst for economic growth, stimulating productivity, technology transfer, and employment generation.

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Albania's attractiveness to foreign investors has been evident in the steady increase in FDI inflows over the past decades, facilitated by liberalization measures, privatization initiatives, and improvements in the business environment. However, the extent to which FDI contributes to sustainable economic growth and development remains a subject of debate.

This study builds upon existing literature on the FDI-growth nexus, with a specific focus on Albania's unique economic context. By employing rigorous empirical methods, including Vector Autocorrection (VAR) modelling and Granger causality testing, we seek to unravel the complex relationship between FDI inflows and economic growth in Albania.

Through exploratory data analysis, correlation analysis, and VAR modelling, we aim to provide insights into the dynamic interactions between FDI inflows and economic growth, capturing both short-term dynamics and long-term trends.

Figure 1. Albanian FDI as percent to GDP
Source: World Bank (2024)

The findings of this study have implications for policymakers tasked with formulating strategies to attract and harness FDI for sustainable economic development in Albania. Additionally, investors and multinational corporations seeking investment opportunities in Albania stand to benefit from a nuanced understanding of the relationship between FDI and economic growth.

This study contributes to the growing body of literature on the FDI-growth nexus, offering empirical evidence and policy insights tailored to Albania's economic context. By elucidating the mechanisms through which FDI influences economic growth, this research aims to inform evidence-based policy decisions and promote inclusive and sustainable development in Albania.

The rest of the paper is structured as follows: Section two provides a literature review. Section three presents the methodology employed in the paper and the results achieved. Section four discusses the results. Finally, section five concludes and makes suggestions for future research.

2. LITERATURE REVIEW

Since Albania transitioned to a market economy in 1989, Foreign Direct Investment (FDI) and trade have played a central role in driving economic activity. Several studies highlight a long-term

positive relationship between FDI and economic growth, often attributing this to capital inflows, technology transfer, and enhanced management practices (Cakerri et al., 2020; Boriçi & Osmani, 2015). Boriçi and Osmani (2015) specifically emphasize FDI's role in technological development and sustained growth.

Gjini (2024) examines the relationship between economic growth and globalization in Albania from 1980 to 2022, finding that higher levels of globalization positively impact economic growth by promoting trade liberalization, attracting foreign investment, and enhancing competitiveness. Empirical findings also suggest that FDI has supported Albania's structural transformation and sectoral competitiveness, particularly in telecommunications and banking. Muço (2001) argues that the impact of FDI is closely tied to institutional quality, highlighting the importance of governance and transparency in maximizing growth benefits.

Hysa and Hodo (2016), using quarterly data from 1991 to 2012, confirm a strong long-term link between FDI and GDP growth, supporting theoretical claims around FDI's contribution through human capital formation and productivity gains. Similarly, Bezo Balili and Lleshaj (2021) find that FDI is a primary driver of economic growth, with greater returns than domestic investment, and a positive relationship with exports, wages, and efficient use of external debt.

Trade and FDI also appear interlinked. Using annual data from 1993 to 2018, Voka et al. (2023) report a long-run positive relationship between FDI and trade, but a negative association between trade and GDP. Granger causality tests indicate that changes in GDP and trade drive FDI. Hobbs et al. (2021) similarly find long-term relationships among FDI, trade, and GDP, though short-run effects show GDP influencing FDI and exports, not vice versa.

However, not all findings are consistent. Golitsis et al. (2018) find no clear link between FDI and economic growth in Albania. Xhindi and Shestani (2020) offer even more complex results, showing a negative impact of FDI on growth, and unexpectedly, a positive relationship between corruption and economic performance, underlining the importance of institutional context in transition economies.

3. METHODOLOGY AND RESULTS

To briefly introduce our model with two variables AGR and FDI. In a simple VAR model, each of these variables will be regressed on its own lagged values and the lagged values of the other variable. Given that we have only two variables this case represents a bivariate VAR model. The system of equations is presented below:

$$AGR_t = \alpha_1 + \sum_{j=1}^{k} \beta_j AGR_{t-j} + \sum_{j=1}^{k} \chi_j FDI_{t-j} + \mu_{1t} \quad (1)$$

$$FDI_t = \alpha_2 + \sum_{j=1}^{k} \varepsilon_j AGR_{t-j} + \sum_{j=1}^{k} f_j FDI_{t-j} + \mu_{2t} \quad (2)$$

Here we are re-writing our two previous equations in a matrix form.

$$\begin{bmatrix} AGR_t \\ FDI_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \beta_1 & \chi_1 \\ \varepsilon_2 & f_2 \end{bmatrix} \begin{bmatrix} AGR_{t-1} \\ FDI_{t-1} \end{bmatrix} + \dots\dots\dots + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \end{bmatrix} \quad (3)$$

Where α_1 and α_2 represent the constants and AGR and FDI on the left-hand side are the endogenous variables. β_j of AGR_{t-j} and χ_j of FDI_{t-j} represent the coefficients of lag variables of AGR and FDI, μ_{1t} and μ_{2t} represent the error terms of each equation respectively.

Hypothesis One: Economic growth stimulates FDI inflows.

Hypothesis Two: FDI inflows stimulate economic growth.

For this paper, we are utilizing annual time series data obtained from the World Bank for the period 1990-2022. We will conduct econometric tests on our variables representing annual growth rate (AGR) and foreign direct investments (FDI). Firstly, we will analyze the stationarity of the variables by employing the Augmented Dickey-Fuller Unit root test. Following this, we will estimate the Johansen Cointegration rank test. Additionally, we will conduct the Granger causality test. Finally, we will conclude by performing a series of impulse response functions to evaluate the effect of one shock on the current and future values of our two main variables, AGR and FDI.

3.1. Augmented Dickey-Fuller Unit Root Test

Before proceeding with a Vector Autoregression (VAR) model, it is essential to assess the stationarity of the variables involved in the analysis. Stationarity is a fundamental concept in time series analysis, because it determines the stability of the underlying statistical properties over time.

Furthermore, stationarity is a prerequisite for the validity of the statistical VAR model. When time series data are non-stationary, traditional statistical techniques may yield biased or misleading results. Therefore, ensuring stationarity is essential for obtaining reliable estimates and making accurate inferences from the VAR model. In Albania, the year 1997 marked a period of significant turmoil and instability, both politically and economically. The country experienced a series of events that had profound consequences on its economy and society. One of the major events of 1997 was the collapse of several pyramid investment schemes, which led to widespread financial losses for many Albanians. These pyramid schemes promised high returns on investments but ultimately proved to be unsustainable, resulting in financial ruin for countless individuals and families. The collapse of the pyramid schemes triggered widespread protests and civil unrest across the country.

We will perform this test for levels and first differences of our variables (excluding the year 1997). From a first estimate, we can see that FDI inflow variable is not stationary, so we are transforming it by calculating the first difference, which aimed to stabilize the series and make them more amenable to statistical analysis within the VAR framework.

Table 1. Augmented Dickey-Fuller (ADF) unit root test at levels and first difference

		Levels			First difference		
Variables	**Sample period**	**ADF T-Stat**	**p-Value**	**Critical Value (5%)**	**ADF T-Stat**	**p-Value**	**Critical Value 5%)**
AGR	Before 1997	-4.421	0.0003	-3.000	-3.336	0.0134	-3.000
AGR	After 1997	-6.294	0.0000	-3.000	-10.582	0.0000	-3.000
FDI	Before 1997	-9.662	0.0000	-3.000	-	-	-
FDI	After 1997	-4.876	0.0000	-3.000	-6.924	0.0000	-3.000

Source: Own calculations

For each of the two variables AGR and FDI (level and first difference) analysis, we can conclude based on the results, that the null hypothesis [the time series data contains a unit root, indicating non-stationarity] can be rejected, and both them are stationary.

3.2. Johansen Cointegration Rank Test

After establishing the stationarity of the variables representing FDI and economic growth, the next step is to assess whether there exists a long-run relationship between them. By conducting the Johansen cointegration test, we aim to determine if FDI and economic growth move together over time despite short-run fluctuations, indicating a cointegrating relationship.

The null hypothesis is that there is no cointegration relationship between the variables, and the alternative hypothesis is that there is at most one cointegration relationship. Based on the Johansen tests for cointegration, we can conclude that there is the presence of at least one cointegration relationship between the variables AGR and FDI. Specifically:

For the Trace test, the null hypothesis of no cointegration (r=0) is rejected at the 5% significance level, indicating that there is at least one cointegration relationship between the variables. Similarly, for the Maximum Eigenvalue test, the null hypothesis of no cointegration (r=0) is rejected, providing further evidence of cointegration.

Additionally, the test for "At most one cointegration (r≤1)" also supports the presence of cointegration, as the null hypothesis of r≤1 is not rejected.

Overall, these results indicate a long-run relationship between economic growth and foreign direct investments, which suggests a movement together despite short-run fluctuations.

Table 2. Johansen cointegration test AGR-FDI (Trace and Maximum EigenValue)

Hypothesis	Test	Rank	Eigenvalue	Test Statistic	Critical Value (5%)
No Cointegration (r=0)	Trace	0	-	40.3578	15.41
At most one Cointegration (r≤1)	Trace	1	0.62863	12.6220	3.76
No Cointegration (r=0)	Maximum Eigenvalue	0	-	27.7358	14.07
At most one Cointegration (r≤1)	Maximum Eigenvalue	1	0.36287	-	-

Source: Own calculations

3.3. Granger causality

Before estimating a VAR model, often researchers conduct the Granger causality test in order to determine causal relationships between variables. Here below we are presenting the results from the Granger causality test. As Table 3 shows the first hypothesis states that annual growth rate does not granger cause FDI.

Based on the Granger causality tests conducted, it was found that there is no statistically significant evidence to suggest that AGR Granger causes FDI, as indicated by a chi-square statistic of 0.6702 with 1 degree of freedom and a corresponding p-value of 0.413. However, there is strong evidence to support the presence of Granger causality from AGR to FDI, with a chi-square statistic of 20.257 and a p-value of 0.000. Hobbs et al. (2021) have achieved the same results in their study.

Table 3. Granger causality: AGR and FDI

	Chi-squared	df	Prob>chi2
AGR to FDI	0.6702	1	0.413
FDI to AGR	20.257	1	0.000

Source: Own calculations

3.4. Joint Lag Selection and VAR Model

The joint lag selection in our time series analysis is the next step to capture the dynamic relationship between AGR and FDI over time in an accurate way. This will help us to identify the optimal level of model complexity that best explains the data without overfitting or underfitting. Based on the results from Table 4 seems that lag3 is the choice for the VAR model for the variables AGR and FDI.

Table 4. VAR lag order selection criteria

Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-92.7888				5.03176	7.29145	7.31932	7.38823
1	-89.4566	6.6644	4	0.155	5.30753	7.34282	7.42642	7.63315
2	-79.3449	20.223	4	0.000	3.34219	6.87268	7.01202	7.35657
3	-68.9822	20.725*	4	0.000	2.08486*	6.38324*	6.57832*	7.06068*
4	-66.8214	4.3215	4	0.364	2.4809	6.52472	6.77554	7.39571

The asterisk (*) denotes the selected lag length. LR (Likelihood Ratio) Test compares likelihood between models with and without lag. Lower FPE (Final Prediction Error) indicates better forecasting. AIC balances fit and complexity, with lower values preferred. HQIC is akin to AIC but penalizes more for complexity. Lower HQIC suggests a better fit. SBIC penalizes parameters, favoring lower values for better fit and complexity trade-off.

Source: Own calculations and processing

Table 5. VAR model

	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
AGR						
AGR						
L1.	-0.020	0.168	-0.120	0.908	-0.349	0.310
L2.	-0.371	0.175	-2.110	0.035	-0.714	-0.027
L3.	0.070	0.190	0.370	0.713	-0.302	0.442
FDI						
L1.	3.097	1.835	1.690	0.091	-0.499	6.693
L2.	-0.453	1.605	-0.280	0.778	-3.600	2.693
L3.	2.528	1.634	1.550	0.122	-0.674	5.729
_cons	-0.090	3.416	-0.030	0.979	-6.785	6.606
FDI						
AGR						
L1.	0.023	0.014	1.650	0.099	-0.004	0.049
L2.	0.032	0.014	2.260	0.024	0.004	0.060
L3.	-0.066	0.015	-4.300	0.000	-0.097	-0.036
FDI						
L1.	-0.008	0.149	-0.060	0.956	-0.301	0.285
L2.	-0.163	0.131	-1.240	0.214	-0.419	0.094
L3.	0.004	0.133	0.030	0.979	-0.257	0.264
_cons	1.370	0.278	4.920	0.000	0.825	1.915

Source: Own calculations and processing

3.5. Residual's Tests

We will perform the Portmanteau test for white noise presented in Table 6 to assess whether the residuals of our model exhibit white noise behaviour, meaning they are independently and identically distributed with constant mean and variance. As we can see from the results The Portmanteau (Q) statistic is 13.3765, while the p-value (Prob > chi2(16)) is 0.6451; meaning that our p-value is greater than the significance level (commonly set at 0.05), and we fail to reject the null hypothesis. Therefore, we do not have sufficient evidence to conclude that there is significant autocorrelation in the residuals. Our residuals appear to be consistent with white noise, indicating that the model adequately captures the serial correlation structure in the data. Also, we will perform the Lagrange-Multiplier Test for Autocorrelation in Table 7 to examine whether there is autocorrelation in the residuals of a time series model up to a specified lag order. The test is conducted at different lag orders, and for each lag order, it produces a chi-squared statistic and associated p-value. The null hypothesis is that there is no autocorrelation at the specified lag order.

Table 6. Portmanteau test

Test	Value
Portmanteau (Q) Statistic	13.3765
Prob > chi2(16)	0.6451

Source: Own calculations and processing

Table 7. Lagrange-multiplier test

lag	chi2	df	Prob>Chi2
1	4.331	4	0.363
2	7.490	4	0.112

Source: Own calculations and processing

Here below in Figure 2, we present the assessment for the stability of our VAR model. We want to check if the model's behaviour remains bounded over time, or if it has an unstable behaviour. The results provided indicate that all the eigenvalues lie inside the unit circle, meaning that the model is stable over time. Also, the model appears to be suitable for the analysis between annual growth rate and FDI, and its predictions are reliable within the context of the data used.

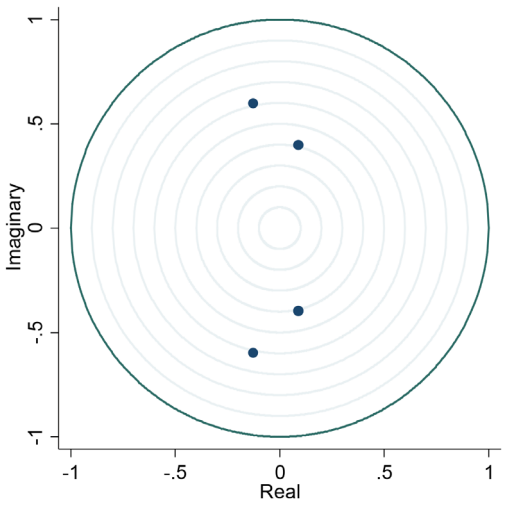

Figure 2. Eigenvalues of the VAR Model

Source: Own calculations and processing

4. DISCUSSION

Overall, our findings contribute to the FDI growth in the existing literature by offering empirical evidence, especially for Albania's economic context. This research provides valuable insights for policymakers, investors, and researchers alike. Informed by these findings, they can formulate evidence-based strategies to attract and harness FDI for sustainable economic development in Albania, while investors can make informed decisions regarding investment opportunities in the country.

However, it is very important to note some limitations. The analysis is based on annual time series data, which sometimes may not capture short-term fluctuations and nuances in the relationship between AGR and FDI. Additionally, the study focuses solely on the quantitative aspects of the FDI-growth relationship, overlooking qualitative factors that may influence investment decisions. Future research could address these limitations by incorporating more granular data and qualitative analysis to provide a comprehensive understanding of the FDI-growth dynamics in Albania.

5. CONCLUSION

The findings of this study offer valuable insights into the dynamic relationship between Foreign Direct Investment (FDI) and economic growth in Albania. By employing Vector Autoregression (VAR) analysis, we aimed to examine the complex interactions between these variables and their impact on Albania's economic performance.

Our analysis revealed several important findings. Firstly, the results of the Johansen cointegration test provided evidence of a long-run relationship between economic growth and FDI in Albania. Despite short-run fluctuations, economic growth and FDI inflows move together over time, suggesting a symbiotic relationship between these variables.

Moreover, the Granger causality test results indicated bidirectional causality between economic growth and FDI inflows. While there was no statistically significant evidence to suggest that AGR Granger causes FDI, strong evidence supported the presence of Granger causality from AGR to FDI. This implies that economic growth stimulates FDI inflows, highlighting the role of economic expansion as a catalyst for attracting foreign investment into Albania.

Furthermore, the VAR model estimation results provided insights into the dynamic interactions between economic growth and FDI inflows. Lag analysis revealed that lag 3 was optimal for capturing the relationship between these variables, suggesting a significant lagged effect on economic growth and FDI.

Additionally, residual tests confirmed the adequacy of the VAR model in capturing the serial correlation structure in the data, with residuals exhibiting white noise behaviour. This indicates that the model adequately represents the relationship between economic growth and FDI in Albania, with reliable predictions and stable behaviour over time.

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Empirical Approaches Regarding the Financial Performance of the US Companies

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Abstract: *The aim of the paper is to determine the factors which have a significant impact on the financial performance of US companies. Using a database consisting of the non-financial companies included in the S&P 500 Index, over the period 2004-2023, there are estimated multiple linear regression models with unbalanced panel data, incorporating fixed effects and random effects. The main results indicate that the global financial crisis led to a decline in the US companies' performance, contrary to the Covid-19 pandemic crisis which conducted to an increase in the performance of the US companies. Moreover, the S&P 500 companies could achieve higher financial performance by increasing the number of members on the board, the percentage of women members on the board, and the company net debt, and lowering the level of company taxation.*

1. INTRODUCTION

In the context of multiple crises, the issue of companies' performance becomes particularly important for research. Over the last two decades, the companies have been hit by two major crises, namely the global financial crisis and the Covid-19 pandemic crisis.

The paper analyzes whether these crises, alongside indicators reflecting the company indebtedness, tangibility, liquidity, taxation, age and size, and other variables characterizing the corporate governance, had a significant impact on the financial performance of the companies, measured as Return on Assets and Return on Equity. There were analyzed other empirical studies which showed both a positive and negative influence of the factors on the companies' performance. Consequently, there were estimated multiple linear regression models with unbalanced panel data, incorporating fixed effects and random effects, using a database consisting of the non-financial companies included in the S&P 500 Index, over 20 years, from 2004 to 2023.

The research results show that net debt, company age, CEO duality, board size, board gender diversity, and the Covid-19 pandemic crisis have a positive impact on the company's performance, while total debt, assets tangibility, taxation, company size, board meetings, and the global financial crisis negatively influences the financial performance of the S&P 500 companies. Moreover, company liquidity positively affects the Return on Assets and negatively influences the Return on Equity.

2. LITERATURE REVIEW

Previous empirical studies highlight both a positive and a negative influence of some factors on the companies performance. According to Boshnak et al. (2023), Harymawan et al. (2020), Kao et al. (2019), La Rocca et al. (2024), Sahoo et al. (2023), Ullah et al. (2020) and Wieczorek-Kosmala et

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al. (2021), indebtedness negative affects the companies performance, Ting et al. (2020) found out that indebtedness has a positive impact on the firm performance, while in the research conducted by Habibniya et al. (2022) the company indebtedness has a positive effect on return on equity and a negative effect on return on assets. The company indebtedness could be expressed in several ways, namely: total liabilities to total assets (Boshnak et al., 2023; Habibniya et al., 2022; Harymawan et al., 2020; Wieczorek-Kosmala et al., 2021), total equity to total assets (Habibniya et al., 2022), total debt to total assets (Kao et al., 2019; La Rocca et al., 2024; Ting et al., 2020; Ullah et al., 2020), total debt to total equity (Sahoo et al., 2023; Ting et al., 2020; Ullah et al., 2020).

Another important factor that could affect the company's performance is represented by the company size measured as the natural logarithm of total assets. The previous studies showed both a positive (Azeez, 2015; Boshnak et al., 2023; Habibniya et al., 2022; Harymawan et al., 2020; Kao et al., 2019; La Rocca et al., 2024) and a negative (Ullah et al., 2020) influence of the company size on the companies performance.

Corporate governance also plays an important role in ensuring company performance. Thence, board size has both a positive (Sahoo et al., 2023) and a negative (Azeez, 2015; Kao et al., 2019) impact on the financial performance of the companies, while board gender diversity only positively affects the firm performance (Boshnak et al., 2023; Sahoo et al., 2023).

Based on the results of the previous studies, there are considered nine research hypotheses:

Hypothesis 1: Indebtedness negatively influences the company performance (Boshnak et al., 2023; Habibniya et al., 2022; Harymawan et al., 2020; Kao et al., 2019; La Rocca et al., 2024; Sahoo et al., 2023; Wieczorek-Kosmala et al., 2021).

Hypothesis 2: Assets tangibility negatively influences the company performance (Harymawan et al., 2020).

Hypothesis 3: Liquidity negatively influences the company performance (Habibniya et al., 2022; Wieczorek-Kosmala et al., 2021).

Hypothesis 4: Company age positively influences the company performance (Azeez, 2015; Sahoo et al., 2023).

Hypothesis 5: Company size positively influences the company performance (Sahoo et al., 2023; Ting et al., 2020; Ullah et al., 2020).

Hypothesis 6: CEO duality positively influences the company performance (Azeez, 2015).

Hypothesis 7: Board size positively influences the company performance (Sahoo et al., 2023).

Hypothesis 8: Board independence positively influences the company performance (Kao et al., 2019; Ting et al., 2020).

Hypothesis 9: Board gender diversity positively influences the company performance (Boshnak et al., 2023; Sahoo et al., 2023).

3. RESEARCH METHODOLOGY

To analyze the factors influencing the performance, there were estimated several empirical models, integrate financial indicators along with indicators characterizing the corporate governance and variables for crisis periods.

The company's performance is represented by two financial indicators, namely Return on Assets (net income to total assets) and Return on Equity (net income to total equity). The independent variables are represented by: indebtedness (total debt to total assets, net debt to total equity), tangibility (tangible assets to total assets), liquidity (current assets to current liabilities), taxation (effective

tax rate), company age (number of years since establishment), company size (natural logarithm of total assets), CEO duality (1 if the CEO is also the Chairman, and 0 otherwise), board size (number of members on the board), board meetings (number of board meetings), non-executive members (the percentage of non-executive members on the board), board independence (the percentage of independent members on the board), board gender diversity (the percentage of women members on the board). There are also two variables to measure the impact that the global financial crisis and the COVID-19 pandemic crisis had on the companies' performance.

The empirical research is carried out on a sample of 442 non-financial companies included in the S&P 500 Index, over 20 years, from 2004 to 2023.

The descriptive statistics of the variables included in the empirical estimations are presented in Table 1.

Table 1. Descriptive statistics

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
ROA	.0719	.0642	-.1038	.2403	.0686
ROE	.1944	.1580	-.3187	1.011	.2247
TDBT	.4212	.4079	0	1.1651	.2673
NETDBT	.6282	.4330	-2.7178	5.4352	1.368
TANG	.2709	.1689	.0192	.8966	.2508
LIQ	1.7913	1.4803	.4956	5.3203	1.0814
ETR	.2374	.2527	-.1680	.5306	.1429
FAGE	33.256	23	1	113	29.9262
FSIZE	23.1700	23.2486	20.0113	25.9597	1.3897
CEOD	.5504	1	0	1	.4975
BSIZE	10.6815	11	7	15	2.0151
BMEET	7.8130	7	4	16	2.9174
NONEXEC	.8583	.8824	.6667	.9333	.0684
INDEP	.8240	.8462	.5556	.9333	.0969
BGENDER	.1930	.1818	0	.6667	.1066
FIN	.1500	0	0	1	.3571
COVID	.1500	0	0	1	.3571

Source: Own computation

The mean value of the Return on Assets is 7.18%, while the mean value of the Return on Equity is 19.44%. The assets' tangibility varies from 1.92% to 89.66%, with an average value of 27.09%. Moreover, the companies included in the S&P 500 Index have a board of directors consisting of 7 to 15 members, while the board gender diversity is not too pronounced, the women members represent, on average, only 19.30% of the total board members.

To evaluate the relationship between variables, Table 2 presents the correlation matrix.

Table 2. Correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) ROA	1.0000					
(2) ROE	0.6031	1.0000				
(3) TDBT	-0.3108	0.3746	1.0000			
(4) NETDBT	-0.2314	0.2820	0.7131	1.0000		
(5) TANG	-0.0547	-0.0230	0.0661	0.1278	1.0000	
(6) LIQ	0.3777	-0.0518	-0.4292	-0.3703	-0.1683	1.0000
(7) ETR	-0.0703	-0.0701	-0.0530	-0.0162	0.1350	-0.0846

(8) FAGE	0.0062	0.0843	0.1134	0.0858	0.0030	-0.1249
(9) FSIZE	-0.3275	-0.0742	0.2828	0.2078	0.1414	-0.3974
(10) CEOD	-0.0954	-0.0078	0.0908	0.0407	0.0565	-0.1529
(11) BSIZE	-0.1858	0.0228	0.2579	0.2076	0.0777	-0.2487
(12) BMEET	-0.1996	-0.0959	0.1492	0.1212	0.0039	-0.1251
(13) NONEXEC	-0.1623	0.0416	0.2595	0.1772	-0.0228	-0.1477
(14) INDEP	-0.1301	0.0229	0.2028	0.1373	-0.0390	-0.1086
(15) BGENDER	-0.0256	0.1459	0.2102	0.1553	-0.0480	-0.2087
(16) FIN	0.0003	-0.0433	-0.0858	-0.0530	0.0444	-0.0017
(17) COVID	0.0302	0.1002	0.0932	0.0758	-0.0050	-0.0687
Variable	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(7) ETR	1.0000					
(8) FAGE	-0.0362	1.0000				
(9) FSIZE	-0.0596	0.1475	1.0000			
(10) CEOD	0.0477	0.2409	0.1838	1.0000		
(11) BSIZE	0.0023	0.2591	0.5096	0.1272	1.0000	
(12) BMEET	-0.0420	0.0511	0.2429	0.0522	0.1503	1.0000
(13) NONEXEC	-0.0546	0.1713	0.3113	0.2094	0.2322	0.0895
(14) INDEP	-0.1170	0.1615	0.2320	0.1968	0.1017	0.0993
(15) BGENDER	-0.1720	0.1729	0.2936	0.0766	0.2020	0.0994
(16) FIN	0.1088	-0.0308	-0.0648	0.0667	-0.0244	0.0297
(17) COVID	-0.2321	0.0537	0.1428	-0.0705	0.0230	0.0486
Variable	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	
(13) NONEXEC	1.0000					
(14) INDEP	0.6450	1.0000				
(15) BGENDER	0.1884	0.2335	1.0000			
(16) FIN	-0.0301	-0.0663	-0.1712	1.0000		
(17) COVID	0.0666	0.1253	0.4239	-0.1553	1.0000	

Source: Own computation

There are identified positive and strong correlations between the variables measuring the company indebtedness, and between non-executive members and board independence, so these variables will be used in different econometric models.

4. EMPIRICAL RESULTS

The empirical study is conducted using multiple linear regression models with unbalanced panel data, incorporating cross-section fixed effects, cross-section and period fixed effects, cross-section random effects, and cross-section random effects with period fixed effects, using Stata 18 software. Table 3 shows the empirical results for Return on Assets models, while Table 4 indicates the econometric results for Return on Equity models.

Table 3. Econometric results for ROA models

Variable	**Model ROA_1**			
	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects and period fixed effects
TDBT	-.0278***	-.0258***	-.0171***	-.0195***
	(.0043)	(.0043)	(.0038)	(.0039)
TANG	-.0261**	-.0234**		.0049
	(.0112)	(.0112)		(.0074)
LIQ	.0046***	.0057***	.0065***	.0075***
	(.0011)	(.0011)	(.001)	(.001)
ETR	-.0641***	-.0642***	-.0608***	-.0582***
	(.0052)	(.0053)	(.005)	(.0052)
FAGE	.002***	.0024***	.0002***	.0002***

	(.0002)	(.0007)	(.0001)	(.0001)
FSIZE	-.0284***	-.0284***	-.0181***	-.0197***
	(.0018)	(.0018)	(.0012)	(.0013)
CEOD	.0058***	.0061***	.0041**	.0052***
	(.0017)	(.0017)	(.0017)	(.0017)
BSIZE	.0006	.0005		.0004
	(.0005)	(.0005)		(.0005)
BMEET	-.0009***	-.001***	-.0011***	-.0011***
	(.0002)	(.0002)	(.0002)	(.0002)
NONEXEC	-.0045	-.0014	-.0091	-.0053
	(.0116)	(.0116)	(.0112)	(.0113)
INDEP				
BGENDER	.0309***	.0222**	.05***	.0277***
	(.0097)	(.0098)	(.0086)	(.0093)
FIN		-.0193***	-.004*	
		(.0072)	(.0021)	
COVID	.0038**		.0068***	.0247***
	(.0018)		(.0016)	(.0067)
C	.6982***	.6885***	.5128***	.5381***
	(.0395)	(.0449)	(.0293)	(.0306)
R^2	.1093	.13	.0957	.1232
No. obs.	4641	4641	4693	4641
Variable	**Model ROA_2**			
	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects and period fixed effects
TDBT	-.0302***	-.0279***	-.0192***	-.0215***
	(.0042)	(.0041)	(.0037)	(.0038)
TANG	-.0281***	-.0251**		
	(.0108)	(.0108)		
LIQ	.0043***	.0054***	.0061***	.0069***
	(.0011)	(.0011)	(.001)	(.001)
ETR	-.0626***	-.0626***	-.0596***	-.0556***
	(.0052)	(.0052)	(.005)	(.0051)
FAGE	.0018***	.0027***	.0002***	.0002***
	(.0002)	(.0007)	(.0001)	(.0001)
FSIZE	-.028***	-.0275***	-.0182***	-.0195***
	(.0017)	(.0017)	(.0012)	(.0012)
CEOD	.0046***	.005***	.0032**	.0041***
	(.0017)	(.0017)	(.0016)	(.0016)
BSIZE	.0005			
	(.0005)			
BMEET	-.0009***	-.0009***	-.001***	-.0011***
	(.0002)	(.0002)	(.0002)	(.0002)
NONEXEC				
INDEP	.0025	.0075	.0069	.004
	(.0091)	(.0091)	(.0086)	(.0086)
BGENDER	.0306***	.0211**	.0479***	.0275***
	(.0094)	(.0095)	(.0084)	(.009)
FIN		-.0125**	-.0037*	
		(.0057)	(.002)	
COVID	.0043**		.0068***	.0328***
	(.0017)		(.0016)	(.0049)
C	.6899***	.6504***	.5024***	.5236***
	(.0373)	(.042)	(.0275)	(.0284)
R^2	.1061	.127	.0931	.1192
No. obs.	4877	4877	4932	4932

Significance level: *** p<.01, ** p<.05, * p<.1. Standard errors are displayed in brackets.

Source: Own computation using Stata 18 software.

Table 4. Econometric results for ROE models

Variable	Model ROE_1			
	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects and period fixed effects
NETDBT	.0447***	.0448***	.0509***	.0487***
	(.0027)	(.0026)	(.0026)	(.0025)
TANG	-.047	-.0495		
	(.0437)	(.0422)		
LIQ	-.0056		-.0047	
	(.0042)		(.0039)	
ETR	-.214***	-.2024***	-.2019***	-.1686***
	(.0203)	(.0198)	(.0196)	(.0192)
FAGE	.0098***	.0071***	.0011***	.0009***
	(.0009)	(.0026)	(.0003)	(.0003)
FSIZE	-.1012***	-.0948***	-.0558***	-.0615***
	(.0071)	(.0068)	(.0051)	(.0049)
BSIZE	.0042**	.0039**	.0031*	.0039**
	(.0019)	(.0018)	(.0018)	(.0018)
BMEET		-.0022**	-.0024**	-.0025***
		(.0009)	(.0009)	(.0009)
NONEXEC	-.0361	-.048	-.0482	-.0286
	(.0449)	(.0433)	(.0439)	(.042)
INDEP				
BGENDER	.1122***	.1002***	.223***	.1242***
	(.0375)	(.0363)	(.0336)	(.0346)
FIN			-.0168**	.0404*
			(.008)	(.0242)
COVID	.014**	.0929*	.03***	.1423***
	(.0068)	(.0508)	(.0063)	(.025)
C	2.2476***	2.1618***	1.5097***	1.5367***
	(.1553)	(.1676)	(.1183)	(.1131)
R^2	.1777	.1805	.1561	.1725
No. obs.	4505	4715	4512	4768
Variable	**Model ROE_2**			
	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects and period fixed effects
NETDBT	.0444***	.0445***	.05***	.0487***
	(.0026)	(.0025)	(.0025)	(.0025)
TANG	-.0788*	-.0741*	-.0352	
	(.0416)	(.0402)	(.0289)	
LIQ	-.0069*		-.0065*	-.0048
	(.004)		(.0038)	(.0037)
ETR	-.1962***	-.192***	-.1996***	-.1748***
	(.0198)	(.0192)	(.0193)	(.0197)
FAGE	.0091***	.0072***	.0011***	.0007***
	(.0008)	(.0025)	(.0003)	(.0003)
FSIZE	-.1026***	-.098***	-.0582***	-.0671***
	(.0067)	(.0064)	(.0049)	(.005)
BSIZE	.0036**	.0034*	.0024	.003*
	(.0018)	(.0017)	(.0018)	(.0017)
BMEET	-.0017*	-.0021**	-.0025***	-.0024***
	(.0009)	(.0009)	(.0009)	(.0009)
NONEXEC				
INDEP	-.0286	-.0132	.0273	-.0084

	(.035)	(.0337)	(.0333)	(.0335)
BGENDER	.1239***	.0989***	.2157***	.1221***
	(.0359)	(.0348)	(.0328)	(.0349)
FIN			-.0171**	.0335*
			(.0078)	(.0177)
COVID	.0177***	.0725	.0318***	.138***
	(.0066)	(.0464)	(.0062)	(.0188)
C	2.3192***	2.2346***	1.5198***	1.6882***
	(.1447)	(.157)	(.1102)	(.113)
R^2	.1781	.1825	.1594	.1778
No. obs.	4696	4960	4696	4751

Source: Own computation using Stata 18 software. Significance level: *** p<.01, ** p<.05, * p<.1. Standard errors are displayed in brackets.

It can be observed that total debt has a negative influence on ROA, while net debt positively impacts ROE. Thus, a 1% increase in the total debt to total assets ratio leads to a 1.71% to 3.02% decrease in Return on Assets, while a 1% increase in the net debt to total equity ratio conduces to a 4.44% to 5.09% increase in Return on Equity. Hypothesis 1 cannot be accepted. Assets tangibility negatively affects both ROA and ROE, meaning that a 1% growth in tangibility results in a 2.34% to 2.81% decrease in Return on Assets, and a 7.41% to 7.88% decrease in Return on Equity. Hypothesis 2 is accepted (Harymawan et al., 2020). Company liquidity has a positive influence on ROA and a negative influence on ROE, meaning that hypothesis 3 is rejected. Company age positively impacts both ROA and ROE, leading to the validation of hypothesis 4 (Azeez, 2015; Sahoo et al., 2023). Return on Assets and Return on Equity are negatively influenced by the company size, and, consequently, hypothesis 5 cannot be accepted.

Moreover, CEO duality has a positive impact on ROA, meaning that when the CEO is also the Chairman, the company's performance increases. Hypothesis 6 is accepted (Azeez, 2015). Board size positively affects ROE, showing that larger boards lead to an increase in the financial performance of the companies. Hypothesis 7 is accepted (Sahoo et al., 2023). Furthermore, hypothesis 8 cannot be accepted, because the board independence does not affect ROA and ROE. Board gender diversity has a positive impact on Return on Assets and Return on Equity, validating hypothesis 9 (Boshnak et al., 2023; Sahoo et al., 2023).

Furthermore, the global financial crisis primarily negatively affected the companies' performance, while the Covid-19 pandemic crisis had a beneficial effect on the companies included in the S&P 500 Index.

5. CONCLUSION

The paper analyzed the factors influencing the performance of the non-financial companies included in the S&P 500 Index, over 20 years, from 2004 to 2023. Given that the studied period crosses two crises – the global financial crisis and the COVID-19 pandemic crisis – the attention was focused on the impact of these crises on the company's financial performance, measured by Return on Assets and Return on Equity. Therefore, in the empirical analysis, alongside variables characterizing indebtedness, tangibility, liquidity, taxation, company age and company size, there were also included indicators regarding the characteristics of corporate governance at the level of the analyzed companies. The empirical study was conducted using multiple linear regression models with unbalanced panel data, incorporating fixed effects and random effects. The results of the empirical research are mostly following the results of previous studies from the literature

review and highlight that the main independent variables which have a positive impact on the company's performance are the company age (Azeez, 2015; Sahoo et al., 2023), the board size (Sahoo et al., 2023), and the board gender diversity (Boshnak et al., 2023; Sahoo et al., 2023), while tangibility (Harymawan et al., 2020), taxation, the company size (Sahoo et al., 2023; Ullah et al., 2020), and the board meetings exert a negative influence on enterprise performance. Five of the nine proposed research hypotheses were validated. Furthermore, the global financial crisis primarily negatively affected the companies' performance, while the Covid-19 pandemic crisis had a beneficial effect on the companies included in the S&P 500 Index.

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Financing SMEs Through Guarantee Instruments During and After the COVID Crisis, Following the Example of the Republic of Bulgaria

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Abstract: *The paper presents an evaluation of the measures to support SMEs as well as the characteristics of the standard guarantee instruments and those that are modified and specially created in connection with overcoming the Pandemic COVID - 19 with derived theory and obtained empirical results. In order to prevent a large part of the real economy from becoming insolvent, most European countries have taken measures to support companies to help their immediate liquidity needs. The measures included: temporary deferment or remission of taxes; moratorium and restructuring of loans with postponement of repayments or extension of terms; guarantees to facilitate obtaining new loans on favourable terms; covering part of the salaries and other operating expenses; direct aid for businesses with imposed restrictions, etc. The measures and guarantee instruments showed different effectiveness, with the greatest positive effect on liquidity being those supporting employment and current expenses, followed by the measures related to debt service and use of new loans, and the least impact showing postponements of taxes.*

1. INTRODUCTION

The history of state-supported guarantee funds after World War II in Europe, especially in the Netherlands and Germany, does reflect their important role in the development of the economy. Especially for the small and medium-sized enterprises (SMEs) sector, these schemes have been essential, providing them with additional support to finance and stimulate economic growth. The fact that many of these guarantee schemes continue to operate today in most European countries testifies to their importance and successful operation in the long term. In the 1990s, after the collapse of the former Soviet Union and the transition to a market economy in Eastern European countries, interest in credit guarantee funds was revived. These funds have proven to be significantly useful and successful in helping small and medium-sized enterprises (SMEs) to access finance in the context of economic transformation and transition.

Table 1. Historical overview of guarantee fund models

Period of creation	Main focus	Main characteristics of the guarantee fund
Europe 19th century	Mutual assistance between small entrepreneurs	Mutual associations to guarantee
Europe and North America 1950-1960	Recovery of the SME sector	State-supported national schemes
Developing countries 1980-1990	SME and agricultural sector development	State-supported or program-based
Oikonomics in transience	Reconstruction and reactivation of the SME sector	State-supported or program-based

Source: Own research based on Deelen and Molenaar (2004)

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Many of these guarantee funds have been successful in helping to boost economic growth and helping SMEs grow their businesses. They have played a key role in creating better financing and support conditions for entrepreneurs in these countries who are struggling to adapt to the new economic realities following the changes in the system. With the main objective of supporting and facilitating businesses‘ access to finance.

2. MODIFICATION OF WARRANTY INSTRUMENTS IN R. BULGARIA

With a decision of the European Commission, the European Fund for Strategic Investments (EFSI) unblocked €1 billion, which served as a guarantee for the European Investment Fund. This allowed the EIF to provide special guarantees to banks and other lenders to encourage the provision of liquidity to more than 100,000 European SMEs and mid-caps.

The provision of guarantees by the European Investment Fund (EIF), supported by the European Fund for Strategic Investments (EFSI), was an important step towards providing liquidity and stimulating financing for these SMEs and mid-caps. Such guarantees helped banks and other lenders to overcome risk fears and provide more flexible financial conditions to affected undertakings, as well as to contribute to the creation of more favorable environment for financing and support the resilience of businesses in times of crisis. In the paper, the authors analyze two main instruments: **Loss Ceiling Guarantee provided by the European Investment Fund – COSME Direct Guarantee** and **InnovFin Risk-Sharing Guarantee.**

In Table 2, we can see that the changes to the COSME programme can be traced as follows. The COSME - Covid programme proposes a higher percentage of the working capital guarantee up to a certain amount and a higher loss ceiling to address the specific economic challenges faced by SMEs as a result of the pandemic.

Table 2. The change in the standard criteria of UniCredit Bulbank‘s programme (COSME)

	COSME (Competitiveness of Enterprises and Small and Medium-sized Enterprises)	**COSME-Covid***
Amount of the guarantee in euro	105,000,000	305,000,000
Loan amount in EUR	3,000,000	3,000,000
Warranty period	Investment loans – 10 years Working capital loans – up to 5 years	Investment loans 10 years Working capital loans – up to 9 years
Types of loans	Investment Loans Working Capital Loans	Investment Loans Working Capital Loans
Guarantee percentage	50%	80% (for working capital up to EUR 150,000)
Loss Ceiling Percentage	6.5%	12%
Term for granting loans	31.12.2022	31.12.2021

Source: Own research

Horizon 2020 is one of the EU‘s flagship scientific initiatives, focusing on research and innovation in the 2014-2020 programming period, with a total budget of € 77 billion, supporting a wide range of projects and initiatives. Horizon 2020 includes financial instruments providing support to innovative businesses, one of which is the guarantee instrument - **InnovFin SME Guarantee Facility** – risk-sharing guarantee. EU Funding for Innovators, which aims to facilitate access to finance for innovative companies across Europe. It includes the SME Guarantee Facility (SMEG),

which provides guarantees and counter-guarantees for debt financing between €25,000 and €7.5 million. This helps to improve financial access for SMEs and mid-caps, who develop innovative projects.

As with the modified COSME program, InnovFin also fell within the scope of improving lending conditions for a certain time during the Pandemic.

InnovFin-COVID* is an adaptation of InnovFin's existing financial instrument in order to respond to the specific challenges faced by companies during the COVID-19 pandemic. It offers a larger portfolio, a longer term for working capital loans and a higher guarantee rate, which is designed to support innovative companies in this critical period.

Table 3. The change in the standard criteria of UniCredit Bulbank's programme (InnovFin):

	InnovFin	**InnovFin- COVID***
Portfolio size in euro	15,000,000	93,000,000
Loan amount in EUR	7,500,000	7,500,000
Warranty period	Investment loans – 10 years Working capital loans – up to 3 years	Investment loans 10 years Working capital loans – up to 7 years
Eligibility criteria	The company or the loan must meet at least one of the criteria for innovation (European Investment Fund, 2020, p. 16)	The company or loan must meet at least one of the criteria for innovation
Types of loans	Investment Loans Working Capital Loans	Investment Loans Working Capital Loans
Guarantee percentage	50%	80%
Warranty fee	0.5%-0.8%	0.5%-0.8%
Loss Ceiling Percentage	n/a	n/a
Term for granting loans	18.12.2022	31.12.2021

Source: Own processing

3. WARRANTY INSTRUMENTS IN BULGARIA

Guarantee instruments are an important aspect of banks' lending policy, as they allow banks to expand their loan portfolio while reducing their credit risk. Through the guarantee instruments, banks supplement the collateral of loans, which allows borrowers to receive financing on more favorable terms, while the bank maintains a certain level of security. Now we will look at the guarantee instruments that are active in Bulgaria during the Covid-19 pandemic.

Table 4. Guarantee schemes in force during Covid-19

Warranty Issuer	**Warranty scheme**	**Maximum guarantee percentage**	**Maximum amount of the guarantee in BGN**	**Status**
EIF	**SME Initiative**	60%	8 800 000	**Adventure**
EIF	**COSME**	50%	3 000 000	**Adventure**
EIF	**InnovFin**	50%	1 500 000	**Adventure**
EIF	**DFF**	80%	750 000	**Acting**
NGF	**NGF 2020**	50%	1 000 000	**Adventure**
NGF	**NGF 2022**	50%	1 000 000	**Acting**
EIF	**EGF Uncapped**	70%	10 268 000	**Adventure**

Source: Own research based on a report by the European Court of Auditors (2020)

The guarantee rate that institutions cover varies and is usually set in percentage rates between 50% and 80%, depending on the specific terms of the loan agreement and the risk associated

with the transaction or borrowers. The number of guarantees on the Bulgarian market, which are usually offered by credit institutions, can reach a certain maximum value, and as standard, for local guarantors, it reaches BGN 3 million. At the European level, the maximum amount of the guarantee depends on the historical data that each bank has provided when applying for the management of an instrument.

The advantages and disadvantages of using guarantee schemes to secure a credit transaction.

The advantages are:

- **Non-depreciable amount of the guarantee**: Compared to the assets used as collateral for a loan, the guarantee usually does not lose value over time. This is beneficial for the bank as it does not need constant revaluation or evaluation of the value of the guarantee.
- **Reducing the risk of default**: The guarantee scheme provides additional security to the bank by reducing the risk of loss if the borrower does not repay the loan.

The disadvantages of warranty schemes include:

- **They do not reduce the final loss, but only redistribute it:** Although guarantees provide additional security to the bank, they do not reduce the actual loss in the event of a borrower‘s default. They simply transfer some of this risk to the guarantee participants.
- **Higher cost for banks when guaranteeing unsecured exposure**: Banks often pay fees or premiums for guarantee services. In particular, when guaranteeing exposures that would otherwise be unsecured, the fees may be higher, which increases the bank‘s operating costs.

Compared to the 2008 crisis and subsequent financial problems, where problems in the financial sector were central, the recession in 2020 is rooted in the external factor - the pandemic. Border closures, travel restrictions and social distancing measures have had major and immediate economic consequences. The disruption of international trade and the disruption of global value chains have also contributed to economic instability.

The pandemic has indeed had a serious and adverse effect on the Eurozone economy. There have been significant declines in various areas of economic activity, especially in the services sector, where the reduction in demand and restrictions on activity have had serious consequences. This led to an extremely rapid decline in GDP in real terms in the second quarter of 2020. Central banks and authorities acted decisively to address these challenges and measures were taken to create favourable financing conditions.

As a result of the pandemic and the restrictive measures introduced, Bulgaria also entered an economic recession. The emergency epidemiological situation in the country, imposed in 2020 and 2021 as a result of the COVID-19 pandemic, led to a contraction of the economy, restriction of the activities of many small and medium-sized enterprises and an increase in the number of unemployed people. To address the economic consequences of the pandemic, the government initiated a package of anti-crisis measures aimed at assisting Bulgarian enterprises in accelerating the process of dealing with the negative impact on their activities. The policies and measures included both entirely national funding and funding with EU funds and national co-financing. Measures to support small and medium-sized enterprises included:

- Wage subsidy scheme „60/40“.
- Support for enterprises operating in the tourism, restaurant, hotel and transport sectors.
- Provision of operating capital for medium-sized enterprises.
- Support to SMEs operating bus and coach services.

The theory of change in SME financing programs shows how SME financing programs are expected to work. Initially, external funds are provided by these programs, and then these funds are converted into assets. In this sense, an improvement in the performance of the firm is expected, which in turn leads to an increase in financial opportunities as a cycle (Kersten et al., 2017).

Life-cycle theory in SMEs suggests that younger and smaller firms tend to rely more on debt financing for information-based reasons. Loan guarantee schemes are being used again to offer credit support to smaller firms during the health pandemic, according to (Cowling et al., 2022). The increased risk to the liquidity of enterprises is caused by the so-called. „dash for cash", in which they began to look for significant cash in a short time. Various forms of credit were a source of additional liquidity. First of all, companies turned to banks to use open credit lines, overdrafts and other forms of loan financing (sources of financing). A study for the United States shows that in the period from March 11 to April 1, 2020 (the period of the pandemic), bank loans to companies increased by 482 billion euros. Dollars. During these three weeks, the growth of bank credit to firms increased by an average of 6% per week, which is 50 times higher than the average for the last 45 years and has no analogue for this period, the value of more than 302 billion dollars, which makes an average weekly value of 33.6 billion, according to research by (Li et al., 2020). For comparison, the average weekly emissions for the period from the beginning of the year before the crisis were only about 5 billion dollars, i.e. the demand for bond financing from firms increased more than 6 times according to (Halling et al., 2020). The results show that, at the beginning of the pandemic, cash was secured almost entirely through debt, and stock issues were minimally researched (Halling et al., 2020; Acharya & Steffen, 2020).

The great need for additional financing of companies cannot always be met by financial institutions. With the onset of the crisis, banks and other lenders became more cautious and had difficulty granting credit, as the creditworthiness of debtors decreased. Thus, for many companies, the demand for financing was higher than what they could provide. Chodorow-Reich et al. (2020) and Kapan and Minoiu (2021) found that this problem is especially important for small and medium-sized companies, which have a harder time accessing credit in times of crisis. If companies are unable to obtain liquidity, they will fall into insolvency, even if their business is viable under normal conditions.

In order to prevent a large part of the real economy from falling into insolvency, most European countries have taken measures to support companies in meeting their immediate liquidity needs. The measures included: temporary deferral or remission of taxes; moratorium and restructuring of loans with deferral of repayments or extensions of deadlines; guarantees to facilitate the receipt of new loans on favorable terms; coverage of part of the working salaries and other operating expenses; direct aid to businesses with imposed restrictions, etc. The measures showed different effectiveness, with the greatest positive effect on liquidity being those supporting employment and current expenditures, followed by the measures related to debt servicing and the use of new loans, and the least impact was shown by tax deferrals. In addition, as a support for the liquidity of firms, the interventions of central banks supporting the normal functioning of financial markets also had an indirect impact. Overall, support measures had the strongest positive impact on firms with higher indebtedness, smaller companies and those with lower liquidity (IMF, 2021).

To address the economic consequences of the pandemic in 2020, the Bulgarian government initiated a package of anti-crisis measures aimed at assisting Bulgarian enterprises in accelerating the process of dealing with the negative impact on their activities. The policies and measures included

both entirely national funding and funding with EU funds and national co-financing. Measures to support small and medium-sized enterprises included:

- Wage subsidy scheme „60/40".
- Support for enterprises operating in the tourism, restaurant, hotel and transport sectors.
- Provision of operating capital for medium-sized enterprises.
- Support to SMEs operating bus and coach services.

The main factor that has supported economic activity to the greatest extent over the past four years is the expected absorption of funds under the National Recovery and Resilience Plan (NRRP) by both the private and public sectors.

Table 5. The results and progress of the implemented economic anti-crisis measures for the last 3 years are as follows:

Procedure	Disbursements	Number of SMEs allocated
2021 and 2022		
Supporting medium-sized enterprises to overcome the economic consequences of the pandemic	Disbursed – 209.4 mln. BGN. Payment is forthcoming – 1.8 mln. BGN.	1530 pcs. 12 pcs.
Support for small enterprises with a turnover of more than 500 thousand. Lv. to overcome the economic consequences of the pandemic	Disbursed: 84.1 mln. BGN. Payment pending: 16.1 mln. BGN.	1682 pcs. 322 pcs.
Working capital support for SMEs affected by temporary anti-epidemic measures (NRA) – Phase III	Paid – 13.5 mln. BGN.	2474 pcs.
Aug. 2020		
Supporting micro and small enterprises to overcome the economic consequences of the pandemic	Disbursed – 191.5 mln. BGN. Payment is forthcoming – 1.8 mln. BGN.	23575 pcs.
Supporting SMEs operating bus and coach services to overcome the economic consequences of the pandemic	Disbursed – 29.1 mln. BGN.	580 pcs.
Supporting SMEs in the tourism sector to overcome the economic consequences of the pandemic	Paid – 11 mln. BGN.	720 pcs.
Working capital support for SMEs affected by temporary anti-epidemic measures (NRA) – Phase I and II	Paid – 120 mln. BGN.	6850 pcs.

Source: Own processing

The government also proposed measures to support liquidity, using mainly EU resources, but also national ones, namely:

a) Increase in the capital of the state-owned Bulgarian Development Bank (BDB) by BGN 700 million. (0.6% of GDP for 2019), of which 500 mln. BGN. to be used for the issuance of portfolio guarantees to commercial banks for the extension of corporate loans, and the remaining 200 mln. BGN. for granting interest-free loans to employees on unpaid leave, self-employed persons and seasonal workers (up to BGN 4500).

b) Allocation of 1 billion. BGN. of the state-owned company „The Fund of Funds" for providing subsidies to micro-enterprises, self-employed persons, entrepreneurs from vulnerable groups and eligible SMEs and companies;

c) Allocation of 800 mln. BGN. for the organization of a joint initiative between the European Investment Fund and the European Commission for the provision of a guarantee/loan to SMEs;

The overall assessment of the anti-crisis measures taken by the government to finance small and medium-sized enterprises is contradictory. According to a large part of the managers of the companies, including small and medium-sized ones, the measures were untimely and not well thought out. At the same time, it is reported that the funds paid by the state in support of medium-sized

companies, according to the latest statistics, amount to BGN 209.4 million. The aid to the business is mainly with funds from EU funds. In addition to the measures described, as a response to the pandemic and the war, the country has prioritized loans to enterprises in order to obtain liquidity, and the small and medium-sized enterprises (SMEs) that have benefited from this type of lending are mainly from the tourism, trade and transport sectors. The crisis affects different sectors differently. The largest decline in sales was observed in consumer services (including tourism and restaurants) (-42.8%), energy and energy resources (-38.5%), transport (-14.1%), automobile manufacturing (-14.1%) and investment goods (-7.7%). For some sectors, there is a positive development with revenue growth – real estate (+14.4%), software (+11.8%), pharmaceuticals (+8.6%), and semiconductors (+8.6%).

Increased costs also have a negative impact on the financial results. First of all, it is due to the rise in the prices of some raw materials and materials, which have problems and delays in the supply chain. Another factor for higher costs is the increased cost of credit, which leads to higher interest costs. Due to unfavorable changes in income and expenses, there is also a decrease in profits. Taxes and depreciation and amortization (EBITDA) in 2020 compared to 2019 was 1.6% (OECD, 2021), while for 2022 it was 0.7% below (EBITDA) for 2021. On the other hand, the strongest growth in operating profits was observed in the real estate sector (+10.9%), software (+8.2%), and semiconductors (+6.9%).

4. FUTURE RESEARCH DIRECTIONS

In conclusion, we can summarize that most studies analyze a single country (developed countries) using qualitative tools. Furthermore, neoclassical theory is mostly used by researchers and policymakers to explain empirical observations and policymaking. In addition, there is quite inconclusive evidence on the relative value of loan guarantee schemes in terms of firm performance. Future research could revise the theoretical overview and assessment methods.

5. CONCLUSION

Guarantee instruments play a key role in providing financial opportunities for SMEs by overcoming some of the main challenges they face in obtaining financing:

- *Overcoming information asymmetry*: Guarantee tools help to compensate for the lack of information or the lack of transparency for the firm, which leads to uncertainty about the credit history or creditworthiness of SMEs. They can serve as a kind of guarantee for the bank or financial institution, thus reducing uncertainty and increasing the likelihood of providing financing.
- *Diversification or risk transfer:* Guarantee instruments allow lenders or investors to allocate the risk of lending to SMEs to third parties, such as guarantee funds or government institutions. This reduces the risk of financial losses for the original lender and makes the transaction more attractive.
- *Reduction of collateral requirements*: Often, guarantees can replace or supplement the standard collateral requirements that are required when obtaining loans or credits. This makes financing available to SMEs that may otherwise not have enough assets to provide traditional collateral.

The introduction of guarantee instruments was an important step to address the economic consequences of the COVID-19 pandemic and support businesses. They have helped to reduce financial risks and ensure the stability of the economy as we address the challenges faced by the global economy.

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Optimizing B2B Industrial Pricing: An AI-Powered Dynamic Approach

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Artificial Intelligence.

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Abstract: *The paper investigates the application of AI-powered dynamic pricing strategies to optimize pricing models for B2B industrial companies. Traditional pricing in the B2B sector often relies on static, cost-plus methods that fail to account for fluctuating market conditions, customer behavior, and competitor actions. Leveraging AI, specifically machine learning and predictive analytics, dynamic pricing models can process vast amounts of real-time data to determine optimal price points tailored to specific customer profiles and market demands. The study outlines the architecture and implementation of these AI-driven systems, detailing their ability to enhance pricing accuracy, improve profit margins, and strengthen customer relationships. By integrating AI, companies can automate pricing decisions, reduce human bias, and react swiftly to market changes. The findings demonstrate that an AI-powered approach not only optimizes revenue but also creates a scalable and adaptive pricing strategy, positioning B2B industrial firms for competitive advantage and sustainable growth in an increasingly volatile market.*

1. INTRODUCTION

In the fast-evolving landscape of B2B industrial markets, pricing strategies play a pivotal role in determining a company's competitiveness and profitability (Mukherjee & Dent, 2024). Traditionally, many industrial firms have relied on static pricing models, often rooted in cost-plus methodologies. While these approaches provide a straightforward way to set prices, they frequently fall short in dynamic environments characterized by fluctuating market conditions, varying customer preferences, and aggressive competitor actions. As a result, businesses may miss opportunities for revenue maximization and risk alienating customers with prices that do not reflect current market realities. Traditional pricing methodologies are increasingly deemed insufficient, necessitating the integration of AI-driven solutions and dynamic pricing frameworks. The utilization of these advanced tools has the potential to enhance gross profit margins by 5% to 10%, while simultaneously fostering sustainable revenue growth and elevating customer perceptions of value (Boston Consulting Group, 2024).

The advent of Artificial intelligence (AI) offers a transformative solution to these challenges. AI-powered dynamic pricing strategies leverage advanced technologies such as machine learning and predictive analytics to analyze vast amounts of real-time data. This capability enables companies to identify optimal price points tailored to specific customer profiles and market demands. By integrating AI into their pricing frameworks, B2B industrial firms can automate pricing decisions, enhance pricing accuracy, and reduce human bias—factors that are crucial for maintaining agility in an increasingly volatile marketplace.

This paper investigates the architecture and implementation of AI-driven dynamic pricing systems within the B2B industrial sector. It outlines how these systems can enhance profit margins, improve customer relationships, and create scalable pricing strategies that adapt to changing market conditions.

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2. DYNAMIC PRICING IN B2B

The growing need for dynamic pricing strategies has become apparent, as traditional static, cost-plus pricing models often fail to account for the complexities and rapid fluctuations inherent in modern markets, with the ability to adjust prices in real-time emerging as an essential factor for maintaining profitability and market relevance amidst increasing competition and evolving customer expectations.

Dynamic pricing refers to the practice of adjusting prices in response to various factors such as market demand, competitor pricing, and cost fluctuations. This approach has been widely adopted in consumer-facing sectors; however, its application within B2B environments has historically been met with skepticism. Many B2B firms have relied on established pricing structures that do not reflect real-time market conditions, leading to potential revenue losses and diminished competitive advantage (Simon-Kucher & Partners, 2022; Bages-Amat et al.,2018). Dynamic pricing is a sophisticated methodology that aligns supply, demand, market trends, and the nuances of client relationships. This approach utilizes advanced algorithms and data analytics to dynamically adjust pricing structures in response to real-time fluctuations in market conditions and consumer behavior (Mayer et al., 2024; Zilliant, 2024; McKinsey & Company, 2021; Kermisch et. al., 2019). By integrating these elements, businesses can optimize their pricing strategies to enhance profitability while simultaneously catering to the unique needs of individual clients (Gupta, 2024). As highlighted by Neubert (2022), the adoption of dynamic pricing strategies is increasing due to their favorable effects on revenue generation and corporate valuation.

Moreover, the increasing complexity of customer relationships in B2B transactions underscores the need for tailored pricing strategies. Customers today expect personalized experiences that reflect their specific needs and purchasing behaviors. Dynamic pricing allows companies to segment their customer base effectively and offer customized pricing solutions that enhance customer satisfaction while optimizing revenue (Zilliant, 2024; Pudi, 2023; Symson, 2023; Simon-Kucher & Partners, 2022).

Therefore, it is essential for B2B companies to strike a balance between agility in pricing adjustments and maintaining transparent communication with customers about pricing strategies. The need for dynamic pricing in B2B industrial sectors is underscored by the demands of a rapidly changing marketplace. Companies that embrace this approach stand to benefit from improved responsiveness to market conditions, enhanced customer relationships through personalized pricing, and ultimately, greater profitability. As businesses continue to navigate an increasingly volatile economic environment, the integration of dynamic pricing strategies will be crucial for achieving sustainable growth and maintaining competitive advantage (Mayer et al., 2024).

In the ever-evolving landscape of B2B transactions, a variety of pricing models orchestrate the intricate dynamics of pricing decisions. These models are specifically designed to address the complex requirements inherent in B2B relationships, providing both adaptability and precision:

These dynamic pricing models form the backbone of B2B pricing strategies, each catering to distinct scenarios and objectives. By selecting the appropriate model or combining multiple models, B2B enterprises can orchestrate their pricing decisions with precision, responsiveness, and strategic intent. The versatility of these models empowers B2B businesses to navigate the intricacies of their industry landscape while maximizing revenue and cultivating valuable relationships.

Table 1. Types of Dynamic Pricing Models for B2B Transactions

Pricing Model	Description
Time-Based Pricing	Prices fluctuate according to designated time intervals, corresponding with periods of heightened demand or seasonal patterns.
Quantity-Based Pricing	Discounts are implemented according to the quantity of items purchased, encouraging customers to place larger orders.
Tiered Pricing	Pricing is categorized into tiers, with each tier presenting a distinct price level for specified quantities or contractual obligations.
Negotiation-Driven Pricing	Dynamic pricing is influenced by continuous negotiations, enabling real-time modifications to reflect the results of these discussions.
Market-Driven Pricing	Prices fluctuate in real-time according to market data, maintaining competitiveness within the industry.
Contract-Based Pricing	Prices conform to the stipulations of contractual agreements, guaranteeing consistency and adherence to predefined terms.
Segment-Specific Pricing	Various customer segments are offered customized pricing that reflects their unique requirements and perceived value.
Dynamic Discounting	Discounts are adjusted in real-time according to multiple factors, including order volume, frequency of orders, and customer loyalty.
Behavioral Pricing	Pricing adjusts according to customer behavior and buying patterns, providing personalized rates for repeat customers.
Demand-Driven Pricing	Prices are modified in response to changes in demand, enabling B2B companies to maximize revenue during periods of high demand.

Source: Adapted from Gupta (2024) and Nagle and Müller (2017)

3. KEY COMPONENTS OF AI-POWERED DYNAMIC PRICING

By leveraging advanced technologies such as artificial intelligence (AI) and machine learning, businesses can analyze vast amounts of data to inform pricing decisions that align with current market dynamics (Basal et al., 2024; Grand View Research, 2023). According to Kotler (2024), the strategic implementation of artificial intelligence in marketing decision-making will be crucial for future corporate success. Research conducted by Hagendorff et al. (2023) and Jansen et al. (2023) demonstrates that AI outperforms traditional problem-solving approaches in certain contexts, highlighting its potential to enhance decision-making processes. The incorporation of artificial intelligence (AI) algorithms into pricing models, utilizing empirical data to discern patterns instead of adhering to a fixed linear framework, signifies a departure from conventional methodologies while retaining analogous input variables. Comparative analyses indicate that AI-driven techniques achieve greater precision in value estimation and minimize errors in price predictions relative to traditional hedonic pricing approaches. However, this advancement often comes at the expense of interpretability, given the inherent opacity of many AI algorithms (Sakri & Ali, 2022; Moreno-Izquierdo et al., 2018; Liu et al., 2018).

The effectiveness of dynamic pricing in B2B contexts is significantly enhanced by the integration of advanced AI technologies. Key components include:

- ***Machine Learning***: Machine learning algorithms are instrumental in analyzing vast datasets to identify patterns and trends that inform pricing decisions. These algorithms continuously learn from new data inputs, allowing them to predict future demand fluctuations and understand customer price sensitivities. By leveraging machine learning, companies can develop models

that dynamically adjust prices based on real-time market conditions and historical sales data (Zilliant, 2024).

- ***Predictive Analytics***: Predictive analytics plays a crucial role in forecasting demand and assessing price elasticity. By simulating various pricing scenarios based on historical data and current market conditions, businesses can identify optimal price points that balance profitability with customer willingness to pay. This proactive approach helps firms avoid the pitfalls associated with reactive pricing strategies (Symson, 2023).
- ***Real-Time Data Processing***: The ability to process real-time data is essential for effective dynamic pricing. Companies can monitor market dynamics continuously, tracking supply chain fluctuations, competitor pricing adjustments, and changes in customer behaviour. This capability ensures that businesses can respond promptly to market changes, maintaining competitive prices while maximizing revenue opportunities (Mayer et al., 2024; Pudi, 2023).

3.1. Architecture of AI-Powered Pricing Systems

The architecture of AI-powered dynamic pricing systems encompasses several key components that work together to optimize pricing strategies:

- ***Data Collection***: Effective dynamic pricing relies on comprehensive data collection from various sources, including historical sales data, competitor prices, market trends, and customer demographics. This data serves as the foundation for informed decision-making.
- **Algorithm Development**: The development of robust algorithms is critical for analyzing collected data and generating actionable insights. These algorithms must be tailored to specific business needs and capable of adapting to changing market conditions.
- **Integration with Existing Systems**: For dynamic pricing systems to function effectively, they must be integrated with existing enterprise resource planning (ERP) systems and other business processes. This integration facilitates seamless data flow and ensures that pricing decisions are aligned with broader organizational objectives.

AI-powered dynamic pricing represents a transformative approach for B2B industrial firms seeking to optimize their pricing strategies. By leveraging machine learning, predictive analytics, and real-time data processing within a well-structured architectural framework, companies can navigate the complexities of modern markets with greater precision and agility. As the landscape continues to evolve, the integration of AI into dynamic pricing models will be essential for achieving sustainable growth and maintaining a competitive edge in an increasingly volatile environment.

3.2. Implementation of AI Dynamic Pricing Systems

The successful implementation of AI-powered dynamic pricing systems involves a systematic approach that integrates advanced technologies to optimize pricing strategies. The prioritization should focus on involving the appropriate experts—individuals with specialized knowledge in key pricing functions essential for AI implementation, even if they do not possess comprehensive expertise across all pricing areas (Erdmann et al., 2024).

The step-by-step process for implementing these systems demonstrates their effectiveness across various industries (Mayer et al., 2024; Bages-Amat et al., 2018):

1. **Defining Objectives** is the initial step in implementing an AI dynamic pricing system. Organizations must clarify their goals, such as maximizing revenue, optimizing inventory use, enhancing customer satisfaction, or increasing market share. By establishing these

objectives at the outset, companies can customize the pricing model and its implementation to align with their broader business strategies.

2. **Data Gathering and Analysis**: Effective dynamic pricing depends on extensive data collection from various sources, including historical sales, competitor pricing, market trends, and customer behaviour. This data forms the basis for informed decision-making. Advanced analytical techniques are utilized to identify patterns and trends that shape pricing strategies. Furthermore, the integration of real-time data processing allows organizations to swiftly respond to market fluctuations and customer demands.
3. **Algorithm Design Tailored to Specific Business Needs:** The development of robust algorithms is essential for analyzing collected data and generating actionable insights. Machine learning models are trained on historical data to identify patterns and relationships, facilitating accurate pricing predictions. These algorithms must be tailored to meet the specific needs and dynamics of the business environment in which they function.
4. **Integration with Current Pricing Frameworks**: For effective operation, AI-powered dynamic pricing systems must integrate with existing enterprise resource planning (ERP) systems and business processes. This integration ensures seamless data flow and alignment of pricing decisions with organizational objectives. Additionally, clear pricing rules and constraints, such as minimum and maximum thresholds, guide the algorithm‘s decision-making.
5. **Testing and Fine-Tuning**: After developing the dynamic pricing model, it undergoes rigorous testing to evaluate its effectiveness and accuracy, often through A/B testing that compares different pricing strategies based on metrics like revenue and customer satisfaction. Continuous monitoring and adjustments are crucial for adapting to changing market conditions and enhancing performance over time.

The adoption of AI-driven dynamic pricing strategies can revolutionize pricing decision-making by enhancing precision through customer segmentation and personalized pricing, with advanced algorithms and machine learning techniques analyzing vast datasets on consumer preferences, purchasing behavior, and market trends in real time (Basal et al., 2024; Mayer et al., 2024; Chen & Chen, 2015; Assad et al., 2020).

3.3. Case Studies

The application of AI-powered dynamic pricing has demonstrated significant success across various industries, underscoring its versatility and effectiveness in optimizing pricing strategies. Table 2. summarizes notable success stories of companies in B2B industries that have effectively implemented AI-powered dynamic pricing strategies, highlighting their implementation details and the resulting impacts on revenue and customer engagement. These examples collectively highlight the growing importance and effectiveness of AI-powered dynamic pricing in diverse sectors, demonstrating its potential to enhance revenue, optimize market responsiveness, and improve customer satisfaction.

In conclusion, the implementation of AI-powered dynamic pricing systems is a multifaceted process that requires careful planning and execution. By defining clear objectives, gathering comprehensive data, designing tailored algorithms, integrating with existing frameworks, and continuously testing and refining the model, B2B industrial firms can leverage dynamic pricing as a strategic tool for enhancing competitiveness and driving revenue growth in an increasingly volatile marketplace.

Table 2. Success Stories in AI-Powered Dynamic Pricing in B2B Industries

Company	Industry	Implementation Details	Impact
Coca-Cola	Beverage	Utilized AI-driven dynamic pricing for vending machines, adjusting prices based on location, time of day, and demand patterns.	Increased sales by up to 10% in high-traffic areas and improved inventory management through predictive analytics.
Siemens	Manufacturing	Implemented AI algorithms to adjust pricing for industrial equipment based on market demand, competitor pricing, and customer profiles.	Achieved a revenue increase of 15% by aligning prices with customer willingness to pay.
BASF	Chemicals	Utilizes AI-driven demand forecasting to adjust prices dynamically based on predicted demand, ensuring competitive pricing.	Enhanced pricing competitiveness and maximized revenue in volatile markets.
DHL	Logistics	Implements dynamic pricing models that adjust shipping rates in real-time based on demand, capacity, and market conditions.	Improved operational efficiency and increased revenue during peak shipping periods.
Caterpillar	Heavy Equipment	Employs AI algorithms to optimize pricing for machinery and parts based on market demand and customer purchasing behavior.	Achieved a significant increase in sales and improved customer satisfaction through tailored pricing.
John Deere	Agriculture	Uses dynamic pricing strategies to adjust equipment prices based on seasonal demand fluctuations and market trends.	Enhanced profitability by aligning prices with real-time market conditions, leading to increased sales.
IBM	Technology	Leveraged Watsonx AI to analyze customer behavior during negotiations and adjust pricing strategies accordingly.	Improved customer retention and satisfaction, leading to a 20% increase in subscription renewals.
Honeywell	Industrial Equipment	Used machine learning models to optimize pricing for various industrial products based on real-time supply chain data.	Streamlined pricing processes, resulting in a 30% improvement in inventory turnover rates.
SYMSON	Agriculture	Developed a dynamic pricing strategy for a wholesaler selling technical irrigation systems, combining key-value item pricing with geographical and rule-based pricing strategies.	Enhanced pricing accuracy while allowing flexibility within established business rules.
Flipkart Commerce Cloud	E-commerce	Implemented dynamic pricing strategies for clients in the fashion accessories category using AI/ML capabilities to maintain competitive pricing.	Improved margins by 30% and increased competitiveness by 500 basis points.
Microsoft	Technology	Set and adjusted prices for its cloud-based products and services using dynamic pricing strategies.	Increased revenue and improved competitive positioning within the cloud services market.
Adobe	Software	Uses dynamic pricing to set and adjust prices for its software products based on market conditions and customer feedback.	Increased revenue and improved customer satisfaction through tailored pricing approaches.
SAP	Software	Implements dynamic pricing for its enterprise software products, adjusting prices according to market demand and competition.	Increased revenue and improved market share through responsive pricing strategies.
Oracle	Technology	Utilizes dynamic pricing to set and adjust prices for its database products based on usage patterns and competitive analysis.	Increased revenue and enhanced customer loyalty through strategic price adjustments.

Source: Adapted from Mayer et al. (2024); Own research

3.4. Benefits, Challenges, and Considerations of Ai-Powered Dynamic Pricing

The integration of AI-powered dynamic pricing systems into B2B industrial companies presents a wide array of benefits alongside several challenges and considerations that organizations must address. One of the primary advantages is ***revenue optimization***, as these systems maximize revenue through real-time price adjustments based on market conditions and customer demand.

Additionally, they enhance ***market responsiveness***, allowing firms to react swiftly to fluctuations in demand and capitalize on emerging opportunities (Chandra, 2024). ***Improved customer experience*** is another significant benefit, as AI can offer personalized pricing strategies tailored to individual customer preferences, thereby enhancing satisfaction and loyalty. Furthermore, ***optimized inventory management*** is achieved by aligning prices with stock levels and demand forecasts, which reduces excess inventory and enhances operational efficiency. Finally, these systems provide a ***competitive advantage*** by enabling rapid responses to competitor pricing changes, thereby maintaining market position while optimizing profitability (Sahota, 2024; Gaurav, 2024).

However, the implementation of AI-powered dynamic pricing also entails several challenges. ***Customer perception*** can be negatively impacted by frequent price changes, which may lead to dissatisfaction or distrust if not communicated effectively (Sahota, 2024). The reliance on ***high-quality data*** is critical; inaccuracies can result in suboptimal pricing decisions, and integrating these systems with existing infrastructure can pose technical challenges. ***Regulatory compliance*** is another important consideration, as organizations must navigate complex regulations regarding pricing practices to avoid legal issues related to price discrimination and consumer protection. ***Ethical considerations*** arise as well, raising questions about fairness and transparency in automated pricing decisions that could potentially disadvantage certain customer segments (Forth, 2024; Dwivedi et al., 2024; Seele et al., 2019). Moreover, dynamic pricing can introduce ***pricing complexity***, particularly in B2B environments that involve multiple products. The complexity of the AI algorithms used often incorporates advanced machine learning techniques, which can reduce transparency and make it difficult for consumers to understand the rationale behind price changes, potentially undermining their trust in the company (Aparicio & Misra, 2023). Concerns regarding ***price stability and customer trust*** are paramount; frequent price adjustments can create perceptions of unpredictability and may erode long-term relationships with clients. Therefore, while the integration of AI-powered dynamic pricing systems offers substantial benefits for B2B industrial firms, it is essential for organizations to carefully navigate these challenges to ensure successful implementation (Zatta, 2024).

4. FUTURE RESEARCH DIRECTIONS

As businesses continue to adopt AI-powered dynamic pricing strategies, several future trends are expected to significantly influence the landscape of pricing optimization within B2B industrial sectors. These trends are primarily driven by advancements in technology, evolving market conditions, and changing consumer expectations, highlighting the growing need for more sophisticated and responsive pricing models. One of the most prominent trends is the enhancement of predictive analytics. As machine learning algorithms become increasingly advanced, they will be capable of analyzing larger datasets with greater accuracy, allowing businesses to forecast demand fluctuations and customer behavior with heightened precision. This improved predictive capability will enable organizations to proactively adjust their pricing strategies, optimizing revenue during peak demand periods while maintaining competitiveness during downturns.

Additionally, the integration of AI-powered dynamic pricing systems with emerging technologies such as blockchain and the Internet of Things (IoT) is expected to gain considerable momentum. Blockchain technology offers the potential to improve data security and transparency in pricing processes, while IoT devices can provide real-time data on inventory levels and customer interactions. This convergence will allow businesses to create more agile pricing strategies that respond not only to market conditions but also to real-time operational metrics. For example, manufacturers could adjust prices based on real-time inventory data collected from IoT sensors, ensuring optimal stock levels while maximizing sales opportunities.

In parallel, a greater emphasis on customer segmentation will shape future pricing strategies. As businesses collect more granular data regarding customer preferences and behaviors, they will be able to implement highly personalized pricing strategies tailored to individual customers. This approach goes beyond simple discounts and involves creating bespoke pricing models that reflect the specific value perceived by different customer segments. Leveraging machine learning algorithms to analyze customer data will allow businesses to develop targeted promotions and dynamic pricing strategies that enhance both customer satisfaction and loyalty.

As AI-driven dynamic pricing becomes more widespread, ethical considerations related to fairness and transparency will emerge as significant concerns. Companies will need to find a balance between maximizing profitability and maintaining consumer trust. Future trends will likely involve the development of ethical frameworks that govern dynamic pricing practices, ensuring that customers perceive pricing strategies as fair and justifiable. In this context, businesses may adopt transparency measures, such as clearly communicating the factors influencing price changes, to foster trust and mitigate potential backlash.

With increasing scrutiny on pricing practices from regulatory bodies, companies will need to ensure that their dynamic pricing strategies remain compliant with evolving regulations. Future trends may include the integration of compliance mechanisms within AI-powered systems, enabling automatic adjustments to pricing practices in accordance with legal requirements. This proactive approach will help businesses minimize the risks associated with non-compliance while ensuring that their dynamic pricing strategies continue to be effective and sustainable.

5. CONCLUSION

As AI-powered dynamic pricing strategies gain traction, several future trends are expected to shape pricing optimization in B2B industrial sectors. These trends, driven by technological advancements, market changes, and evolving consumer expectations, underline the need for more sophisticated pricing models. A key trend is the enhancement of predictive analytics. As machine learning algorithms advance, businesses will be able to analyze larger datasets more accurately, improving demand forecasting and customer behavior predictions. This will allow for proactive pricing adjustments, maximizing revenue during peak periods and maintaining competitiveness in downturns.

The integration of AI-driven pricing with emerging technologies like blockchain and IoT will also grow. Blockchain can enhance data security and pricing transparency, while IoT will provide real-time operational data, such as inventory levels, enabling agile pricing strategies. Manufacturers, for instance, could adjust prices based on real-time inventory data from IoT sensors, optimizing stock levels and sales opportunities. Increased customer segmentation will also define future pricing strategies. Businesses will gather more detailed data on customer preferences and behaviors, allowing for personalized pricing models tailored to each segment. Machine learning will support the creation of targeted promotions and dynamic pricing strategies that boost customer satisfaction and loyalty. As AI-driven pricing becomes more prevalent, ethical concerns around fairness and transparency will emerge. Companies will need to balance profitability with consumer trust, potentially developing ethical frameworks and transparency measures to ensure pricing strategies are perceived as fair.

Finally, regulatory scrutiny on pricing practices will increase. Businesses will need to integrate compliance mechanisms into AI-powered systems to ensure pricing practices align with evolving regulations, minimizing legal risks while maintaining effective and sustainable pricing strategies.

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Cryptocurrencies and the Legislative Provisions for the Prevention of Money Laundering in the Republic of Slovenia

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Abstract: *Cryptocurrencies represent the future of the digital money system. It is an innovative online payment system that allows transactions to be recorded using decentralised accounting without the control of a central institution. There´s a high degree of user anonymity and users can further obscure the transaction trail by using various anonymisers. Cryptocurrencies are based on a complex infrastructure involving a large number of so-called miners and users coming from different countries, and transactions are validated and recorded globally, making it impossible for Anti-Money Laundering authorities to obtain relevant information on suspicious transactions.*

The present article deals with cryptocurrencies and the process of »mining«, which is the process of validating transactions on a cryptocurrency network and adding them to a blockchain. Also, money laundering issues are highlighted and the Slovenian legislative provisions in this area are presented. Finally, guidelines to prevent money laundering are presented.

1. DEFINITION OF CRYPTOCURRENCIES AND RELATED TERMS

The rise of internet technology and innovation in finance has introduced a completely new currency that is exclusively electronic and brings with it a wealth of new financial possibilities. Digital money relies on information systems and solutions that allow the rapid exchange of data between two entities. In line with this, the concept of decentralisation has emerged, which is completely opposed to the centrally coordinated monetary system that was in place before the rapid rise of digitalisation (Glaser et al., 2014). Cryptocurrency can be defined as any form of currency that exists digitally or virtually and uses cryptography to secure transactions. Cryptocurrencies do not have a central issuing or regulatory authority but use a decentralised system to record transactions and issue new units. They operate on a distributed public ledger called a »blockchain«, which is a decentralized ledger of all transactions, and is updated and maintained by the holders of the currencies. It is therefore a digital payment system that does not use a bank to verify transactions and therefore there is no money in physical form. Cryptocurrency payments exist only as digital entries in an online database where certain transactions are recorded (Ashford, 2023). Nowadays, cryptocurrencies can be purchased through central exchanges, brokers and individual currency owners. The simplest way to buy and sell cryptocurrencies is through exchanges or online platforms such as Coinbase[3]. Crypto wallets exist in two forms: software and hardware. Software wallets can be downloaded onto a computer or phone, while hardware wallets are physical vaults that store cryptocurrency data on a specially designed hard drive in the device. Hardware wallets are designed to be as secure as possible and can be backed up in multiple ways (Suratkar et al., 2020).

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[3] Coinbase is a cryptocurrency exchange where popular coins such as Bitcoin, Ethereum and Solana can be purchased. While there are thousands of different cryptocurrencies available worldwide, the Coinbase platform hosts more than 260 different types of cryptocurrencies, allowing trading in the most popular types of cryptocurrencies (Haegele, 2024).

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1.1. Decentralisation

Decentralisation means dispersing the departments of a large organisation away from a single administrative centre. In the case of Bitcoin, this can be explained by the fact that Bitcoin is the first cryptocurrency and decentralisation means that no single entity can gain control of the network. The network is based on two pillars, i.e. individual Bitcoin nodes (so-called »full nodes«) and the computing power of the miner. In principle, a node can be operated by anyone by installing the Bitcoin Core Wallet and downloading the Blockchain in its entirety (all transaction data since bitcoin has existed). It then lets the wallet calculator run on the computer, thus contributing to the decentralisation of bitcoin. Many individual network nodes ensure that the Blockchain technology itself is stored in many different locations and that new transactions can be distributed. The basic principle of decentralisation is that no one gets full control over the operation of the Bitcoin infrastructure (Vidrih, 2019).

2. BLOCKCHAIN

Blockchain[4] (blockchain technology) is a type of distributed ledger technology that stores and transmits information in the form of blocks of data linked by a chain of data. The data in a blockchain is cryptographically protected and the mechanism uses specific mathematical algorithms to verify and create a constantly growing chain of databases (the chain of transactions can only be extended and existing data cannot be removed) that form transaction blocks. The system allows for a relatively secure and pseudonymous transfer of value directly between individual entities (peer to peer transactions), independent of the trust and existence of a central entity, as it is collectively maintained and controlled by a distributed network of participants (computing nodes) (Bank for International Settlements, 2018).

When a miner creates a new block of transaction data, information about it starts to be shared across the network in an encrypted form that makes the details of the transactions unavailable to the public. All miners then jointly decide on the validity of the new block of information (consensus mechanism), based on a predefined algorithmic method. The network always considers the longest blockchain as valid. Once validated, the new block is integrated into the blockchain, as evidenced by the update of all copies of the distributed record in the network at the same time. Thus, each miner has an identical copy of the entire transaction record at all times, which is encrypted in such a way as to prevent reversibility of transactions (World Bank Group, 2017).

3. TYPES OF CRYPTOCURRENCIES

Cryptocurrencies can be divided into cryptocoins and crypto tokens, depending on how they are used. Some are intended as units of exchange for goods and services, others are stores of value, and some can be used to participate in specific software applications such as games and financial products (Rosen, 2024).

3.1. Bitcoin

Bitcoin is the most popular cryptocurrency. In January 2009, a mysterious pseudonymous man named Satoshi Nakamoto introduced Bitcoin, which offered lower transaction fees than other

[4] Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets across a business network. Almost anything of value can be tracked and traded on a Blockchain network, reducing risk and costs for all involved (IBM., n.d.).

traditional payment mechanisms. Bitcoins are held only in digital form, where they are kept as balances in a public ledger that everyone has access to. Miners are responsible for processing transactions on the blockchain and are rewarded for their work with fees paid in bitcoins. In 2010, Bitcoin started to appear on exchanges, making it easier to sell, buy, trade and store. In the following year, miners and programmers started to build other networks, such as Etherium and Litecoin. The use of Bitcoin as a currency increased as selected companies started to accept Bitcoin as a means of payment alongside traditional currencies. In total, only 21 million bitcoins can be minted. In April 2022, slightly more than 19 million total bitcoins had been minted (Likos & Hicks, 2022).

3.2. Etherum

Ethereum is the second-largest cryptocurrency by market value as of January 2022. It is essentially a platform based on blockchain technology. It maintains a vast network of computers around the world and requires majority agreement for any change to the blockchain. The Ethereum platform is designed to support multiple applications, not just Ethereum and other cryptocurrencies. It differs from Bitcoin in that, among other things, the Bitcoin blockchain was created with the sole purpose of supporting the Bitcoin cryptocurrency, whereas Ethereum is a network with a lot of programming possibilities for many applications. The number of Bitcoins that can enter circulation is limited to 21 million, while the amount of Ethereum that can be generated is unlimited (Frankenfield, 2022).

3.3. Tokens

Tokens are a programmed digital asset that operates on an existing blockchain. They can represent specific units of an existing asset, such as money or electricity, and are also used to create and enforce unique smart contracts that are executed when certain conditions are met. Tokens can be classified into the following categories (Copeland, 2023):

- Utility tokens are used as a means of transaction or investment and also play a role within a blockchain. For example, a cloud storage project using a blockchain may allow the purchase of a larger memory capacity using tokens of use value.
- Security tokens are used to buy, sell and track ownership of projects or companies. Unlike other tokens, security tokens are the only ones that have laws and rules of use in order to protect investors.
- Stablecoin was created to counter the large fluctuations in the value of cryptocurrencies. They do this by being tied to stable assets such as commodities or cash.
- Privacy tokens were created to ensure anonymity. Examples of such cryptocurrencies are Monero and Zcash. Monero uses a special technology called »ring signatures« to obscure the details of a transaction, while Zcash uses a special technology called »Zk-SNARK« that allows the verification of a single transaction without revealing its details.
- Non-fungible tokens (NFTs) are a unique form of digital asset and have their own value. NFT tokens are therefore primarily used for the ownership of digital art, which takes the form of music, digital artwork, virtual real estate and virtual worlds.

4. MINING CRYPTOCURRENCIES

It is the process of verifying transactions on a cryptocurrency network and adding them to a blockchain. By doing this, miners help protect the network and are rewarded with small amounts of cryptocurrency. Bitcoin uses a proof-of-work (PoW) consensus algorithm that requires miners to perform complex mathematical calculations in order to add new blocks to the blockchain. Each

time a miner successfully compacts a block, he is rewarded with a certain amount of bitcoins. Miners use specialised computers to perform the necessary calculations. These devices are usually equipped with high-performance graphics processing units or specific integrated circuits designed specifically for cryptocurrency mining. Miners need to continuously upgrade their hardware to remain competitive (Fortuna, 2022).

5. CRYPTOCURRENCY TRANSACTIONS

The main purpose of cryptocurrency trading is to make a profit. The advantages of buying and selling cryptocurrencies are the all-day open market, the anonymity of transactions, the immediacy of the transaction and the drastic fluctuations that offer traders the possibility of making a quick profit (Fang et al., 2022). A cryptocurrency transaction is a multi-step process that allows Bitcoin to be transferred from one user to another. The transaction from start to finish is illustrated in the following steps (Viitaharju, 2024):

1) The transaction phase is where the essential information for the transaction is determined and the user selects three options, namely the sending address, the receiving address and the amount to be sent, and then completes the transaction by pressing the 'Send' or 'Withdraw' button, including a digital signature.
2) In the broadcast phase, the details of the transaction are sent to the Bitcoin network, where servers, known as nodes, that store the history of the Bitcoin network ensure that the transaction complies with the rules of the Bitcoin network. Once the nodes have verified that the transaction is correct, the transaction moves to a holding area called the Mempool (short for memory area).
3) The last stage of a Bitcoin transaction is the settlement of the transaction. Miners compete with computing power to see who can solve the problem first and add the next block to the Bitcoin blockchain. Once confirmed, the new block is added to the blockchain copy of all participants on the network. At this point, the transaction and the new block are considered as confirmed. Over time, a practice has been established that prevents a transaction from being duplicated or cancelled after the creation of a new block, which may occur due to a temporary deadlock in the blockchain.

6. ONLINE SCAMS AND FRAUD

There are a variety of scams in the crypto world, such as the following (Republic of Slovenia, Ministry of the Interior, 2022):

6.1. Email intrusions or so-called BEC fraud

In Buisness Email Compromise (BEC) fraud, the perpetrators hack into the email server and use special filters to search for messages that contain information about the transaction that is currently being concluded. The perpetrators set up the forwarding of the received messages to their e-mail address and informed the other business entity that they had changed the account number. Once the transaction has been made to the perpetrator's account, the perpetrator then transfers the funds to a third-country account or makes a cash withdrawal (Republic of Slovenia, Ministry of Internal Affairs, 2018).

6.2. Investment fraud

Such schemes are advertised through social networking profiles and phone calls to random numbers. The fraudster poses as a crypto exchange employee and falsely represent to the victim that there

are funds of several thousand euros waiting for them in a virtual wallet. The withdrawal of these funds is conditional on the installation of a remote access programme (Anydesk, Supremo, etc.) on the computer and/or mobile device. With the help of this application, the perpetrators enter the victim's online bank and steal all the funds from the transaction account (Republic of Slovenia, Ministrstvo za notranje zadeve, 2024).

6.3. Phishing

This type of online fraud usually starts with a fake email or SMS message on behalf of the bank where the perpetrators falsely state various needs for action by the online bank user (e.g. an urgent update or upgrade of e-banking). The message usually contains a link that needs to be clicked. When the link is clicked, a web page identical to the e-banking website is opened. In some cases, once the victim has entered the required information, fraudsters obtain all the necessary information for unauthorised access to the online bank and subsequently empty the victim's bank account (Republic of Slovenia, Ministrstvo za notranje zadeve, 2024). Data fishing via private messages or so-called Smishing works on the same principle, except that the victim receives a message with a link to a fake site via SMS, or an app such as Messenger, Viber, Whatsapp, etc. In most cases, these attacks aim to obtain the username and password of the victim's social network (Safe on the Internet, 2024). Anyone can request a phishing website of their preferred post office or bank from different providers, and payment for subscribing to such a service is most often made in cryptocurrencies (Becher, 2024).

7. LEGAL FRAMEWORK FOR CRYPTOCURRENCY OFFENCES

The fundamental duty of the police is to ensure the safety of individuals and communities, respect human rights and fundamental freedoms, and strengthen the rule of law (Žaberl et al., 2017).

Criminal offences in the Slovenian legal order are defined by the Criminal Code (KZ-1), which, in accordance with the principle of legality, defines them clearly, precisely and in advance at the statutory level (Criminal Code, 2012). The Criminal Procedure Act is essentially a procedural law, the purpose of which is to ensure the effective investigation of criminal offences, while regulating the repressive powers of state authorities and ensuring fair procedure and trial for those involved in criminal proceedings (Šepec, 2023). While the Criminal Code penalizes offenses and defines their sanctions, the Criminal Procedure Act lays down procedural rules for implementing the provisions of substantive criminal law, thereby primarily ensuring that someone innocent is not convicted (Constitution of the Republic of Slovenia, 1991).

7.1. The offence of Money Laundering

Money Laundering is the process of concealing the link between an illicit source of profit and the underlying criminal activity (International Monetary Fund, 2014). The offence of Money Laundering is defined in Article 245 of the Criminal Code (KZ-1), which reads: 'Whoever, by laundering or attempting to launder, conceals the origin of money or property which he has received, kept, used in an economic activity or in any other way, and who knows or ought to have known that it has been obtained by means of a criminal offence, has committed a criminal offence' (Criminal Code, 2012).

According to Article 2 of the Law on Prevention of Money Laundering and Terrorist Financing (ZPPDFT-1), Money Laundering is defined as »any conduct which conceals the origin of money

or other property obtained through a criminal offence, and includes: exchange or transfer in any way money or other property derived from the offence (ZPPDFT-1, 2016).

There are three phases of money laundering (Lamberger, 2009):

1) **Money transfer/placement:** this step represents the starting point of money laundering, which is characterised by the conversion of the form of the primary asset. The process takes place by the offender handing over or electronically transferring money to the launderer. The launderer is a person who is not connected to the offence or any other offence. The reason for this is that he/she has no problem opening a new bank account or smuggling money across the border, where he/she exchanges the money at a money changer or deposits it in a bank account.
2) **Layering:** the second stage of money laundering occurs when dirty money enters the financial system. In order to hide the origin of the money, launderers make a large number of random international transactions to different banks around the world, making it difficult to trace. A certain degree of anonymity allows for the fact that, in the course of business, the details of the directors and beneficial owners are concealed and are not written on any public document or register. Another characteristic of offshore companies is that in most cases financial and legal information is not passed on to foreign tax and judicial authorities.
3) **Integration:** this stage occurs when the money trail has been successfully covered and several layers have been stacked between the source and the laundered money. In this phase, the money is integrated into the legitimate financial system, allowing the money to be disposed of as if it had been legitimately obtained in the first place. The money obtained is then often invested in legitimate activities and some cases reinvested in criminal activity.

7.2. Money laundering through cryptocurrencies

Like accounts in the traditional banking system, bank wallets are susceptible to restrictions on record-keeping and identification of account holders. In a digital environment, it is difficult to track blockchain transactions through IP address anonymisers[5] . IP anonymisers mask the actual location of the wallet owner and mixers help to conceal the origin of funds. Cryptocurrencies pose a risk of money laundering due to the lack of regulation and specific features such as: the decentralisation of the system, the pseudonymity of users and the international nature of the system. The Bitcoin protocol does not require any identification of users in order to use the system and is not verified, nor is any identification data recorded in the transaction log, but transactions are only recorded using users' public keys. The absence of a central institution overseeing the cryptocurrency system prevents AML authorities from obtaining relevant data on suspicious transactions and customers across the cryptocurrency system. As a result, AML regulation is focused on specific intermediaries in the system where cryptocurrency transactions are at least partially centralised (FATF Report, 2014).

8. PREVENTION OF MONEY LAUNDERING IN THE REPUBLIC OF SLOVENIA

As a member of the European Union, Slovenia's laws and regulations on Anti-Money Laundering (AML) and Counter Financing of Terrorism (CFT) are aligned with EU legislation. The following EU directives are particularly relevant in this field (OpenAI, 2024):

[5] An IP address anonymiser is a tool or technology that allows you to hide or disguise the actual IP address of a user in order to protect their privacy and reduce the tracking of their online activities. The main goal of an IP address anonymiser is to prevent third parties, such as ISPs, advertisers, or even webmasters, from collecting information about a user's network behaviour, such as websites visited, location, device, etc. (OpenAI, 2024).

1) Directive (EU) 2015/849 on the prevention of money laundering (4th Money Laundering Directive): is the key piece of legislation setting out the basic measures to prevent money laundering and terrorist financing in the EU. It includes the following important provisions:
   - Know Your Customer (KYC) obligations: under this Directive, financial services firms (including those dealing in cryptocurrencies) are obliged to verify the identity of their customers and monitor transactions for possible suspicious activity.
   - Extension of scope: the Directive extends the scope to »third country residents« and includes new obligations for companies offering cryptocurrency services (e.g. crypto exchanges and cryptocurrency exchange platforms).
   - Suspicious transaction reporting obligation: financial institutions, including cryptocurrency exchanges, are obliged to report suspicious transactions.
2) Directive (EU) 2018/843 amending and supplementing the 4th Directive (5th Money Laundering Directive): the provisions of that Directive include significant changes that have had a direct impact on the treatment of cryptocurrencies:
   - Explicit inclusion of cryptocurrencies: the cryptocurrency providers (e.g. crypto exchanges, brokers and exchange platforms) must also comply with the same legal requirements as traditional financial institutions, including obligations to verify customers and monitor suspicious activity.
   - Reporting obligations and traceability of transactions: The directive requires all cryptocurrency transactions to be traceable in order to facilitate the tracing of potential illegal activities such as money laundering.
   - Greater transparency: greater transparency in the ownership of cryptocurrency-related companies and accounts is required to prevent the use of these funds for money laundering or terrorist financing.
3) The Whistleblower Directive (EU) 2019/1937: it offers an important framework for the protection of whistleblowers, including money laundering and cryptocurrency abuse. Businesses, including cryptocurrency businesses, are obliged to put in place whistleblowing mechanisms, which are important for the detection and prevention of crypto money laundering.
4) Regulation (EU) 2018/1724 on the European Anti-Money Laundering Regulation (EMD): it ensures the consistent implementation of AML/CFT legislation in the EU. It is a key legal framework that facilitates the exchange of information and ensures a uniform approach by EU Member States in the fight against money laundering, including the use of cryptocurrencies.
5) Markets in Crypto-Assets (MiCA): MiCA (Markets in Crypto-Assets) is a proposed regulatory framework that will introduce more specific rules for crypto markets in the EU. The aim is to create a single legal framework to prevent money laundering and terrorist financing in the crypto sector.

8.1. The Bank of Slovenia's powers

Article 3(48) of the Act on Prevention of Money Laundering and Terrorist Financing (ZPPDFT-2) defines virtual currency services as services provided by a natural or legal person as a business or profession to a third party: an exchange between fiat and virtual currencies, the transfer of virtual currencies between different accounts or addresses, the custody or management of virtual currencies, including the provision of private cryptographic key protection services on behalf of its clients, for the storage, safekeeping and transfer of virtual currencies, services relating to the issue or sale of virtual currencies (ZPPDFT-2, 2016). The Bank of Slovenia is also responsible for monitoring the consistent implementation of the obligations of virtual value service providers. On 9 June 2023, the Markets in Crypto-assets Regulation was published in the Official Journal of the European Union, which establishes uniform requirements for (Banka Slovenije, 2017) the

issuance, public offering and admission to trading on a trading platform of asset-linked tokens, e-money tokens that are neither asset-linked tokens nor e-money tokens; and cryptocurrency service providers (e.g. exchanging cryptocurrencies for cash). The provisions of the Regulation (EU) on cryptoasset markets on the conditions for issuing asset-linked tokens and e-money tokens apply from 30 June 2024, while the remaining provisions will apply from 30 December 2024 (Banka Slovenije, 2017).

8.2. Responsibilities of the Office for the Prevention of Money Laundering of the Republic of Slovenia

The Office for the Prevention of Money Laundering of the Republic of Slovenia (hereinafter referred to as the UPPD) is a body operating within the Ministry of Finance and is responsible for monitoring and preventing money laundering and terrorist financing in Slovenia. The UPPD is responsible for collecting data, analysing suspicious transactions and cooperating with other national and international institutions such as the Financial Intelligence Unit (FBI) and Europol (Republic of Slovenia, 2024). As virtual currency transactions take place in a virtual world and between individuals from different countries, traditional mechanisms for combating money laundering, terrorist financing and tax evasion are often not as effective as in the case of traditional transactions (Republic of Slovenia, Court of Auditors, 2019).

Slovenia has taken various measures to address the risks associated with the use of cryptocurrencies for illicit purposes (OpenAI, 2024):

1) Regulation of cryptocurrencies: Slovenia is part of the European framework for the regulation of cryptocurrencies, such as the EU legislation governing Anti-Money Laundering (AML) and Countering the Financing of Terrorism (CFT) guidelines. Cryptocurrencies are treated as a means of payment, which means that they have to be managed in accordance with AML requirements.
2) User identification: companies that facilitate cryptocurrency exchanges or provide other services related to cryptocurrencies are obliged to implement Know Your Customer (KYC) procedures, which include verifying the identity of users to prevent anonymous or illegal transactions.
3) Suspicious transaction reporting: under the legislation, companies trading in cryptocurrencies are obliged to report suspicious transactions and cooperate with money laundering investigations.
4) Cooperation with international institutions: Slovenia cooperates closely with other countries and international organisations such as the European Commission, the European Central Bank and other financial institutions to exchange information and coordinate measures to prevent cryptocurrency abuse.

9. CONCLUSION

Cryptocurrencies are an innovation that complements the traditional payment system. However, their anonymity, fast transactions and lack of regulatory frameworks have made them attractive vehicles for illicit activities such as money laundering. Money laundering with cryptocurrencies is one of the key threats posed by this technology, as it allows the rapid, often anonymous and cross-border transfer of funds. In practice, this means that individuals or organised criminal groups can use cryptocurrencies to »clean« illegally obtained money, allowing the conversion of illicit funds into apparently legitimate ones. This is possible due to the nature of cryptocurrencies, which often provide a degree of anonymity and harder-to-trace transactions compared to traditional banking systems.

The regulation of virtual currencies in the context of anti-money laundering is the European Union's first response to this issue. Although legislation in this area is still under development in Slovenia, measures have already been taken to better track and monitor transactions in the crypto world. In any case, further steps in the development of appropriate regulations and cooperation with international bodies will be crucial to prevent abuses and ensure the security of the financial system. In addition, it is important to raise public awareness of the risks associated with cryptocurrencies and to educate the public on how to avoid money laundering risks. Companies and individuals using cryptocurrencies need to be alert to potential illegal activities and adhere to regulatory guidelines to ensure that this technology remains a tool for innovation and progress, not a means for financial abuse. A comprehensive approach to regulation, aligned with international practices, will help protect Slovenia from the risks of using cryptocurrencies for illicit purposes.

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Evaluating Utility-Based and Coherent Risk Measures in Financial Risk Management

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Abstract: *Risk is an inherent part of our daily personal and professional life, and it can be found in every aspect of it. Particularly in finance and economics, managing and understanding risk is very important, yet defining and measuring it is a challenge due to its subjective nature.*

Effective risk management requires different tools and methodologies, many of which originated from Markowitz's work in 1952. This paper examines risk measures, emphasizing the concept of coherence introduced by Artzner et al. (1999). A coherent risk measure satisfies monotonicity, positive homogeneity, sub-additivity, and translation invariance.

Key measures, including variance, skewness, Value at Risk (VaR), and Conditional Tail Expectation (CTE) will be analyzed in this paper. While widely used, variance and skewness lack coherence. VaR, popular in finance, also fails to meet coherence standards. In contrast, CTE emerges as a coherent and reliable metric, addressing VaR's shortcomings by focusing on extreme scenarios.

1. INTRODUCTION

Risk is and always has been a concern in our lives. However, risk is not an objective concept, thus, it is not easy to give a precise definition to it. Roughly speaking, risk means a chance that a certain injury or loss associated with a given action happens. Because of the great variety of risks and the increased coincidence of different events associated with risk occurring, it is becoming increasingly difficult to identify and measure risks. Also, it is becoming indispensable for one working in certain areas of finance, insurance, microeconomics, etc. to be able to measure, control and mitigate risk. Because of the importance of risk management, a great deal of studies, tools and measures have been developed in the past decades, highlighting the need for a proper definition of risk as well as specific measures to calculate and predict risks. In this paper, we will show and describe different methods and measures which are used to quantify risk. Since the pioneering work of Markowitz (1952), plenty of different risk measures and methods have been proposed. Acerbi and Tasche (2002) state that if a measure is not coherent, then it can simply not be named a risk measure, while the notion of coherence itself was first introduced by Artzner et al. (1999) and currently, is a fundamental concept related to the acceptability of a risk measure.

2. COHERENCE OF A RISK MEASURE

In order to discuss the coherence of a risk measure, some preliminary details are needed. First, let (Ω, F, P) be a probability space and let $L^0(\Omega, F, P)$ (or short L^0) denote the space of all random variables (i.e. all measurable functions) on this probability space. A financial position X is an element of $L^0(\Omega, F, P)$ modeling an uncertain payoff. A risk measure on the other hand is a function

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$\rho : L^0 \rightarrow R$ (or sometimes $\rho : L^0 \rightarrow R \cup \{+\infty\}$) which defines a preference order on L^0 allowing a decision-maker to choose between any two given positions (Assa, 2011).

In easier terms, a coherent risk measure means the risk measure covers all the maximum risks possible. On the other hand, four mathematical axioms must be fulfilled for a risk measure to be called coherent (Artzner et al., 1999).

Definition 1. Let K be a convex cone[3] in L^0 containing R (R as the space of constant functions). A function $\rho : K \rightarrow R$ is a coherent risk measure if ρ is

1. positive homogeneous, i.e. $\rho(\lambda X) = \lambda\rho(X)$, $\forall X \in K$ and $\lambda \in (0,+\infty)$.
2. sub-additive, i.e. $\rho(X+Y) \leq \rho(X) + \rho(Y)$, $\forall X, Y \in K$.
3. translation invariant, i.e. $\rho(X+m) = \rho(X) - m$, $\forall X \in K$ and $m \in R$.
4. decreasing, i.e. $\rho(X) \leq \rho(Y)$, $\forall X, Y \in K$ such that $X \geq Y$ almost surely.

If axioms (1) and (2) are replaced by

5. convexity, i.e. $\rho(\lambda X + (1-\lambda)Y) \leq \lambda\rho(X) + (1-\lambda)\rho(Y)$, $\forall X, Y \in K$ and $\lambda \in [0,1]$, the risk measure ρ is called a convex risk measure.

In economic terms, Axiom (1) shows that increasing exposure to a risky position leads to a proportional rise in the level of risk. Notably, this axiom introduces a new preference relation in the framework of coherent risk measures that cannot be replicated within the expected utility approach (Assa, 2011). Axiom (2) reflects the widely accepted principle that diversification reduces risk, a feature also present in the expected utility framework due to the concavity of the utility function. Axiom (3) grants coherent risk measures a cash-invariance property[4]. Lastly, Axiom (4) shows that if the payoff of one financial position consistently exceeds that of another, the risk measure will preserve this order (Assa, 2011). Based on these axiom criteria or properties some risk measures will be described and their coherence (or lack of) will be proved.

3. VARIANCE

Variance is a statistical measure that quantifies the dispersion of returns around the mean (average) return of an investment or financial position. In economic terms, it is used as a risk measure to represent the uncertainty or variability in the potential outcomes of an asset's returns. A higher variance indicates greater variability and, therefore, a higher level of risk, as it implies a wider range of possible outcomes around the expected return (Wasserman, 2013).

However, variance as a risk measure assumes that all deviations from the mean—both positive and negative—are equally undesirable, which may not align with how investors perceive risk (Kagan & Shepp, 1998). For this reason, while variance is a foundational concept in finance (e.g., in portfolio theory), it is often supplemented by other risk measures, such as standard deviation, Value at Risk (VaR), or downside risk measures, to better capture real-world preferences and risk aversion (Grootveld & Hallerbach, 1999).

[3] In linear algebra, a cone is a subset of a vector space that is closed under positive scalar multiplication; that is, Cis a cone if $x \in C$ implies $sx \in C$ for every positive scalar s.

[4] The cash-invariance property ensures that the risk measure responds linearly and predictably to changes in cash levels, which is crucial for practical applications like setting capital reserves or determining the amount needed to hedge a risky position. It reflects the idea that holding additional cash reduces financial risk, as cash serves as a buffer against potential losses.

3.1. Definition

Let X be a numerically valued random variable with expected value $\mu = E(X)$. Then the variance of X, denoted by $Var\,(X)$, is given as

$$Var\,(X) = E((X-\mu)^2) \tag{1}$$

3.2. Coherence of Variance

As mentioned above a measure cannot be called a risk measure, in case it is not coherent. And to show that $Var(X)$ is not coherent, it is needed to show that $Var(X)$ is neither positive homogenous nor sub-additive.

Let X and Y, be two random variables. Let $Var(X)$ indicate the variance of X, and with $\sigma(X)$ its standard deviation. It is known that $\sigma(X) = (VarX)^{1/2}$

1. Positive homogeneity: If X is multiplied by a scalar α (i.e. a number), the properties of variance tell us that $Var(\alpha X) = \alpha^2 Var(X)$, because the variance is not linear. However, $\alpha^2\ Var(X) \neq \alpha Var(X)$, hence the variance is **not** positive homogenous.

Proof: Let X be a random variable and α, a constant. Then $Var(\alpha X) = \alpha^2 Var(X)$. From the definition of variance and repeatedly applying linearity of expectation, we have:

$$\begin{aligned} Var(\alpha X) &:= E((\alpha X - \mathrm{E}[\alpha X])^2) \\ &= E[(\alpha X)^2 - 2\alpha X\,\mathrm{E}[aX] + E^2[\alpha X] \\ &= E[(\alpha X)^2] - E[2\alpha X\,E[\alpha X]] + E^2[\alpha X \\ &= \alpha^2 E[X^2] - 2\,E[\alpha X]\,E[\alpha X] + E^2[\alpha X] \\ &= \alpha^2 E[X^2] - \alpha^2 E^2[X] = \alpha^2(E[X]^2 - E^2[X]) \\ &= a^2\,Var\,X^2 \end{aligned} \tag{2}$$

2. Sub-additivity: From the properties of variance, it is known that

$$Var(X+Y) = Var(X) + Var(Y) + 2Cov(X,Y),$$

where $Cov(X,Y)$ is the so-called covariance[5].

Using correlation $\rho(X,Y) = cov(X,Y)/(\sigma(X)\sigma(Y))$, the $Var(X + Y)$ can be re-written as :

$$Var(X+Y) = Var(X) + Var(Y) + 2\rho(X,Y)\sigma(X)\sigma(Y) \tag{3}$$

Unless $\rho(X,Y)$ is zero (X and Y are not linearly dependent) or negative (they are negatively correlated), we have that the right-hand side of the previous equation is always bigger than the simple sum of the variances, therefore $Var(X+Y) \geq Var(X) + Var(Y)$. Therefore, variance is not sub-additive. Even if the other two properties (monotonicity and translation invariance) are respected, the variance is not a coherent risk measure.

[5] Covariance is a measure of the joint variability of two random variables. The sign of the covariance, therefore, shows the tendency in the linear relationship between the variables (Rice, 2007). In economic and financial terms, covariance shows how two assets move in relation to each other. It provides diversification and reduces the overall volatility for a portfolio. A positive covariance indicates that two assets move in tandem. A negative covariance indicates that two assets move in opposite directions. In the construction of a portfolio, it is important to attempt to reduce the overall risk and volatility while striving for a positive rate of return.

4. SKEWNESS

Another measure of risk is its third moment, differently known as the skewness. In probability theory and statistics, skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable about its mean (Groeneveld & Meeden, 1984). Skewness not only measures asymmetry in distribution but also provides insights into the nature of extreme values or outliers. It quantifies how much the distribution of data deviates from a symmetrical bell curve. When the skewness is positive, it often suggests that the mean is greater than the median due to the influence of high outliers. Conversely, negative skewness implies that the mean is less than the median, often because of the impact of low outliers (Von Hippel, 2005).

4.1. Definition

Mathematically, the skewness of a random variable X is the third standardized moment γ_1, defined as

$$\gamma_1(X) = E\left[\left(\frac{X-\mu}{\sigma}\right)^3\right] = \frac{\mu_3}{\sigma^3} = \frac{E[(X-\mu)^3]}{(E[(X-\mu)^2])^{3/2}} \tag{3}$$

where μ is the mean, σ is the standard deviation, E is the expectation operator and μ_3[6] is the third central moment. Generally, skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point.

4.2. Types of Skewness

The first thing noticeable about a distribution's shape is whether it has one mode (peak) or more than one. If it's unimodal, the next thing is noticeable whether it's symmetric or skewed to one side, just as seen in Figure 1 (Doane & Seward, 2011).

1. If the bulk of the data is at the left and the right tail is longer, the distribution is skewed right or positively skewed.
2. If the peak is toward the right and the left tail is longer, the distribution is skewed left or negatively skewed.
3. And in the case where the skewness = 0, then the data are perfectly symmetrical.

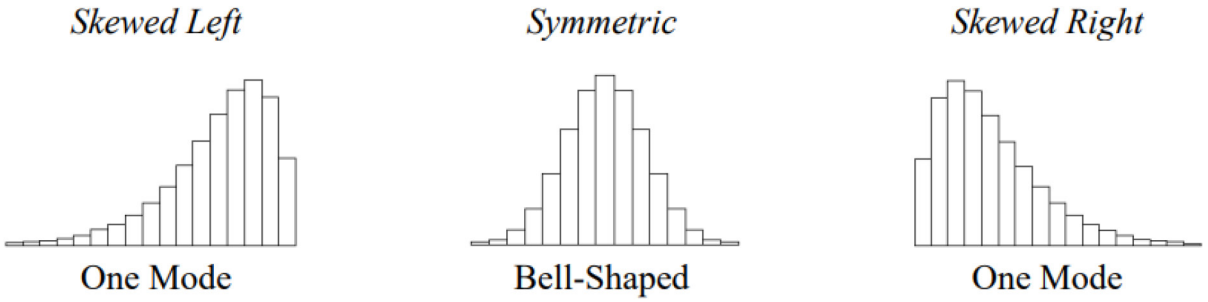

Figure 1. Types of Skewness illustrated by histograms
Source: Doane and Seward (2011)

[6] A central moment is a moment of a probability distribution of a random variable about the random variable's mean; that is, it is the expected value of a specified integer power of the deviation of the random variable from the mean (Stirzaker, 1999).

4.3. Coherence of Skewness

Skewness is also not a coherent risk measure, because it violates monotonicity, subadditivity, positive homogeneity, and translation invariance. In order not to prolong this paper, only one of these violations (which suffices to not define a risk measure as coherent) will be shown.

For $\lambda > 0$, a coherent risk measure must satisfy $\rho(\lambda X) = \lambda\rho(X)$. From the definition of skewness, we have that

$$\gamma_1(\lambda X) = \frac{E[(\lambda X - \lambda\mu)^3)]}{(\lambda\sigma)^3} = \frac{\lambda^3 E[(X-\mu)^3]}{\lambda^3\sigma^3} = \gamma_1(X). \tag{5}$$

Thus, skewness is scale-invariant (remains the same regardless of the chosen λ), which violates the positive homogeneity property of coherence.

5. VALUE AT RISK

The need to improve control of financial risks has led to a uniform measure of risk called value at risk (VaR), which the private sector is increasingly adopting as a first line of defense against financial risks (Holton, 2014). The Basel Committee on Banking Supervision announced in April 1995 that capital adequacy requirements for commercial banks are to be based on VAR[7] and in December 1995, the Securities and Exchange Commission issued a proposal that requires publicly traded U.S. corporations to disclose information about derivatives activity, with a VAR measure as one of three possible methods for making such disclosures (Jorion, 1996). Thus, the unmistakable trend is toward more-transparent financial risk reporting based on VAR measures.

5.1. Definition

Value at Risk is a statistical measure that aggregates all the risks of a portfolio into a single number suitable for use in the boardroom, reporting to regulators, or disclosure in an annual report. It is simply a way to describe the magnitude of likely losses in a portfolio, so VAR summarizes the worst expected loss over a target horizon within a given confidence interval (Duffie & Pan, 1997). More precisely, VaR is defined as follows.

Let X be a random variable and $\alpha \in [0,1]$, q is called an α-quantile if

$$P[X < q] \leq \alpha \leq P[X \leq q]. \tag{6}$$

Given the random variable X and a number $\alpha \in [0,1]$, define

$$\mathrm{VaR}_\alpha(X) = -q_\alpha(X). \tag{7}$$

X is called VaR-acceptable if $\mathrm{VaR}_\alpha(X) \leq 0$ or, equivalently, if $q_\alpha(X) \geq 0$.

VaR has the following properties:

1. $X \geq 0 \rightarrow \mathrm{VaR}_\alpha(X) \leq 0$;
2. $X \geq Y \rightarrow \mathrm{VaR}_\alpha(X) \leq \mathrm{VaR}_\alpha(Y)$
3. $\mathrm{VaR}_\alpha(X)\ (\beta X) = \beta \mathrm{VaR}_\alpha(X)\ (X)$, for $\forall\beta \geq 0$; and
4. $\mathrm{VaR}_\alpha(X)\ \ (X + k) = \mathrm{VaR}_\alpha(X)\ (\mathrm{X}) - k$, for $\forall k \in R$.

[7] Also known as BCBS, is a committee of banking supervisory authorities that was established by the central bank governors of the Group of Ten (G10) countries in 1974.

VaR is always specified with a given confidence level α – typically $\alpha = 95\%$ or $\alpha = 99\%$. This generalized definition of VaR can be calculated for any random variable.

5.2. Coherence of Value at Risk

Consider two independent random variables X and Y (representing portfolio returns) and define Value at Risk as follows:

$$\mathrm{VaR}_{\alpha} = \inf \{x \in R : P(Z \leq x) \leq 1 - \alpha\} \tag{8}$$

Where Z represents a portfolio's return, and $\alpha \in (0,1)$ is the confidence level. The subadditivity property requires:

$$\mathrm{VaR}_{\alpha}(X + Y) \leq \mathrm{VaR}_{\alpha}(X) + \mathrm{VaR}_{\alpha}(XY). \tag{9}$$

The subadditivity property ensures that diversification does not increase risk, reflecting the principle that combining two portfolios should not lead to higher risk than assessing them individually. In order to show that VaR fails to satisfy the coherence axioms, we need to construct a counterexample.

Let X and Y have the following probability distributions: $P(X = -1) = 0.05$, $P(\mathrm{X} = 0) = 0.95$ and $\mathrm{P}(Y = -1) = 0.05$, $\mathrm{P}(Y = 0) = 0.95$. Furthermore, assume X and Y are independent random variables.

At confidence level $\alpha = 0.95$, compute $\mathrm{VaR}_{0.95}(X)$. Since $P(X = -1) = 0.05$, the worst 5% of outcomes occur when $X = -1$. Thus: $\mathrm{VaR}_{0.95}(X) = 1$. Similarly, $\mathrm{VaR}_{0.95}(Y) = 1$, because Y has the same distribution as X.

Now calculate $\mathrm{VaR}_{0.95}(X + Y)$. The possible value of $X + Y$ are: $X + Y = -2$, $X + Y = -1$, $X + Y = 0$. To determine $\mathrm{VaR}_{0.95}(X + Y)$, the smallest value x such that $\mathrm{P}(X + Y \leq x) \leq 0.05$ is needed. From the distribution $\mathrm{P}(X + Y \leq -2) = 0.0025$, $\mathrm{P}(X + Y \leq -1) = 0.0025 + 0.095 = 0.0975$. Since $\mathrm{P}(X + Y \leq -1) > 0.05$, the worst 5% of outcomes occur at $X + Y = -1$. Thus $\mathrm{VaR}_{0.95}(X + Y) = 1$.

The subadditivity axiom on the other hand requires that $\mathrm{VaR}_{0.95}(X + Y) \leq \mathrm{VaR}_{0.95}(X) + \mathrm{VaR}_{0.95}(Y)$. From the computed values of the counterexample, we know that $\mathrm{VaR}_{0.95}(X + Y) = 1$, $\mathrm{VaR}_{0.95}(X) = 1$ and $\mathrm{VaR}_{0.95}(Y) = 1$, making the satisfaction of the subadditivity axiom impossible to satisfy. This means that even though VaR is commonly used in most of the financial and banking sectors, it still does not comply with the definition of a coherent risk measure.

5.3. Drawbacks of Value at Risk

As mentioned VaR is not a coherent risk measure, meaning that there are some drawbacks in using it as an adequate measure of risk (Frey & Embrechts, 2010):

1. First, VaR loses convexity properties, so it does not fulfill the property of sub-additivity, therefore it cannot be a coherent measure.
2. It is tail insensitive. It tells us that in the $\alpha \cdot 100\%$ of the cases the loss will not be greater than a certain level, but it does not give any information about the size of the loss in the remaining $(1 - \alpha) \cdot 100\%$ of the cases.
3. It is ineffective in recognizing the dangers of concentrating on credit risk.
4. Finally, VaR does not indicate the severity of the economic consequences of exposure to rare events.

6. CONDITIONAL TAIL EXPECTATION

The quantile risk measure (meaning the VaR, discussed in Chapter 5) assesses the "worst case" loss, where the worst case is defined as the event with a $(1 - \alpha)$ probability. As we mentioned above, one problem with the quantile risk measure is that it does not take into consideration what the loss will be if that $(1 - \alpha)$ worst-case event occurs (Danielsson & de Vries, 1997). The loss distribution above the quantile (VaR) does not affect the risk measure. The Conditional Tail Expectation (or CTE) was chosen to address some of the problems with the quantile risk measure (VaR). It was proposed simultaneously by several research groups, so it has many names, including Tail Value at Risk (or Tail-VaR) or Tail Conditional Expectation (or TCE) (Peng, 2009).

TCE provides a measure of the riskiness of the tail of a distribution and is an index that has gained popularity over the years. It has been getting more and more attention for measuring risk in any situation with a non-normal distribution of losses.

6.1. Definition

Like the quantile risk measure, the CTE is defined using some confidence level α, $0 \leq \alpha \leq 1$. As with the quantile risk measure, α is typically 90%, 95% or 99%. In other words, the CTE is the expected loss given that the loss falls in the worst $(1 - \alpha)$ part of the loss distribution. The worst $(1-\alpha)$ part of the loss distribution is the part above the α-quantile, q_α. If q_α falls in a continuous part of the loss distribution (that is, not in a probability mass) then we can interpret the CTE at confidence level α, given the α-quantile risk measure q_α, as

$$CTE_\alpha = E\left[L \middle| L > q_\alpha\right] = E\left[L \middle| L > \text{VaR}_\alpha(L)\right], \tag{10}$$

where L is the random loss and VaR is the Value at Risk. Intuitively, CTE measures the average loss exceeding the α-quantile of the distribution, considering the worst-case outcomes beyond the Value-at-Risk threshold (Artzner et al., 1999). This formula does not work if q_α falls in a probability mass, that is, if there is some $\varepsilon > 0$ such that $q_{\alpha+\varepsilon} = q_\alpha$.

6.2. Coherence of Conditional Tail Expectation

1) Monotonicity: If $X \leq Y$ almost most surely, then $\text{CTE}_\alpha(X) \leq \text{CTE}_\alpha(Y)$. This holds because the higher losses in Y will increase both the VAR_α and the expected losses beyond that threshold.
2) Subadditivity: $\text{CTE}_\alpha(X + Y) \leq \text{CTE}_\alpha(X) + \text{CTE}_\alpha(Y)$. This property ensures diversification benefits, as combining risks X and Y cannot result in a greater risk than summing their individual risks. The mathematical justification arises from the fact that CTE, being an expectation conditional on a tail event, is a convex function.
3) Positive Homogeneity: For any $\lambda > 0$, $\text{CTE}_\alpha(\lambda X) = \lambda \text{CTE}_\alpha(X)$. Scaling all outcomes by λ scales the Value-at-Risk and the expected shortfall by the same factor.
4) Translation Invariance: For a constant c, $\text{CTE}_\alpha(X + c) = \text{CTE}_\alpha(X) + c$. Adding a constant c shifts all outcomes by c, which increases the expected shortfall by the same amount.

The CTE has become a very important risk measure (since it has proven to be coherent) in actuarial practice. It is intuitive, easy to understand and to apply with simulation output. It provides a more comprehensive assessment of risk compared to Value-at-Risk (VaR) by considering not just the threshold loss (VaR) but also the average of losses beyond that threshold (Artzner et al., 1999). Moreover, unlike VaR, which only provides a point estimate, CTE delivers a richer picture of potential risk, making it more reliable for stress testing and financial decision-making in volatile markets. As a mean, it is more robust concerning sampling error than the quantile (Landsman & Valdez, 2005).

7. CONCLUSION

In conclusion, the concept of coherence in risk measures is crucial for ensuring that financial risk is evaluated consistently and effectively. Coherent risk measures provide a robust framework by satisfying key properties such as subadditivity, monotonicity, positive homogeneity, and translation invariance, which are essential for rational decision-making and effective risk management. Among the discussed risk measures, Conditional Tail Expectation (CTE) stands out as a fully coherent measure, capturing tail risks comprehensively and offering a more reliable perspective for extreme loss scenarios. In contrast, Value-at-Risk (VaR), while widely used in the industry, fails to meet the subadditivity property, which limits its ability to reflect diversification benefits. Similarly, Variance, although mathematically simple and commonly employed, is not coherent due to its inability to differentiate between upside and downside risk, as it considers all deviations from the mean equally. Skewness, while informative for asymmetry, lacks coherence as it is not monotonic or sub additive, making it more suited as a complementary measure rather than a standalone risk metric.

Despite its limitations, Value-at-Risk (VaR) remains the industry standard and the most commonly used risk measure in the financial industry due to its regulatory acceptance and simplicity. However, as the industry evolves, there is growing recognition of the superior theoretical properties and practical relevance of CTE, especially for stress testing and assessing tail risks in volatile markets.

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The Role of Tech-Enabled Business Models in Enhancing Financial Inclusion: The Case of Albania's Financial Sector

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Abstract: *In today's technological and business world it is crucial to ensure that everybody has access to financial services and can actively participate in economic activities, leading to faster economic development. Financial inclusion refers to the fundamental right of all individuals to access basic banking services, regardless of their socio-economic circumstances. Tech-enabled business solutions provide the necessary means to ensure financial inclusion, break traditional barriers, and ensure financial access for everyone, particularly to the unprivileged and marginalized groups. Financial inclusion is a global challenge, and middle-income countries like Albania cannot remain unaffected by its impact. In recent years, particularly in the post-COVID era, the financial system has maintained stability; however, several obstacles are encountered in attaining full financial inclusion. These primary obstacles encompass restricted availability of capital, particularly in rural regions and for specific demographic groups, low levels of financial literacy, and underdeveloped non-bank financial services.*

This study explores the impact of tech-enabled business models in enhancing financial inclusion. Considering the global challenge and the abovementioned obstacles, this research aims to answer the question of whether tech-enabled business models and tech-enabled efforts in traditional financial institutions can improve the financial sector and financial processes by enhancing and ensuring financial access to everyone. After conducting a thorough analysis and in-depth interviews with key financial service providers in Albania the findings reveal that integrating technology in financial services has led to positive changes in how financial organizations operate and communicate with their customers, and how tech-enabled business models expand financial services to marginalized communities.

1. INTRODUCTION

There is no generally accepted definition for financial inclusion (Sanderson et al., 2018), but researchers in a broader perspective define it as a process that ensures the weaker and vulnerable members of society access to fundamental financial services such as credit, money transfers, savings and insurance. The ecosystem and especially the financial sector is a key element in enhancing financial inclusion in a country.

In the wake of the digital revolution, financial sectors around the world are experiencing a paradigm shift, with conventional barriers to financial access being destroyed by the rapid adoption of technology. This transition is most visible in emerging economies, where digital financial services have ushered in a new era of inclusion and accessibility. On the other side, The COVID-19 pandemic hastened the digital shift in financial services, presenting both challenges and opportunities (Balla, 2020). Globally, the crisis accelerated the data revolution in finance, with traditional banks adopting data-driven solutions (Remolina, 2020). This changing landscape presents dangers to consumers and financial stability, which authorities must address (Remolina, 2020).

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Business models play a crucial role in the whole ecosystem as they are a sustainable form of understanding customers' needs and creating value for profit generation (Nielsen et al., 2018). Due to the rise of technological advancements and increased need for financial access, the banking sector is experiencing huge transformations which has led to tech-enabled financial services and more importantly tech-enabled business models (Dapp et al., 2015; Broby, 2021).

Albania, with a unique economic landscape and development trajectory, is an intriguing case study in this global narrative. As we delve deeper into Albania's financial sector, it becomes clear that, while digital transformation has enormous potential to foster financial inclusion, its actual realization depends on a variety of factors such as technological adoption, regulatory frameworks, and socioeconomic conditions (Demirgüç-Kunt et al., 2018).

This study aims to understand the impact of technology and innovation on transforming business models that can enhance financial inclusion, bridge financial barriers and more important empower Albania's economically deprived groups. Addressing these issues is crucial for enriching the academic discourse on financial inclusion and for informing policy and operational strategies that could significantly enhance the efficacy of digital financial services in Albania and broader.

2. LITERATURE REVIEW

The COVID-19 pandemic has accelerated the digital transformation of financial services worldwide, including Albania, reshaping the industry and exposing new challenges and opportunities. In Albania, the use of financial technology (fintech) has been critical in maintaining service delivery despite constraints, emphasizing its role in boosting financial inclusion (Balla, 2020). Internationally, this change reflects a wider pattern in which data-driven solutions address financial challenges while raising concerns about consumer protection and systemic stability (Remolina, 2020; Lahreche et al., 2020).

Albania's financial sector has made significant strides toward aligning with EU standards, facilitated by institutional reforms and macroeconomic stabilization. However, unresolved issues such as high euro consumption, non-performing loans, and uneven sectoral development continue to pose substantial challenges (Uldedaj et al., 2024). Despite advances in online banking and fintech adoption, the industry confronts legislative and operational concerns, such as maintaining strong frameworks to prevent money laundering in digital transactions (Habili et al., 2023; Balla, 2020).

Albania's financial environment has always mirrored the country's overall socioeconomic development. Before 1944, the sector saw the rise of domestic and foreign-backed institutions. Between 1944 until 1991, the banking sector was consolidated under state ownership, while post-1991 reforms allowed for market liberalization and the introduction of foreign capital, modernizing financial operations (Albanian Association of Banks, 2012). As of 2024, Albania's financial ecosystem comprises 11 licensed banks, 39 non-bank financial institutions, and 16 savings and loan associations, regulated by the Bank of Albania (2023).

Financial inclusion, a global developmental priority, remains a complex challenge in Albania. Structural barriers, including limited rural financial access, low financial literacy, and an underdeveloped non-bank sector, hinder comprehensive inclusion (Mexhuani & Ribaj, 2018; Dushku, 2022). While 70% of Albania's adult population held payment accounts in 2023, only 44% had bank accounts in 2021, underscoring the gap in financial accessibility (Bank of Albania, 2023).

Electronic payment systems have grown in popularity, with digital transactions increasing by 25.5% between 2022 and 2023, due to mobile and home banking services. Despite this increase, financial literacy remains low, with just 53% of the population demonstrating adequate financial knowledge and practices (Dushku, 2022). Furthermore, the banking sector's concentration, with four big banks accounting for more than 66% of total assets, combined with regulatory and infrastructure constraints, restricts access to credit and alternative financing (Mexhuani & Ribaj, 2018).

The existing literature highlights critical gaps in understanding the evolving dynamics of Albania's financial sector. Notably, research into the integration of emerging technologies, such as artificial intelligence and big data analytics, is still limited. These tools have the potential to dramatically improve service personalization, efficiency, and risk management, but they have yet to be explored in Albania.

Furthermore, little consideration has been paid to specific neglected categories, such as rural communities, young people, and low-income groups, whose exclusion undermines overall financial inclusion initiatives. Finally, while innovations like blockchain and mobile money have been lauded for their disruptive potential, their long-term implications for financial stability, consumer protection, and regulatory compliance are still unknown. Further investigation is essential to assess their viability within Albania's financial ecosystem.

3. RESEARCH METHODOLOGY

This study employs a qualitative research method to provide a comprehensive analysis of the situation in the Albanian landscape. Previous studies do support the use of these kinds of approaches to answer questions similar to the ones this paper treats (Koefer et al., 2024). Table 1 lists the selection criteria that properly present an inclusive sample. In total, 10 organizations have been reached out to, and the response rate toward scheduling an interview is 50%. The selected sample consists of 2 Banks, 2 Microfinance institutions, and 1 FinTech organization. At each organization, one interview with a representative of the organization has been conducted.

The data collection process involved semi-structured interviews with five inclusive finance organizations in Albania. This method was chosen for its flexibility and ability to offer diverse perspectives and insights into how these firms address financial inclusion through tech implementation and innovation of digital financial services. This protocol included a pre-interview discussion, a structured interview script, and a series of preset open-ended questions. Prompts were utilized to keep concentration. The interview questions were focused on characteristics of the business model, contributions to financial inclusion, the use of digital technology, approaches to financial literacy, and initiatives for developing digital literacy to improve financial inclusion. These inquiries sought to elicit insights about the organizations' actions and their impact on these critical areas, ultimately revealing light on their approaches to financial and digital inclusion.

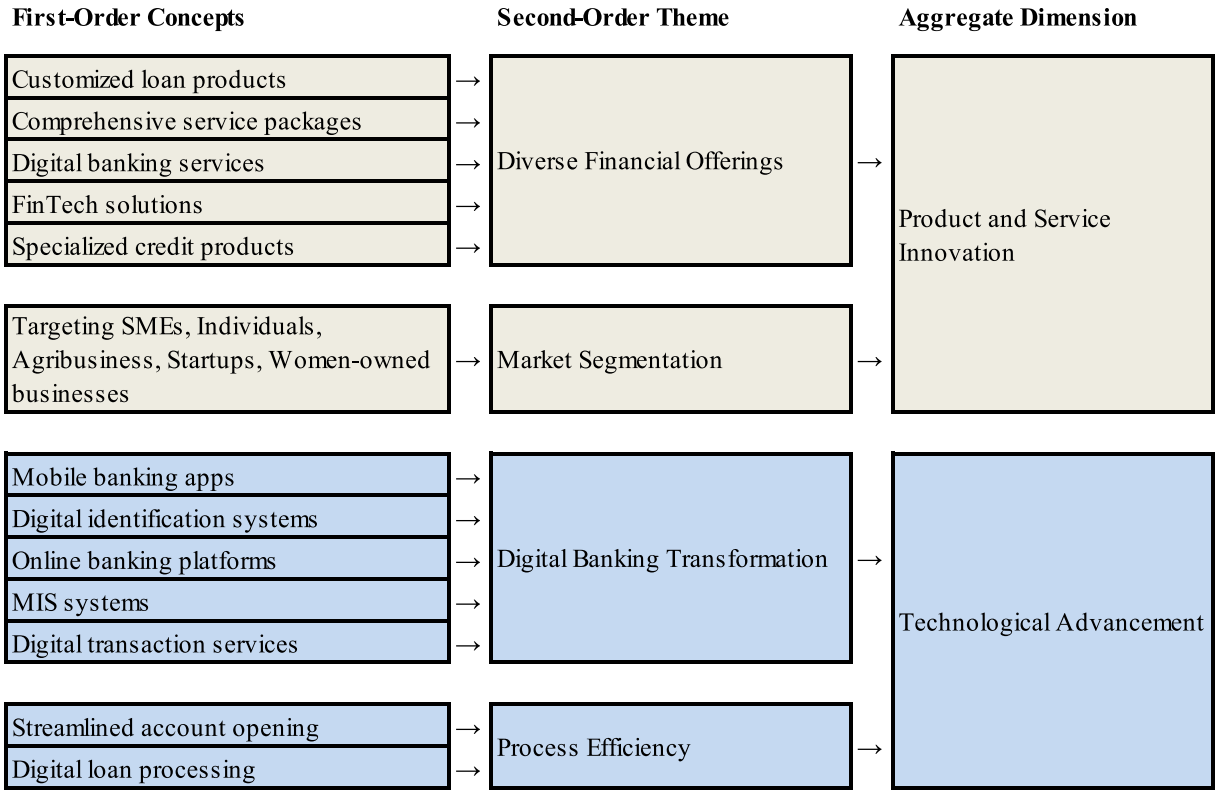
Gioia technique, an inductive qualitative methodology (Gioia et al., 2013), was used to analyse the data. This approach divides data into first-order concepts, second-order themes, and aggregate dimensions. A graphical model that depicts the dynamic interactions between these elements was designed and is presented in Table 2. The analytical part included the following processes: transcription and coding of the interviews, examination of the relevant keywords in the code, production of first-order concepts, first-order concepts investigation for similarities and contrasts, resulting in second-order themes that correspond to the interview questions, combination of second-order themes into aggregate dimensions that describe the key points of discussion.

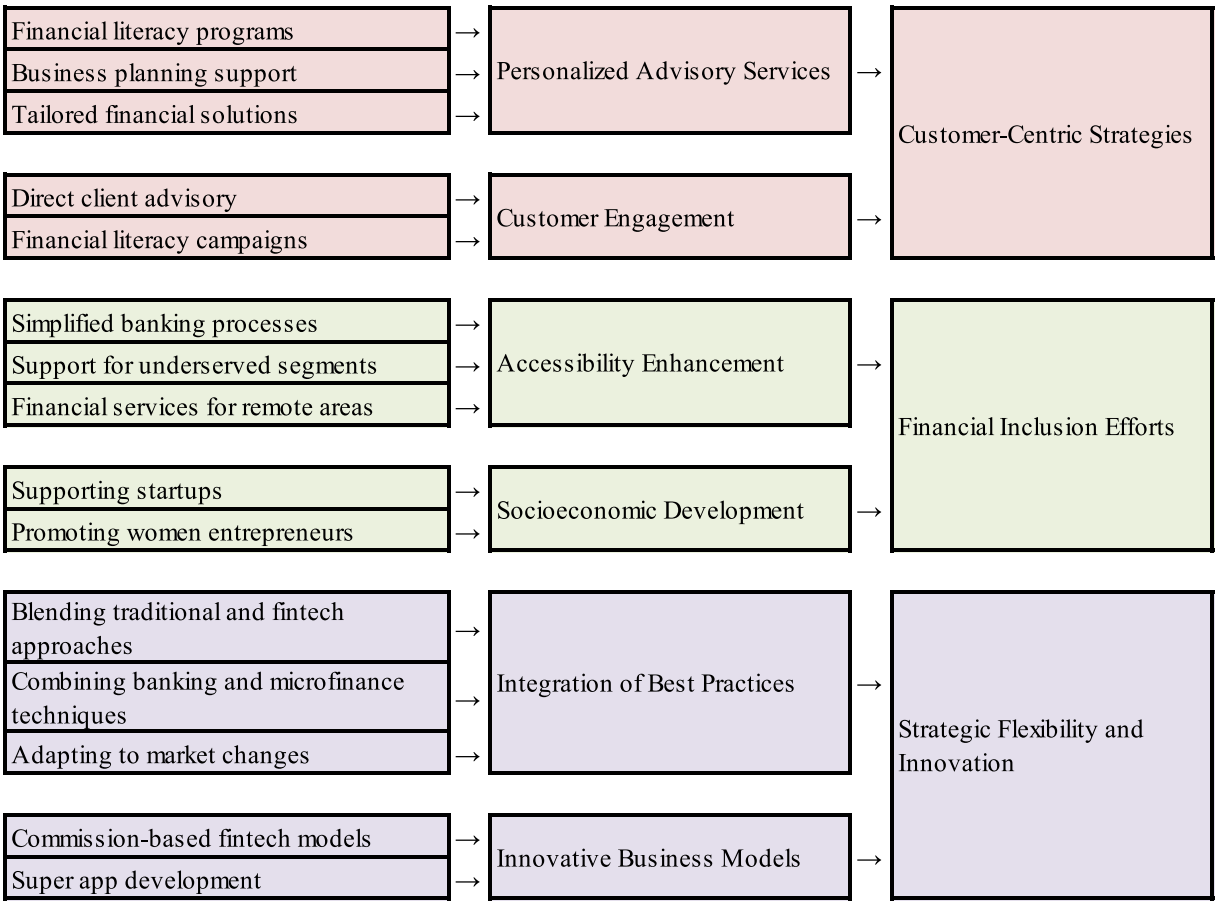
Table 1. Institution selection criteria

Institution	Selection criteria
Banks	• **Target Demographic**: The bank should have initiatives or products specifically designed to serve underserved communities. • **Commitment to Financial Inclusion**: The bank must demonstrate a clear commitment to increasing financial inclusion, particularly through the use of digital technologies. • **Innovation in Financial Services**: The bank should be engaged in innovating financial services to make them more accessible and user-friendly for all segments of the population, including those not well served by traditional banking models. • **Range of Services**: The bank provides a comprehensive suite of services, including but not limited to borrowing, savings, investments, and offering bank accounts that cater to both personal and entrepreneurial needs. • **Digital Engagement**: The bank should utilize digital platforms and technologies to enhance service delivery and customer interaction, ensuring that services are accessible via digital means.
MFIs	• **Target Community**: MFIs should target underserved communities as their customer segment. • **Focus on Financial Inclusion**: They should focus on strategies and products that increase the financial inclusion of these communities. • **Social Impact**: MFIs should strive for positive social outcomes through their services. • **Comprehensive Financial Services**: They must offer a variety of financial services tailored to the needs of their clients, including borrowing, savings, investments, and accounts for personal or entrepreneurial purposes.
FinTech organizations	• **Consumer Targeting**: FinTech organizations should focus on individual consumers or small enterprises, addressing specific needs unmet by traditional financial institutions. • **Customer-Centric Approaches**: They should prioritize the customer experience by making the use of financial services more accessible and simpler. • **Social and Inclusive Objectives**: FinTechs should have a clear aim toward social and inclusive goals, contributing to broader access to financial services. • **Diverse Financial Services**: They need to provide a spectrum of services such as borrowings, savings, investments, and financial management. • **Digital and Innovative Solutions**: FinTechs should offer their services primarily through digital channels using innovative technologies, ensuring that customers can access and use these services effectively and conveniently.

Source: Own research

Table 2. Results of Qualitative Interviews; Gioia Method





Source: Own research

4. INTERVIEW RESULTS

4.1. The Gioia Method Framework: First-Order Concepts, Second Order Theme and Aggregate Dimension.

Using the acquired and processed data, a visual data structure that organizes the initial first-order concepts into second-order themes and aggregate dimensions were created, as shown in Table 2. This structure comprises five aggregate dimensions: Product and Service Innovation, Technological Advancement, Customer-Centric Strategies, Financial Inclusion Efforts, and Strategic Flexibility and Innovation. The following session presents the results analysis from this process.

4.2. Results Analysis

In this section, results analysis for each aggregate dimension are presented.

Product and Service Innovation: Financial institutions in Albania have developed a diverse range of products to meet the specific needs of their target customer segments. Some of them are focused on tailored loan products for sectors such as SMEs, agribusiness and startups. This comprehensive package aims to provide grater value and convenience for customers. These solutions are designed to make financial transactions more seamless and accessible, especially for tech-savvy customers and those looking for flexible payment options. Such diversification plays a crucial role in advancing financial inclusion by ensuring that various customer groups, including underserved populations, have access to customized financial services.

Technological Advancements: The institutions have made significant investments in technological innovations to enhance service delivery, boost operational efficiency, and improve customer engagement. The integration of digital platforms and cutting-edge technologies is a central strategy for advancing financial inclusion and ensuring broader access to financial services. One of the institutions has rolled out various FinTech solutions targeting both individuals and merchants, such as QR code payments, virtual POS systems, and innovative services like buy now pay later. Others have upgraded their online banking platforms, enabling customers to conduct a wide range of transactions from the comfort of their homes or offices. Additionally, Institutions leverage automated systems to streamline internal processes, manage customer data, track transactions, and ensure regulatory compliance.

Customer-Centric Strategies: The institutions have embraced customer-centric strategies to offer personalized advisory services and support. This approach aims to improve customer engagement, satisfaction, and financial literacy—key factors for promoting financial inclusion and empowering customers to make informed financial decisions. Some institutions run financial literacy programs to educate customers about financial management, services and fintech solutions. One of the main challenges in Albania is the lack of adequate financial and digital literacy. Therefore, these educational initiatives are particularly important in the Albanian context as they guide and help customers develop the skills and knowledge to make sound financial decisions.

Financial Inclusion Efforts: Institutions have made considerable efforts to improve access to financial services, by streamlining processes, supporting underserved segments, and offering inclusive financial products. These initiatives aim to eliminate obstacles to financial inclusion and ensure that a larger segment of the population can access and benefit from financial services. Institutions have implemented simplified banking processes to make financial services more accessible. They prioritize supporting underserved segments including startups, women-owned businesses, and micro and small enterprises. Through personalized advisory services and financial solutions, these institutions assist these groups in overcoming challenges related to accessing finance, thereby promoting economic growth and financial stability within these communities.

Strategic Flexibility and Innovation: Institutions demonstrate strategic adaptability by blending traditional banking practices with innovative fintech approaches. This integration allows them to adapt to market changes and offer unique financial solutions that meet the evolving needs of their customers. By continuously evolving their strategies to align with market dynamics, these institutions maintain competitive advantage and ensure long-term viability. Others offer innovative financial solutions, including commission-based fintech models and super app development. These innovative business models cater to the specific needs of different customer segments, providing them with customized financial services. The development of super apps, which consolidate multiple financial services into a single platform, showcases how institutions are utilizing innovation to improve customer convenience and engagement.

Table 3. Summary Table for Interviews

Inst.	Digital Technologies (Integration)	Customer-Centric Strategies	Financial Inclusion Efforts	Enhanced Financial Inclusion	Enhanced Customer Satisfaction
1.1	24/7 digital banking, online tutorials	Personalized advisory, face-to-face interactions	Simplified processes, tailored products	Yes	Yes
1.2	Digital platforms and innovative tools	Continuous workshops, youth programs	Simplified processes, sustainable activities	Yes	Yes

2.1	MIS for internal processes plans for online modules	Business planning support, advisory services	Supports startups, women-owned businesses	Yes	Yes
2.2	Modern portable systems, plans for digital signatures	Close interaction, tailored solutions	Formalizing businesses through advising	Yes	Yes
3	Mobile apps, digital identification software	Financial literacy campaigns, university lectures	Online payments, remittance solutions	Yes	Yes

Source: Own research

Table 3 represents a summary of the interviews. As can be seen, companies that invest in technology and integrate tech tools into their business model can enhance better their financial inclusion and customer satisfaction.

5. DISCUSSION

The integration of technology has transformed how financial institutions operate and connect with customers, addressing traditional barriers to financial access. This study highlights key factors influencing the relationship between technological adoption and financial inclusion.

Tech-Enabled Business Models: Innovative business models leveraging digital platforms have reduced barriers like high costs and limited-service access, enabling institutions to better serve underserved groups. These models streamline processes, improve efficiency, and provide tailored solutions for rural populations, women-owned businesses, and micro-enterprises.

Technology as a Driver of Inclusion: Tools like mobile banking, digital IDs, and data analytics allow institutions to offer innovative, accessible financial products. Super apps and fintech solutions have simplified interactions and promoted financial literacy, addressing Albania's low digital and financial literacy levels.

Customer-Centric Strategies: A focus on personalized support and financial education enhances customer satisfaction and long-term financial stability. Simplified processes and inclusive products effectively meet the needs of underserved groups, fostering a more inclusive financial ecosystem.

Despite progress, challenges remain, including regulatory gaps and uneven digital infrastructure. Addressing these issues is vital for sustained growth and broader inclusion.

6. CONCLUSION

This research highlights the transformative impact of tech-enabled business models on financial inclusion in Albania. By integrating digital technologies into their operations, financial institutions have made financial services more accessible, affordable, and inclusive, particularly for marginalized and underserved communities.

While challenges such as low financial literacy and limited rural access remain, the efforts made in recent years demonstrate that technology, when effectively harnessed, can serve as a powerful equalizer. Institutions that innovate their products, services, and business models have successfully addressed many barriers to financial access, enabling more individuals and businesses to participate in the formal financial system.

The findings emphasize that the integration of technology is not merely a tool but a strategic imperative for fostering financial inclusion. Continued efforts to enhance digital literacy, develop regulatory frameworks, and promote customer-centric approaches will be critical to sustaining this progress. By doing so, Albania can advance its journey toward building a more inclusive and equitable financial ecosystem, paving the way for broader socioeconomic development.

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IT Implementation Challenges in Accounting and Auditing

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Abstract: *The application of information technologies in the business of modern organizations is taken for granted today. The sustainability of an organization without the implementation of information technologies in almost all business functions of that organization is not possible. An information system designed in this way is subject to frequent errors and data loss, so permanent internal and external monitoring is necessary. Consequently, a completely new profession is developing, which is the auditing of information systems. The audit of information systems is complicated, and the field of its action is much wider than the audit of financial statements. The domain of information systems audit is both accounting and non-accounting information systems. This paper deals with defining the subject and role of information system audit.*

1. INTRODUCTION

Information technologies are expanding, and their application in the business operations of modern organizations is now taken for granted. The operations of an organization cannot be imagined without the implementation of information technologies in almost all its business functions. However, both the implementation and maintenance of information technologies within an organization require significant financial investment as well as expertise. The risk of integrating information technologies within the organization is significant, both during the setup of information systems in business and throughout the ongoing operations of the organization that rely on these systems. The risk is even greater when considering that information systems function based on the use of data and information that are easily manipulated and prone to fraud and abuse. For this reason, the management and maintenance of information systems require educated and professional staff, who must continually improve and adapt in line with the development of the information systems.

An information system set up in this way is subject to frequent errors and data loss, so constant internal and external monitoring is necessary. In this sense, a completely new profession is developing, which is the auditing of information systems. It is no longer enough to simply audit the company's financial reports; a process is also required to collect and evaluate evidence to assess the success of information systems—specifically, whether the system functions to ensure data integrity and achieve the organization's defined goals. Additionally, the audit of information systems determines whether these systems operate in the interest of preserving the organization's assets and ensuring the efficient use of resources.

Therefore, the audit of information systems is highly complex, and its scope is much broader than that of auditing financial reports. The domain of information systems audit encompasses both accounting

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and non-accounting information systems. This work defines the subject and role of information systems audit and, in addition to the introduction and conclusion, consists of three main sections. First, the concepts of technology and information technology, along with the stages of development of IT in accounting and auditing, are examined in detail. The purpose, role, and types of information systems audits are then discussed. Finally, the characteristics of the profession of information systems auditor, as well as the skills and qualifications required of auditors, are examined in detail.

2. DEFINITION OF TECHNOLOGY AND IT IMPLEMENTATION PHASES IN ACCOUNTING AND AUDITING

2.1. Definition of technology

Contemporary business conditions dictate new trends that imply the necessity of implementing technology in business. In order for the company to remain competitive in the "market game" and to remain efficient both in the function of organization and in the function of management and development, it must use IT as a tool in defining and achieving business goals.

The term "technology" is used today for many everyday activities that do not have a clear definition. The original definition of technology is that it is a comprehensive science of the intertwining of technique, economy and society, which was given in 1777 by J.G. Bachmann (Ropohl, 1979). Kukoleča gave several definitions of technology, and one of them led to the wide use of this term in different contexts, because it determines technology as any work process of physical and mental work in the economy and outside it (Kukoleča, 1986).

In any case, technology is defined as a science, and as such, it coordinates with other sciences, including social sciences (Šarić & Čatić, 1998). For this paper, the relationship between technology and economic science is important as an important social science, so the emphasis will be on the relationship between technology and, above all, accounting and auditing.

2.2. Stages of Technology Development in Accounting and Auditing

2.2.1. Phase 1: A System Based on Paper Documents

Traditional accounting does not imply the use of technology to perform the accounting function. Tasks were performed manually, and on paper, and the accounting function was not integrated with other functions in the organization, so there was no adequate data flow. For an interested employee to get some data that is important to him, he would have to go directly to the premises where the accounting function is physically located. Data were stored in computers, but financial reporting was insufficiently developed.

2.2.2. Phase 2: Initial Technology Based on Personal Computers (PC)

In this phase, data stored in computers that were based on paper documents were transferred to PCs and local network systems. In this way, reports containing only basic information could be printed. Information technologies in accounting and finance were designed so that all data could be archived on one network, where each computer, as part of the network, was either a client or a server. Servers are powerful computers that manage files and provide services to clients, which, on the other hand, are computers and other workstations that users use to run software applications (Glogić et al., 2019).

2.2.3. Phase 3: Electronic Database System

The development of relational databases marked the next phase of technology development and implementation in accounting and auditing. In the most practical sense, a relational database can be understood as a system of interconnected tables, in which the most rational and economical method of recording data is sought (codeBlog, 2020). This means that information from different tables, files, and locations can be integrated, producing much more complex reports that contain the elements necessary for economic analysis. Additionally, there has been an increase in the use of the Internet in organizations, and therefore also in the field of accounting and auditing. Now, the accounting and auditing functions can offer much more meaningful data to managers for decision-making, through the integration and exchange of information across the entire organization, facilitated by relational databases and network architecture (Glogić et al., 2019).

2.2.4. Phase 4: Web-Based Technology

At this stage, technology has already been deeply integrated into all parts of an organization because its positive impact on the efficiency and effectiveness of operations has been repeatedly noticed and proven. Accounting and auditing have embraced business modernization through the implementation of web-based technology. This technology allows users to access information via the Internet from any server using a password. The accounting and auditing functions still store financial data about organizations, but their importance for internal and external stakeholders is increasing, as the reports produced by these functions are now much more detailed and purposeful. For now, most accounting systems are still not in the cloud, but the trend toward cloud implementation in accounting is on the rise.

3. INFORMATION TECHNOLOGY AND AUDIT

As emphasized previously in the text, in the earlier stages of the development of accounting and auditing, the computer was not used as a tool for performing tasks in this area, while today the business of any function, including accounting and auditing, cannot be imagined without modern information technology (Andrić et al., 2011). The expansion of the implementation of information technologies has a strong influence on the development of the auditing profession. Today, the audit of financial statements without the application of information technology is unthinkable. Many factors lead to the necessity of implementing information technologies in the auditing and accounting process: the use of information technologies in the processing of clients' accounting data, the increased number of client transactions, and the large volume of client data that are subject to audit, the geographical distance of audit team members, the manipulation of client data submitted in electronic form, a limited period of time during which it is necessary to realize an increasing number of audit activities, etc. (Trklja et al., 2023). The indirect impact of information technologies on the development of the audit profession is reflected through the development and modernization of the accounting profession, while the direct impact is seen through the modernization of audit software and the necessary tools that provide safer access to the application solutions of audit clients, as well as the possibility of complete downloading, processing, and analysis of all data required for the revision process (Perić et al., 2021). Also, in performing their tasks, auditors rely on a wide range of computer-aided techniques and tools, which results in a significantly increased demand for auditors with adequate IT qualifications (Trklja et al., 2023). Modern audit procedures supported by the IT sector can be used to perform various audit procedures that include testing and processing of accounting information for clients, analytical review of uncertainty identification procedures, etc. (Nazarova et al., 2021). Ultimately, everything listed

should lead to an increase in quality and efficiency and contribute to a reduction in the time spent on audit work, wider coverage and more comprehensive analysis of balance sheet positions, as well as assurance that internal controls are well positioned in business processes and that business risks are effectively managed (Perić et al., 2021). A challenge faced by auditors as a consequence of IT implementation is the different IT environments for different clients. In addition, information technologies develop and therefore change very quickly, while audit clients react to them with more or less success. Furthermore, the quality of accounting processing in different companies using the same software platform may vary depending on the success of the software customization procedure, retraining of personnel, adaptation to changes, etc. (Andrić et al., 2015). Thanks to these innovations and the application of advanced auditing software, auditors can perform more detailed analyses, leading to more precise and reliable conclusions that will give the end users of accounting data a more reliable opinion on financial statements.

3.1. Purpose and Roles of IS Audits

The penetration of information technologies into all aspects of business has fundamentally changed the definition of goals and their execution. In addition to the previously listed consequences of the application of modern technology on the development of the accounting function and auditing, a new field of action is emerging within the auditing profession itself, which is IS auditing. Namely, the process of implementing information technologies in business is complicated, both in terms of implementation and financial investments, which are extensive and risky. Furthermore, once an information system is implemented, it requires continuous adaptation and upgrading in line with the further development of modern technology. The electronic data used by the information system are vulnerable to manipulation and abuse. Also, the volume of tasks that can be realized by the information system is constantly growing, so the costs and risks associated with them are simultaneously higher. All of this simultaneously requires personnel changes in terms of management, which is still not sufficiently qualified to manage information systems. In the final instance, everything above indicates that it is necessary to control and monitor information systems in the organization, which is precisely what information systems audit deals with.

IS audit is a process of gathering and independent, professional assessment of evidence, which checks the effectiveness of actions and assesses the quality of IS companies (Todorovic & Ljubisavljevic, n.d.). An IS audit is an assessment of the information technologies, practices and operations that ensure the integrity of the information subject. Such an assessment implies an assessment of the effectiveness, efficiency and cost-effectiveness of computer-aided practices (Trklja et al., 2023).

3.2. Audit Types

From the previous definitions, we can conclude that IS auditing involves not only auditing accounting systems but also non-accounting information systems. In this sense, there are differences between traditional audits and IS audits, which will be discussed in more detail later.

3.2.1. An Audit Created in the Context of a Traditional Audit

An audit is defined as a systematic process, carried out by an independent and competent auditor, who collects and evaluates sufficient and relevant evidence about business transactions and their consequences in order to examine how the condition, ownership, valuation and disclosure of those actions are shown in the accounting and the level of compliance reporting those changes with accounting standards. The established results are communicated to interested users in the form of

an audit report (Ljutić., 2005). Audit can be seen as external and internal. The term external audit refers to the audit of financial statements. The goal of auditing financial statements is to communicate to interested users an independent opinion on the compliance of financial statements with established criteria. That communication is formalized through the *Auditor's Report*. Therefore, the audit includes the reporting phase, where the auditor communicates their opinion to interested users, as well as the evidence-gathering phase, where evidence is collected and evaluated to form an opinion (Stanišić, 2018). External auditing is performed by separate, independent firms, while internal auditing is part of the organization itself. Namely, internal audit is a systematic process of collecting and evaluating evidence about the internal control systems set up in the organizations in question. The goal of internal control is to examine and detect potential problems in the procedures and systems of internal controls and provide proposals for their elimination on time.

The development of modern information systems has had an irreparable impact on any type of business, so audit as a business function and profession has changed. Information technologies have become an integral and inseparable part of the audit process. On the other hand, information systems themselves, due to their presence and importance for modern business, require their own audit, which implies the development of audit in the context of the audit of information systems themselves.

3.2.2. Revision of Information Systems in the Scope of Revision of the Information Systems Themselves

In the previous part of the paper, it was emphasized that in the third phase of development and implementation of techniques and technology in accounting and auditing, the automation of the accounting process as the basic task of the computer occurred. In this regard, the audit of electronic data processing primarily focused on hardware and software. Today, IS auditing is viewed much more widely, considering the general networking, the application of IT not only in data manipulation but also in decision-making and management based on information created by IS (Todorovic & Ljubisavljevic, n.d.). Audit of information systems includes those internal controls that depend on the processing of information systems and includes general controls (entity, system, business process application level), business process application controls (input, processing, output, master file, interface and data management controls), and user controls (controls performed by people who are in an interactive relationship with information systems) (Stanišić, 2014). The control function focuses on process control, where the emphasis is on deviations from the rules and the responsibility for non-compliance with certain standards or values (Malešević & Vranković, 2007).

The objectives of controlling information and similar technology are essentially no different from controls in other processes or procedures. The primary objective of an IT system audit refers to the observation and evaluation of parts of the system in order to determine whether the system produces timely, accurate, complete and reliable information necessary for business decision-making. When performing audit procedures, and in order to realize the main audit objective, the answer to the main audit question should be sought: Does the auditee's IT system function appropriately, while maintaining the integrity of the data necessary for business decision-making? (Stanimirović & Gajić, 2017). In addition to the main objective, IS audit should enable the realization of a whole range of audit objectives that can be grouped into four areas (Mijić, 2009):

- protection of data and information resources,
- ensuring the truthfulness and objectivity of financial reporting
- ensuring the efficiency and effectiveness of the functioning of information systems i
- ensuring the functioning of the internal control system under the defined rules.

Every IT solution implemented in business has its life cycle that includes certain stages, i.e. phase of detection, reaction and correction. Viewed in this way, there was a need to view IS audit as a separate discipline and profession within informatics.

From the very definition of IS audits, which is aimed at ensuring data security, but also at the processing process itself, as well as the results of that processing, i.e. different information contents, originating from different subsystems of the IS company, are derived from the subject of the IS audit (Davis et al., 2007):

- controls present at the level of the entire organization that represent the basis of the control environment;
- physical facilities and data center;
- network and communication infrastructure that includes devices for working online and with networks;
- operating system;
- middleware or a program that ensures the integration of two independent programs;
- databases, i.e. an application that organizes and provides access to data used by various applications and
- applications or programs used by users to realize various requests.

3.3. Revision of RIS

The accounting function is central to the operations of an organization. All the necessary information that is essential for defining the goals and operations of the company is the output of the work of the accounting function, shown through financial reports. On the other hand, the modern operation of the accounting function cannot be imagined without information support, because accounting in combination with modern information technologies represents a powerful tool for company management and a tool for making decisions based on business data. The accounting information system (RIS) is a crucial part of the organization's information system. In the accounting information system, all the data about the organization's operations that represent inputs are poured, and as an output, quantitative information is obtained that is suitable for analysis and as such a parameter for making business decisions. The accounting information system occupies perhaps the central place in the information system of an organization because it realizes cause and effect connections with other systems (Ilić & Anđelić, 2017).

Standard RSS 33 - Accounting software standard adopted and adopted by the Association of Accountants and Auditors of Serbia in 2003, revised in 2008, regulates the field of accounting software, i.e. accounting information systems (Glogić et al., 2020). According to this Standard, the basic qualitative features of the accounting information system are (Ministarstvo finansija Republike Srbije, n.d.):

- Functionality,
- Reliability,
- Usability
- Efficiency,
- Ease of maintenance,
- Portability.
- The role of RIS, based on the application of IT, includes the following (Todorovic & Ljubisavljevic, n.d.):
- to maintain and strengthen the company's activities - which is an aspect of process management;
- to support the decision-making process and ensure the production of relevant information - which is an aspect of management information;

- to ensure management, procurement control, use of resources - which is an aspect of internal control;
- to enable the fulfillment of legal, social and political obligations and responsibilities, to enable the fulfillment of regulatory requirements - which is an aspect of external control.

An accounting information system audit includes a compliance audit, an operational audit, and an audit of financial statements (Boczko, 2007). Compliance audit in a broader sense refers to the audit of normative compliance, i.e. the creation of opinions and assessments regarding compliance with each type of regulation (laws, standards, procedures, regulations, etc.). Specifically, in the case of the AIS audit, the compliance audit determines compliance with the concrete standard (Radovanović, 2010). An operational audit is a comprehensive activity, which is designed to analyze the organizational structure, internal control systems, the flow of the work process, a broader assessment of creditworthiness and the results of the management's work. An operational audit is an instrument of the company's operations, a management tool, but also its corrector. It measures the degree of achievement of the goals of an organization concerning the planned ones. Operational audit deals with the overall achievement of goals, the effectiveness of business procedures and internal control, the results of individual managers and other non-financial aspects of business (Nerandžić, 2004). Revision of financial statements involves a systematic examination of financial statements, accounting and related business changes to determine compliance with generally accepted accounting principles and legal regulations (Ljubisavljević & Jovković, 2016).

4. PROFESSION OF AUDITOR OF INFORMATION SYSTEMS

Information technologies undergo continuous development, with constant improvements and upgrades. As the entire business of the organization changes with the development and implementation of modern technology, so too do human resources, and therefore the profession of auditors has been affected by this process. IS auditors are a rare resource. IS auditors must be technical experts with audit knowledge, which they need to continually upgrade and refine.

If the audit is to maintain its place as a central mechanism for ensuring the stability of financial markets, auditors in the IT environment must provide quality audit reports that contain an opinion that increases the credibility of financial statements to an acceptable level. However, auditors must take into account that accounting and control environments, affected by information technologies, also require specific audit approaches (Andrić et al., 2011). The field of information is still insufficiently covered by regulations, so the auditor's role has been expanded to include system testing (Andrić et al., 2015). The exponential increase in the volume of accounting data creates inherent limitations for traditional audits to provide an appropriate level of quality assurance. A large volume of information must be used effectively for the audit engagement to be of high quality. In the modern environment, large and complex data sets are analyzed using robust and predictive software solutions (Vuković et al., 2023). In addition, competence in working with large data sets opens opportunities for auditors to offer new consulting services to the market (Earley, 2015; Richins et al., 2017). Furthermore, data analytics can be used in the area of non-financial data and external data to improve the audit planning process, especially for risk assessment, as well as in areas that require the auditor's subjective judgment, such as valuation issues (Earley, 2015).

Over time, the need to more specifically and seriously regulate the IS audit area also arose. The EDP Auditors Association (EDPAA) was founded in Los Angeles in 1969 and changed its name to the Information Systems Audit and Control Association (ISACA) in 1994. The most important tasks of this association are the development of standards and codes of ethics for IS auditors, the organization of educational seminars, the certification process, the publication of professional publications, and

the organization of conferences, among other activities. It is a global professional organization that unites professionals dealing with issues related to IT management, control, and security (Todorovic & Ljubisavljevic, n.d.). ISACA has also published two groups of standards: 1) standards for auditing information systems (Information Systems Auditing Standards) and 2) standards for professionals who control information systems (Information Systems Control Professionals Standards). IS audit standards define the mandatory requirements for auditing and reporting, and refer to (ISACA, n.d.):

- the minimum level of fulfillment of obligations defined by the ISACA Code of Professional Ethics;
- user expectations from the work of IS professional auditors;
- requirements for holders of the Certified Information Systems Auditor (CISA) certificate, as well as the consequences of non-compliance with standards (investigations and disciplinary procedures).

5. FUTURE RESEARCH AND DIRECTIONS

The development of the audit of information technologies also requires the education of new professional staff, i.e., the development of a new profession—the auditor of information systems. All these innovations are happening very quickly and require constant improvement, harmonization, and monitoring of trends. Information systems auditing, as a new area of business, is still under-researched due to the lack of empirical evidence on the impact of information technology on auditing. Future research in the Republic of Serbia could move in this direction, specifically in analyzing the impact of information technology on the audit profession and the audit process.

6. CONCLUSION

We are witnessing the turbulent changes that are happening in everyday life, including in the fields of business and economic development. The most significant change is the enormous increase in the use of information technologies in business. As already emphasized in the paper, a modern organization cannot perform its business functions without the implementation of information technologies. The process of incorporating information systems into a business requires significant financial expenditures and continuous maintenance. The consequences of applying information technology are noticeable and inevitable. The entire business landscape is shifting toward the use of information systems in all areas of business. There are changes in the process of defining goals, organizing business, and achieving objectives. As drastic changes occur in the operations of all business functions, accounting and auditing transform both their processes and organization. The application of information technologies expands the field of auditing and introduces a new area—auditing information systems. The risk of integrating information technologies is high because, first and foremost, data and information that can be subject to abuse and fraud are manipulated. For this reason, it is necessary to increase the level of both external and internal control, which consequently affects the evolution of the audit process itself and the development of a new profession—auditing information systems.

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The Influence of the Audit on the Quality of the Company's Financial Reporting

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Abstract: *The financial collapse of world-famous companies at the end of the last and the beginning of this century actualized the problem of the quality of financial reporting. The factual situation is that manipulative actions most often occur in financial reports, where the practice of creative accounting reporting threatens to endanger not only the accounting profession but also mislead managers when making crucial investment decisions. Accordingly, the purpose of the work is to review the most important aspects of business and determine the spheres in which there is the greatest risk of materially significant errors. The subject of the work will be research and analysis of business situations that favor manipulations, as well as an assessment of the quality of financial reporting.*

1. INTRODUCTION

The term revision comes from the Latin word "revisio" which means re-viewing, renewal of the process or the last review before public disclosure. The word audit is not necessarily related only to the field of accounting and checking financial statements, this term is used every day during the control and checking of many activities in various spheres of both economic and social life. However, since the paper is about the audit of the company's operations, we can single out its definition according to Kukoleča (1990), "...The audit of financial operations includes a detailed examination of the entire operation in a certain period or an examination of a narrower part when it is necessary to accurately shed light on the true situation; when the existence of financial abuses is suspected or when it is necessary for management bodies for some special reasons" (p. 1319).

What is characteristic of the audit is that it is a set of activities that are coordinated and adjusted for each company individually, depending on the specifics of the type of economic activity, the size of the company, the way the business is organized, the ownership structure in the same, etc. A person who audits financial statements is called an auditor, and he/she must be a professional who possesses a set of intellectual knowledge and skills from the profession, which is also confirmed by the mandatory certificate of the title of authorized auditor and/or authorized internal auditor, among which the most prestigious certificates in the world are the AICPA (certificate of the American Institute of Certified Public Accountants) and ACCA (Association of Chartered Certified Accountants), while in Serbia they often acquire the title of certified auditor by taking an exam in the Chamber of Certified Auditors[4].

Many individuals and world-renowned associations are involved in the improvement and improvement of auditing both in theory and practice. One of the more well-known is the above-mentioned

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AICPA, whose Committee on Basic Auditing Concepts defines it as a systematic process of impartial collection, processing and evaluation of evidence about some facts related to business events. The aim of the audit is to determine the degree of correlation between the stated claims and some previously defined criteria, as well as to communicate the results of those comparisons to interested users. According to the IFAC (International Federation of Accountants) in the ISA (International Standards of Auditing), an audit is defined by its objective: "The objective of an audit of financial statements is to enable the auditor to express an opinion on whether the financial statements, in all material respects, compiled following the identified Financial Reporting Framework". Based on the systematization of the previously mentioned definitions of audit, we can conclude that it represents a systematic process through which the auditor collects and evaluates information and evidence about business transactions and the results that certain business activities contributed to the economic entity so that after the completion of the audit process, an audit report is created as a "final product", a report stating the auditor's opinion.

There are four types of auditor's opinions. We differentiate between positive, reserved opinion, dissenting opinion. and negative opinion. A large number of factors influence the formation of the auditor's opinion, which will be discussed later. Before that, it is necessary to define the goal, subject and task of the audit.

The ultimate goal of the audit of financial statements is the preparation of an Audit Report in which the independent opinion of the auditor is presented. In order to reach the "final product" of the audit process, ie. audit opinion, it is necessary to go through two stages:

- the first phase represents the research phase in which the evidence is collected and evaluated, on the basis of which the audit opinion is formed i
- the second stage - the reporting stage, in which the auditor presents his opinion to interested users of the information of the financial statements.

In order to make an opinion, the auditor must determine whether the financial statements have been prepared according to pre-established criteria. Something that decisively affects the auditor's opinion is whether the financial statements are prepared in accordance with accounting standards, where we highlight the observance of IAS (International Accounting Standards) adopted by the IASB (International Accounting Standards Board). In order for the auditor to determine whether the financial statements have been prepared according to the aforementioned standards, it is necessary to collect and evaluate evidence. According to Andrić et al. (2009), "Evidence of the degree of agreement between the statements in the financial report and accounting standards can be found in accounting documents (invoices, checks, contracts, inventory lists, payment orders, receipts, etc.)" (p. 3).

The object of the audit also follows from the objective of the audit. The subject of the audit is business events that are recorded in the business books in the form of business transactions and that are always presented quantitatively whenever possible. Of course, on the other hand, there are business events that cannot be quantified due to their nature and are expressed qualitatively, where they are most often presented in the Annual Report on the company's operations. Information that can be quantified falls within the domain of audit observation, while qualitative information is not the subject of the audit process.

The task of auditing arises from the need of the users of financial information for someone to verify the interpreted financial statements by the management of the company. Task auditing is not the compilation of financial reports, but rather instilling confidence in the objectivity, reliability and credibility of the entity's presented financial reports.

2. REASONS AND NEEDS FOR THE AUDIT OF FINANCIAL STATEMENTS

First of all, we distinguish between internal and external users of financial statement information. Internal users include company employees such as managers, accountants and internal auditors. There are divided opinions about the shareholders (owners) of the company regarding their grouping into internal and/or external users. In addition to the owner, external users include investors, creditors (financial institutions), suppliers, customers, the Government and its agencies, as well as state bodies that deal with the control of law enforcement. The goal of all users is to receive reliable and objective information based on which they will make effective decisions and effectively meet the set goals. For example, company managers need to have constant insight into the realistic picture of the achieved goals concerning the set goals, and they get that information from the accounting department, which has the task of translating all accounting data about business transactions into appropriate business and/or financial reports. Based on these data, the efficiency of the company or certain segments of the company is evaluated by the management and further decisions are made. As for external users, if we take the case of an investor, his main goal is to invest capital while minimizing risk. Such a thing requires reliable information that has been verified by an independent third party, which is an auditor. By expressing his opinion, the auditor increases the certainty of the information provided by the financial statements. As early as 1972, the American Accounting Association (AAA, 1972, p. 25) illustrated the process of transferring information to end users:

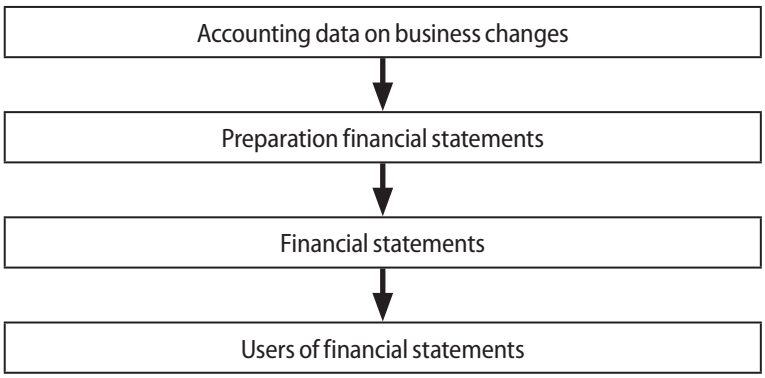

Figure 1. Transfer of accounting information

Source: American Accounting Association (1972)

Within this process of transferring information to end users, according to AAA (1972), there are five significant reasons for the need to verify financial statements:

- quality of information
- conflict of interest
- complexity
- distance
- consequences.

2.1. Quality of information

The quality of information is one of the key reasons for auditing financial statements. According to Andrić et al. (2009), auditing contributes to the improvement of the financial reporting process through two dimensions. The first dimension is information credibility and the second is control. Auditing is the process of controlling the existence and recording of business changes in the correct way following accounting standards, principles and adopted accounting policies. Subjecting financial statements to the audit process increases the credibility of accounting information and instills confidence in both

internal and external users in the reliability and accuracy of information from financial statements. On the other hand, the audit significantly affects the control of the quality of information from the financial statements because the audit is an independent external control (verification) of the accounting information and additional pressure is exerted on managers to pay special attention to objective financial reporting because they will be subjected to an independent external control (audit).

2.2. Conflict of Interest

The conflict of interest can best be explained by the classical phenomenon of the principal-agent problem.

The principal-agent problem is constantly present in large joint-stock companies, due to the separation of the function of ownership from the function of control. Owner-shareholders (principals) hire managers (agents) to make decisions and manage the company on their behalf. Managers are better informed about the company and its prosperity than shareholders. When one party is better informed about the activities of the other party, then the parties are asymmetrically informed. Due to asymmetric information, the owners do not know whether the managers, to whom they have delegated responsibility, act following their interests or ignore them, in favor of their interests. Company owners, as external users, usually get insight only into financial reports as a product of the company's accounting system. Based on information from financial reports, they make decisions about additional investment in a given company and/or reallocation of capital and also make decisions about the further fate of the company's management. It is already obvious that it is in the management's interest that the financial reports show the company's financial condition and success in the best possible light, because future managerial positions, salaries, bonuses and/or compensation packages will depend on it. Since management can influence the accounting system and presentation of information in its favor through various formal and informal procedures, independent external verification of claims from financial statements is approached to protect the interests of business owners.

2.3. Complexity

As the word itself says (complexity), it refers to the complex problem of translating business transactions into accounting information. This can lead to inadvertent errors in the incorrect accounting of ongoing business transactions. Sometimes it is very complex for users of information from financial statements to determine whether certain business transactions are presented reliably and objectively by the company's accounting system. For this reason, auditing appears as a reasonable solution for this type of problem. With his opinion in the Audit Report, the auditor verifies the information contained in the financial reports, so individuals as users of financial information don't need to burden themselves with understanding complex business transactions and their proper accounting inclusion.

2.4. Distance

Physical distance can be one of the reasons why individuals (competent to assess the quality of reporting on business events) and users of financial reports cannot independently decide the quality of information from financial reports. In addition to physical distance, there are sometimes certain legal restrictions due to which external users do not have the opportunity to personally determine the quality and reliability of information from financial reports, which imposes the need for an audit.

2.5. Consequences

Business owners, investors, financiers, suppliers, and other users of financial statements make decisions based on information from them. If the information non-objectively and unreliably shows the state and success of the entity, it will mislead the decision-makers, which will result in wrong decisions and significant financial consequences for them. Therefore, there is one more reason in favor of performing the audit process of financial statements.

3. FACTORS AFFECTING THE FORMATION OF THE AUDITOR'S OPINION AND THE IMPROVEMENT OF THE INFORMATION SYSTEM

According to the International Standard on Auditing (ISA) 700 (IAASB, n.d.), the auditor forms an opinion on the financial statements by considering whether they are prepared following the applicable financial reporting framework. To form an opinion, the auditor must be satisfied that he has obtained reasonable assurance that the financial statements, taken as a whole, are free from material misstatement, whether due to fraud or error. The auditor is expected to evaluate, based on his or her competence, whether the financial statements are prepared following the requirements of the applicable financial reporting framework in all material respects. According to ISA 700, this evaluation should include consideration of the qualitative aspects of the entity's accounting policies, including indicators of possible bias in management's judgment.

According to this standard, the auditor assesses (ISA 700):

A) Whether the financial statements adequately disclose the significant accounting policies selected and applied. In making this assessment, the auditor should consider the relevance of the accounting policies to the entity and whether they are presented understandably;
B) Whether the accounting policies selected and applied are consistent with the applicable financial reporting framework and are appropriate;
C) Whether management's accounting estimates are reasonable;
D) Whether the information presented in the financial statements is relevant, reliable, comparable and understandable. In making this assessment, the auditor should consider the following:
   - Whether the information that should have been included has been included and whether that information has been appropriately classified, aggregated or disaggregated and characterized.
   - Whether the overall presentation of the financial statements is marred by the inclusion of information that is not relevant or that makes it difficult to understand the matters disclosed.
E) Whether the financial statements provide adequate disclosures designed to enable users to understand the effect of material transactions and events on the information contained in the financial statements; and
F) Whether the terminology used in the financial statements, including the title of each financial statement, is appropriate.

Regarding the auditor's opinion as the final product of the audit process according to ISA and Generally Accepted Auditing Standards (GAAS), we distinguish the following types of auditor's opinion:

- positive opinion (opinion without reservation/affirmative opinion),
- opinion with reservation,
- dissenting opinion (abstention from opinion),
- negative opinion.

A positive auditor's opinion on the financial statements is issued when the auditor has a reasonable belief that the financial statements have been prepared truly and fairly and following the applicable Financial Reporting Framework. According to Andrić et al. (2009), the auditor's reasonable belief is formed by looking at the following questions:

1. whether the financial statements were prepared in accordance with the company's accounting policy,
2. that there were no restrictions during the collection of evidence in the audit process,
3. that the financial statements have been prepared in accordance with the legal regulations and the valid Law on Audit prescribed in the given country and if there are certain deviations, whether they have been presented in an adequate manner with a suitable explanation,
4. that all key information necessary to create a realistic picture of the company's financial condition and success is published in the correct way.

According to ISA 700, if the auditor:

a) concludes that, based on the audit evidence obtained, the financial statements as a whole are not free from material misstatement; or
b) is unable to obtain sufficient appropriate audit evidence to conclude that the financial statements as a whole are free from material misstatement, the auditor should modify the opinion in the auditor's report in accordance with ISA 705.

The auditor will express a qualified opinion (opinion with reservation) when he notices that there are appropriate irregularities or some limitation in terms of scope, but it is not of such material importance that a negative opinion or abstention from opinion is made. These are usually balance sheet items that are important and must be mentioned in the auditor's report, about which there are disagreements in the matter of presentation in relation to the management of the company or there are corresponding problems in the matter of scope. However, in addition to the importance of that item to be mentioned in the audit report, it is not of crucial importance to express a negative opinion or for the auditor to refrain from an opinion. The question of the opinion with a reservation and the "importance" (materiality) of the balance sheet item is raised. The answer lies in the auditor's own professional judgment regarding this relationship. When composing of the auditor's report in which an opinion with a reservation is stated as an opinion, the auditor must have a position in which he precisely states the reasons for expressing a reservation regarding certain balance sheet items. There is common auditor terminology used when expressing a qualified opinion by using the expression "except for" on the matters to which the qualified opinion relates.

According to ISA, we express a qualified opinion when:

1. the auditor cannot obtain the appropriate scope of audit evidence,
2. the auditor's communication with legal representatives is limited or completely prevented by the management of the company,
3. the auditor is unable to obtain satisfactory evidence regarding a specific business event,
4. the disclosure was not made in an adequate manner,
5. if the management does not want to cooperate in providing the appropriate statements that the auditors require,
6. the auditor concludes that the level of detection risk cannot be reduced to an acceptable level.

Dissenting opinion. According to ISA 705 (p.3), "the auditor shall disclaim an opinion when the auditor is unable to obtain sufficient appropriate audit evidence on which to base the opinion, and the auditor concludes that the possible effects of undetected misstatements on the financial statements, if any, could be both material and pervasive." The auditor shall disclaim an opinion in extremely rare

situations involving a large number of uncertainties. The inability to obtain sufficient appropriate audit evidence may be due to restrictions imposed by management after the auditor has accepted the engagement. In such a case, if the auditor becomes aware of the restrictions imposed by management after the engagement, the auditor shall request management to remove the restriction so that the auditor may not express a qualified opinion or a disclaimer of opinion. If management refuses to remove the limitation, the auditor shall communicate this situation to those charged with governance, unless all those charged with governance are involved in the management of the entity, and determine whether alternative procedures can be performed to obtain sufficient appropriate audit evidence (ISA 705).

The auditor's negative opinion has as a consequence significant negative financial effects both on the state of the audit client and on his future business. Therefore, when the auditor expresses an adverse opinion, he must gather sufficient evidence to justify his decision to express the aforementioned opinion. By expressing a negative opinion, the auditor believes that the financial statements do not show the real financial situation, business results and cash flows because they are not compiled following accounting standards. In practice, negative opinions are a rare occurrence because clients generally accept the auditor's advice related to the true and fair presentation of business following accounting standards.

4. CONCLUSION

The opinion expressed by the auditor in his Audit Report can have significant both positive and negative financial consequences for the audit client. Given that in modern, unpredictable and dynamic business conditions, the audit is seen as an imperative for further business, management must make special efforts so that the final result of the financial statement audit process is a positive opinion of the auditor. To achieve this, management is expected to ensure an objective and fair presentation of financial statements as well as all business transactions. This is achieved by complying with the prescribed accounting standards and financial reporting standards, the national Accounting Law, by complying with the adopted Framework for the preparation and presentation of financial reports as well as the adopted accounting policies of the company. During the audit process, the auditors provide guidance to the company's management for the elimination of materially significant errors that lead to a negative opinion or abstention from an opinion. If the auditor's advice is adopted and materially significant balance positions are corrected that are not presented following the applicable Framework and/or ISA and do not reflect objectively and truthfully the state, success of the company and cash flows, the auditor will not express his negative opinion regarding the financial statements. In this way, the quality of financial reporting will improve, and in the future, audit clients will know how to treat appropriate business transactions and present them fairly and truthfully in their reports.

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Digital Innovation and Financial Literacy Are the Foundations of a Sustainable Economy

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Abstract: *In modern society, financial literacy and digital innovation are becoming increasingly important for creating a sustainable economy. As technology evolves rapidly, understanding basic financial concepts and being able to manage one's finances are becoming crucial for individuals and communities. This paper investigates the role of these elements on a sample of 642 respondents of different ages, to define their influence on sustainable economic development. The results show that financial literacy is essential for individuals in managing their own finances, which affects their ability to make informed decisions. Respondents who had a better understanding of basic financial concepts had a greater tendency to adopt digital tools, which enabled them to manage resources more efficiently. Also, research has shown that digital innovations, such as mobile applications for financial management and online investment platforms, play a significant role in fostering financial literacy. Connecting digital solutions with financial knowledge creates a synergy that can contribute to sustainable development through increased economic stability and responsible management of resources.*

1. INTRODUCTION

Financial literacy has become a key competence of modern society, permeating almost every aspect of an individual's daily life. With the development of digital technologies and the increasing complexity of financial products, consumers are faced with numerous decisions every day that directly affect their financial well-being. From personal budget management to investing and retirement planning, understanding basic financial terms and principles can significantly improve an individual's ability to make informed and financially literate decisions. A high level of financial literacy not only contributes to personal stability and security but also has broader positive effects on the economy as a whole. When individuals are able to effectively manage their finances, consumption increases, debt is reduced and sustainable economic growth is encouraged. In this context, the development of financial literacy becomes imperative, not only for personal development but also for strengthening the economic foundations of the community. This paper explores the importance of financial literacy in today's society, emphasizing its role in making better financial decisions and consequently building a more sustainable economy. With the development of the financial market, new and increasingly complex financial products are constantly appearing, which indicates the need for financial education. An appropriate level of financial literacy is essential for making sound financial decisions, and the basic financial knowledge and skills that individuals already possess can be significantly improved through appropriate education. Despite the progress and availability of modern digital technologies in the field of finance, there is a lack of knowledge of how they affect financial literacy and individual behavior. Therefore, the problem of research work is the identification and analysis of specific trends and changes in individual behavior when making everyday financial decisions, which result from the application of modern digital technologies, and the study of how these changes affect the formation of long-term habits in individuals when making various financial decisions.

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2. THEORETICAL KNOWLEDGE ABOUT FINANCIAL LITERACY

In the academic literature, the topic of financial literacy is relatively "young" and most articles have been published in the last twenty years. During that period, the number of research in the field of financial literacy of citizens increased, which enriched the relevant literature (Lusardi & Mitchell, 2009; Atkinson & Messy, 2012). A large part of professional literature refers to books published by the Organization for Economic Cooperation and Development (OECD). The sudden increase in interest in this topic is explained by the global financial crisis that affected many countries in 2008 (Klapper et al., 2012). The negative consequences of the economic crisis influenced the identification of the need to improve financial literacy, that is, the need to introduce financial education. Significant market changes and rapid technological development have imposed the need for a financially literate population. The sudden increase in interest in the phenomenon of financial literacy also influenced the appearance of many definitions of this term. For now, there is no generally accepted definition in the literature, which is probably a partial consequence of the fact that there is no agreement on the structure and scope of financial literacy. According to the simplest definition, financial literacy is the skill of managing personal finances (Chen & Volpe, 2002). This is followed by a definition according to which financial literacy is an indicator of the level of understanding and application of knowledge about managing personal finances (Lusardi & Mitchell, 2009). Bahovec, et al. (2015) believe that financial literacy reflects the individual's ability to understand financial concepts, financial products and services and ensure the ability to control individual financial resources. It increases the individual ability to manage and plan personal finances and consists of financial decisions about money, inflation, savings, interest rates, investments, borrowing, credit and currency risks, all types of financial contracts and other financial instruments (Vehovec et al., 2015).

The financial market offers sophisticated products and instruments that enable individuals to manage their finances more actively but require a higher level of skills than those required for personal or family finances. At the same time, there has been a transfer of financial responsibility from the national and corporate levels to individuals, which increases the risk in many sectors due to the possible consequences of poor management of personal finances (Baelden et al., 2017). OECD defines financial literacy as the combination of financial awareness, knowledge, skills, attitudes and behaviors needed to make the right financial decision and ultimately achieve financial well-being. He defines financial education as a process by which financial consumers, i.e. investors, improve their understanding of financial products, concepts and risks and, through information, instructions and/or objective advice, develop skills and confidence to become more aware of financial risks and opportunities, in order to make informed choices, to know where to turn for help and to take other effective actions to improve their financial well-being.

With the growth of interest in financial literacy, scientific and professional works presented numerous definitions. Chen and Volpe (2002) simply defined it as the skill of managing personal finances. Lusardi and Mitchell (2011) describe financial literacy as the level of understanding and application of knowledge in managing personal finances. However, the most commonly used definition comes from the Organization for Economic Co-operation and Development (OECD), the leading organization in the research and promotion of financial literacy. The paper "Measuring Financial Literacy: Results of the OECD / International Network on Financial Education (INFE) Pilot Study" (Atkinson & Messy, 2012) presents the results of a pilot study conducted in 14 countries, which analyzed financial literacy, behavior and attitudes of citizens. The study showed significant variations in the level of financial knowledge between countries, as well as within them, depending on sociodemographic factors. The results suggest that there is significant room for improving the financial behavior and attitudes of citizens, which indicates the need to improve financial education and develop national policies in this area.

3. THE IMPORTANCE OF FINANCIAL LITERACY FOR AN INDIVIDUAL

Financial literacy includes understanding basic concepts such as budgeting, saving, investing, debt and credit. A basic knowledge of these concepts enables individuals to recognize how to properly manage their finances. For example, the ability to create and track a personal budget helps identify areas where money can be saved and unnecessary expenses avoided.

One of the most important benefits of financial literacy is the ability to control one's finances. When individuals understand how to manage their money, they can better plan for future expenses and goals. This includes saving for emergencies, children's education, or planning for retirement. Financially literate families are often better prepared for unforeseen situations, such as job loss or health crises, which can significantly reduce stress and improve quality of life. Financial literacy is also key to understanding how credit and debt work. Individuals who are educated about interest rates, loan terms and the proper use of credit cards are less prone to incurring debt that can become insurmountable. Awareness of the risks of over-indebtedness helps to make informed decisions about buying on credit and debt management, thereby avoiding a financial crisis. Financially literate individuals better understand the importance of investing and saving. They can evaluate different investment options, understand the risks and rewards, and make informed decisions about where and how to invest their money. In addition, savings can be used not only for emergencies but also for long-term goals, such as buying real estate or financing education. In order to improve financial literacy in society, it is crucial to invest in education. Schools, non-profit organizations and communities should provide financial education programs that will cover the basic concepts of money management. Also, families can play an important role in teaching children about finances and encouraging them to develop healthy habits from an early age.

Through a review of existing literature and theoretical frameworks, this study underscores the necessity of financial literacy in enhancing individual economic empowerment and overall well-being. Financial literacy encompasses the understanding and application of financial concepts necessary for effective money management. In an increasingly complex financial landscape, the acquisition of financial knowledge is imperative for individuals to navigate personal and economic challenges.

Financial literacy equips individuals with the knowledge required to make informed financial decisions (Lusardi & Mitchell, 2014). Understanding fundamental financial concepts enables individuals to evaluate options regarding savings, investments, loans, and purchasing decisions, ultimately leading to better financial outcomes. Effective budgeting is a cornerstone of financial management. Financially literate individuals are proficient in creating and maintaining budgets, which facilitates the prioritization of expenses and encourages saving for future goals (Huston, 2010). Research indicates that individuals who budget are less likely to accumulate debt and more likely to save consistently (Dew, 2009). Understanding the implications of various types of debt is essential for financial stability. Financial literacy provides individuals with the necessary tools to manage debts responsibly and develop strategies to reduce liabilities (Shim et al., 2010). Knowledge of interest rates, repayment terms, and credit scores is vital in this regard. Financial literacy enhances individuals' ability to engage in investing. It allows them to comprehend different investment vehicles, assess risk, and make educated choices that contribute to long-term wealth accumulation (Lusardi & Mitchell, 2014). An understanding of market principles is crucial for navigating investment opportunities effectively. The importance of financial literacy in retirement planning cannot be overstated. Knowledge of retirement accounts, such as 401(k)s and IRAs, as well as the significance of compounding interest, positions individuals to plan effectively for their future (Miller & Mazumder, 2016). Financially literate individuals tend to save more for retirement and adopt healthier financial behaviors. Financial literacy fosters a comprehensive understanding

of various financial products, including loans, mortgages, insurance, and investment options. This understanding aids individuals in selecting products that align with their financial situations and goals, minimizing the risks associated with poor financial choices (Kaiser & Menkhoff, 2017).

3.1. Broader Implications of Financial Literacy

Financial literacy contributes to social empowerment, enabling individuals to take control of their financial futures (Friedman, 2020). Individuals equipped with financial knowledge typically experience lower levels of financial stress, leading to improvements in overall quality of life. A financially literate population plays a vital role in fostering economic stability. Consumers who make informed choices stimulate economic growth by engaging in responsible spending and investment behaviors (Hastings, 2013). Additionally, effective consumer behavior reduces personal and systemic financial risk. Financial literacy serves to break cycles of poverty by empowering individuals to make sound financial decisions. By imparting financial knowledge to future generations, financially literate individuals can foster an environment of financial competence within families (Miller & Mazumder, 2016).

Financial literacy is an indispensable skill set that empowers individuals to navigate a complex financial landscape effectively. The benefits extend beyond personal finance; they encompass economic stability, social empowerment, and the promotion of intergenerational financial competence. As such, fostering financial literacy through educational initiatives and community programs should be a priority for policymakers and educators alike.

4. MODERN DIGITAL TECHNOLOGIES AND TOOLS AS THE BASIS OF A SUSTAINABLE ECONOMY

By enhancing efficiency, reducing waste, and enabling innovative solutions, technologies play a pivotal role in addressing the multifaceted challenges of environmental sustainability. The discussion encompasses various sectors, highlighting specific technologies and their contributions to promoting sustainable practices. The transition towards a sustainable economy necessitates an intersection of technological innovation and environmental stewardship. Modern digital technologies, including big data analytics, the Internet of Things (IoT), and artificial intelligence (AI), present opportunities to improve resource efficiency, promote sustainability, and shape economic practices conducive to environmental health.

4.1. Technological Contributions to Sustainability

Big data analytics facilitates data-driven decision-making by providing insights into consumption patterns, resource use, and environmental impacts. This technology enables stakeholders to optimize processes, reduce waste, and identify areas for improvement within various industries (Janssen, 2020). IoT devices enhance real-time monitoring of resource consumption, thus allowing for improved management in sectors such as agriculture, manufacturing, and energy. This connectivity promotes smarter resource use and sustainability initiatives by providing actionable data. AI optimizes processes across various sectors, such as energy management, predictive maintenance, and resource allocation. Its ability to analyze vast datasets enables organizations to transition towards more efficient and environmentally friendly practices (Baker, 2021). Blockchain enhances transparency and accountability in supply chains, allowing for the verification of sustainable sourcing and ethical practices. This innovation reduces the risks of fraud and promotes responsible consumerism (Saberi et al., 2019). Smart grid technologies improve energy distribution efficiency by integrating renewable sources and responding dynamically to fluctuations in demand, thereby

reducing energy waste and promoting sustainable energy use (Amin & Wollenberg, 2005). Digital platforms not only facilitate local business operations but also reduce transportation-associated carbon footprints by promoting online transactions and deliveries, thus supporting sustainable consumption patterns (Kumar, 2020).

4.2. Additional Innovations Supporting Sustainability

The rise of telemedicine reduces the need for physical travel for medical consultations, thereby lowering transportation emissions while increasing healthcare accessibility. Digital tools aid urban planners in designing sustainable cities that incorporate green spaces, efficient public transport systems, and environmentally friendly infrastructures (Bibri & Krogstie, 2017). Innovation in waste management, utilizing automation and machine learning, enhances recycling processes, thus minimizing waste and promoting a circular economy. Digital platforms for carbon accounting enable organizations to measure and manage their carbon footprints, facilitating sustainability reporting and tracking progress toward environmental goals. Modern digital technologies are instrumental in driving sustainable economic practices. Their ability to promote efficiency, enhance transparency, and facilitate informed decision-making contributes significantly to the broader goals of environmental sustainability. Future research should focus on the collaborative integration of these technologies across sectors and the development of policies that support equitable access to technological resources.

5. RESEARCH METHODOLOGY

The authors of this paper conducted online research based on a questionnaire. The survey took place in 2024 between June 21 and September 6. Respondents provided entirely anonymous answers to the questionnaire's questions. The primary data gathered by the survey questionnaire is displayed in the research results, which were conducted and involved 642 respondents. There were fifty-nine questions on the survey.

In modern society, digital innovation and financial literacy have become key factors shaping a sustainable economy and the future. With the rapid development of technology, access to information and financial management tools has become available to the general population, which opens up new opportunities for economic growth and stability. However, to take full advantage of these benefits, individuals must possess a basic understanding of financial terms and the ability to think critically about their financial decisions. Financial literacy encompasses knowledge of how to manage personal finances, including budgeting, saving, investing and understanding financial products. At the same time, digital innovations, such as mobile applications for financial management and online investment platforms, play a significant role in facilitating access to the information and resources necessary to make informed decisions. The research conducted on a random sample of 642 respondents seeks to examine the interaction between financial literacy and digital innovation and their contribution to a sustainable economy. As global challenges, such as economic inequality and climate change, increase, there is a need to integrate these elements into educational and economic policies. The research will cover different age groups and their attitudes towards financial literacy and digital tools, with the aim of identifying strategies that can encourage the development of sustainable economic practices. This research will not only contribute to a better understanding of the importance of financial literacy in the digital age, but will also provide guidance for policy making that can support individuals in acquiring the necessary skills to face the challenges of the modern world. This research aims to shed light on the way to a sustainable economy that empowers people and communities to handle their money more wisely and make responsible decisions. The following is how the research's objectives are defined:

- look into the degree of financial literacy among various age groups and pinpoint the major determinants of this level;
- examine how digital innovations can enhance personal financial management and financial literacy;
- investigate how, at the individual and community levels, greater financial literacy and the use of digital tools support a sustainable economy;
- suggest methods for enhancing financial literacy and laying the groundwork for creating a sustainable economy using digital innovations.

The hypotheses that the research will try to prove are:

Hypothesis 1: The connection between digital innovation and financial literacy positively affects the sustainability of the economy, enabling individuals to make more informed financial decisions.

Hypothesis 2: There is a significant difference in the level of financial literacy and the use of digital tools between different age groups.

The survey included a sample of 642 respondents. Respondents expressed their evaluations and attitudes through a survey questionnaire, which ensured anonymity (Google form). In the first part of the questionnaire, questions were asked that defined the socio-demographic characteristics of the respondents, such as questions about gender, age, place of residence, level of education, work status, and the sector in which they work.

6. RESULTS

The first question was related to the gender of the respondents. Men make up 46.10% of the total sample, while women make up 53.90%. Although the difference in the number of men and women is not large, a higher proportion of women in the sample is noticeable. The questionnaire also offered the possibility for respondents to declare that they were of unspecified gender, but none of them chose that option. Considering the age of the respondents, 6 age categories were offered. The largest share of respondents (44.08%) belongs to the age group of 18 to 25 years, while a significant share (32.40%) consists of respondents aged 35 to 45 years. A smaller share of respondents is in the age groups of 26 to 34 years (13.08%) and 56 years and older (10.44%), while the least respondents are in the age group of 55+ years (0%). The research may have attracted the attention of other age groups who had a greater interest in the topic of financial literacy, while the topic may have been less relevant to more "mature" respondents. The methodological approach and method of data collection may also have played a role, such as the use of specific platforms or channels that did not appeal to this age group. It is recommended that future research be focused more on this age group, in order to obtain more comprehensive data on the financial literacy of the 55+ generation. As for the place of residence, the vast majority of respondents (79%) come from the city of Zagreb, which is also a limitation of the research. The largest number of respondents (37.70%) have completed graduate studies. A little less (34.90%) have a secondary vocational education, while 26.50% of respondents have completed undergraduate studies. A smaller percentage of respondents have completed postgraduate studies (0.9%).

Looking at the work status of respondents, as many as 92.21% of respondents are employed, which is not a limitation, as it does not deviate too much from the current situation with the employment rate in the country. 3.1% of them are unemployed, and the same share is retired. Only 1.49% of respondents are students or (unemployed). As the results research is based on the self-assessment of respondents, the given answers may be subjective. Respondents in such circumstances may give answers that reflect their wishes or expectations instead of actual experiences or attitudes.

But despite the mentioned limitations, the conducted research brings certain insights related to the impact of modern digital technologies on an individual's financial literacy.

To test the measuring instrument, Cronbach's alpha coefficient was performed, which is used to assess the internal consistency of the instrument. In this case, the measuring instrument consists of 59 particles (questions or items).

Table 1. Cronbach´s Alpha coefficient

Reliability Statistics	
Cronbach's Alpha	N of Items
0,900	59

Source: Own research

Cronbach's alpha coefficient values range from 0 to 1, with higher values indicating greater internal consistency of the set of items. A value of 0.900 indicates a very high internal consistency of the measuring instrument. The number of items (N of items) indicates the total number of items used to measure a certain construct or phenomenon, and in this case 59 items were included in the reliability analysis. In summary, the results show that the measuring instrument used in the study is highly reliable, with a Cronbach's alpha coefficient of 0.900, which is well above the standard threshold for acceptable internal consistency. Therefore, considering the obtained result of the measurement scale, we can consider it reliable. The results of the descriptive statistics and One-Sample t-test presented in Table 2 clearly indicate a high level of awareness and recognition of the importance of financial planning among the respondents. All respondents expressed a high degree of agreement with the statements related to tracking income and expenses via online or mobile banking. The highest mean value (M = 4.393) is recorded for the statement that "a clear overview of personal monthly expenses is a prerequisite for successful financial planning". With an exceptionally high t-test value ($t = 92.870$; $p < 0.001$), this result confirms a strong belief that tracking expenses is the foundation of personal financial stability.

Table 2. Descriptive statistics on the role and importance of financial planning, awareness of monitoring income and expenses

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Diff.	99% Confidence Interval of the Difference	
					Lower	Upper
A clear overview of personal monthly expenses is a prerequisite for successful financial planning	92,870	642	,000	4,393	4,27	4,52
Tracking personal income and expenses via Internet and/or mobile banking affects my financial behaviour so that I am fully aware of my regular monthly expenses.	80,605	642	,000	4,271	4,13	4,41
Tracking personal income and expenses via Internet and/ or mobile banking affects my financial behaviour in such a way that the current balance of my account affects my future decisions about purchases.	80,510	642	,000	4,307	4,17	4,45
Tracking personal income and expenses via Internet and/or mobile banking influences my financial behaviour and helps me to spend less than I earn	69,196	642	,000	3,957	3,81	4,11
Tracking personal income and expenses via the Internet and/or mobile banking influences my financial behaviour by helping me set aside part of my income for savings or investments.	59,201	642	,000	3,864	3,69	4,03

Source: Own research

The statements regarding the impact of digital tools on financial behavior also show high mean scores: respondents agree that tracking income and expenses via the Internet or mobile banking allows them to be more aware of their monthly expenses (M = 4.271; t = 80.605), and that their account balance influences their future purchasing decisions (M = 4.307; t = 80.510). This indicates an active use of technology for the purpose of better managing personal finances.

Slightly lower, but still high mean scores are recorded for the statements that digital financial monitoring encourages behaviors such as spending within one's means (M = 3.957; t = 69.196) and encouraging saving or investing (M = 3.864; t = 59.201). Although these results are lower compared to the previous statements, they still show significant agreement among respondents with the positive impact of digital tools on responsible financial behavior. Overall, all results have high statistical significance ($p < 0.001$), confirming the reliability of the data obtained. These findings indicate that respondents are aware of the importance of monitoring their finances and are actively using available digital tools for planning, controlling spending, and saving.

Table 3. Hi-hvadrat test on the influence of gender on literacy

	Observed N	Expected N	Residual
Men	278	164.5	-114.5
Women	364	164.5	-114.5
Total	642		

Source: Own research

Table 4. Chi-square results

Chi-Square	73.024[aa]
Df	1
Asymp. Sig.	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 164.5.

Source: Own research

The results of the Chi-square test shown in Table 4 indicate that there is a statistically significant difference (χ^2 =73,024; df=1; p=0.000) in the respondents' answers, and it can be concluded that there is a difference in the acceptance of financial literacy between men and women, and men are more inclined to savings, investments, and thus a sustainable economy. Financial literacy has become a key skill in modern society, and younger generations show greater ability and willingness to adopt these skills. Based on a survey conducted among 642 respondents, there are several key reasons why younger generations adopt financial literacy more quickly and easily. Younger generations are growing up in a digital environment, which gives them easier access to information and tools for financial management. Spending tracking apps, online banking, and educational platforms allow them to quickly and easily acquire financial knowledge. These characteristics not only contribute to their personal financial stability, but also to strengthening the sustainability of the economy as a whole. Investing in the financial literacy of younger generations is therefore a key step towards a healthier and more resilient economy.

The correlation between FL_3 and FL_4 is strong and positive ($r = 0.510$, $p < 0.01$), which means that the perception that new technologies help in understanding financial concepts (FL_3) positively correlates with the perception that these technologies help in making better financial decisions (FL_4). There is also a strong positive correlation ($r = 0.473$, $p < 0.01$) between FL_2 and FL_3, which suggests that the perception that digital technologies facilitate access to information (FL_2) positively correlates with the perception that these technologies help in understanding financial

concepts (FL_3). All correlations are positive, which indicates that there is a significant connection between the level of financial literacy and the perception of the usefulness of modern digital technologies in the financial sector.

Table 5. Correlations combine digital technologies and simpler and easier management of personal finances

		FL_1	FL_2	FL_3	FL_4	FL_5
The importance and influence of the level of financial literacy (financial knowledge and behaviour and attitude towards money) on personal financial well-being.	Pearson Correlation	1	,375**	,302**	,199**	,165**
	Sig. (2-tailed)		,000	,000	,001	,006
	N	642	642	642	642	642
Modern digital technologies and tools facilitate access to information about financial products and services.	Pearson Correlation	,375**	1	,473**	,376**	,088
	Sig. (2-tailed)	,000		,000	,000	,140
	N	642	642	642	642	642
New technologies in the financial sector make it easier to understand basic financial terms and their use plays a significant role in raising the level of financial literacy of an individual.	Pearson Correlation	,302**	,473**	1	,510**	,123*
	Sig. (2-tailed)	,000	,000		,000	,039
	N	642	642	642	642	642
The use of modern digital technologies and available tools in the financial sector can help make better personal financial decisions and influence long-term financial habits. (FP 4)	Pearson Correlation	,199**	,376**	,510**	1	,092
	Sig. (2-tailed)	,001	,000	,000		,126
	N	642	642	642	642	642
Modern digital technologies and tools in the financial sector are sufficiently user-friendly that anyone can use them.	Pearson Correlation	,165**	,088	,123*	,092	1
	Sig. (2-tailed)	,006	,140	,039	,126	
	N	642	642	642	642	643

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Source: Own research

Table 6. ANOVA test on the connection between financial literacy and sustainable economy

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Financial literacy contributes to a sustainable economy in the segment of personal debt reduction	Between Groups	18,250	4	4,562	12,020	,000
	Within Groups	55,419	146	,380		
	Total	73,669	150			
Financial literacy contributes to a sustainable economy in the segment of increased savings and investments among citizens	Between Groups	41,754	4	10,438	20,191	,000
	Within Groups	75,478	146	,517		
	Total	117,232	150			
Financial literacy contributes to a sustainable economy in the segment of increased consumption of local products and services	Between Groups	34,332	4	8,583	19,234	,000
	Within Groups	65,151	146	,446		
	Total	99,483	150			

Source: Own research

The F-value tells us how different groups of respondents gave different answers to the statements. The higher the F-value, the greater the differences. The p-value tells us the probability that these differences are due to chance. If the p-value is less than 0.05, it means that the differences are statistically significant (not by chance). In the case of this research, the p-values are all 0.000, which means that the differences between the groups of subjects are very significant. In other words, financial literacy is closely related to a sustainable economy, given that financial literacy reduces personal debts, given that it enables clear, transparent monitoring of one's consumption, increases savings and investments, and increases local consumption of products and services. Based on the conducted research, the obtained results confirm both hypotheses:

Hypothesis 1: The connection between digital innovation and financial literacy positively affects the sustainability of the economy, enabling individuals to make more informed financial decisions.

The analysis of the collected data confirmed a positive correlation between the use of digital tools (such as mobile banking, budgeting applications, online investment platforms) and the level of financial literacy. Respondents who regularly use digital innovations showed a higher level of understanding of financial concepts, as well as more responsible financial behavior, which contributes to a more stable and sustainable economic environment.

Hypothesis 2: There is a significant difference in the level of financial literacy and the use of digital tools among different age groups.

The results of the analysis show that younger generations (especially the age group from 18 to 35) use digital financial tools to a much greater extent than older generations. Also, a difference was noticed in the degree of financial literacy, whereby younger generations show a greater understanding of modern financial concepts, while older groups often have a more traditional approach to finance.

The research conclusions support the validity of both hypotheses, emphasizing the importance of digital literacy as a key factor in the modern financial environment and pointing to the need for additional education of different age groups in order to reduce generational differences.

7. CONCLUSION

The expansion of digital technologies and the increasing complexity of financial products have profoundly affected the financial development of consumers. Understanding essential financial principles, including managing a budget, creating investment strategies and planning for retirement, can greatly improve an individual's decision-making ability. Financial literacy and digital innovation are key to creating a sustainable economy. The conducted research analyzes the effects of financial literacy and digital innovation on 642 respondents of different ages, with the aim of understanding their impact on sustainable economic development.

Research results indicate that a high level of financial literacy improves individual stability and security, while also contributing positively to the wider economy. Effective financial management results in increased spending, lower debt and sustainable economic expansion. The study indicates a significant relationship between financial literacy and the perceived usefulness of digital technology in the financial industry. Individuals who possess a superior understanding of essential financial principles are more inclined to use digital tools, thereby increasing the efficiency of resource management.

Digital advances, such as smartphone apps for financial management and online investment platforms, are significantly improving financial literacy. Combining digital technologies with financial expertise promotes sustainable development by strengthening economic stability and guaranteeing responsible management of resources.

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Innovative Comparative Approaches to Transport and Transport Infrastructure Between Romania and Other European Union Countries

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Abstract: *Transport infrastructure plays a critical role in economic growth, trade facilitation, and improving the overall quality of life. This paper provides a detailed comparative analysis of Romania's transport infrastructure relative to other European Union (EU) countries, with a focus on road, rail, maritime, and air transport systems. It explores the challenges Romania faces in modernizing its infrastructure, examines current policies, and offers innovative solutions that are critical for the country's progress. Additionally, the paper underscores the importance of sustainability, particularly the need to reduce carbon emissions and align with the EU's environmental goals. Through the integration of various data sources and policy recommendations, this paper suggests how Romania can enhance its transport infrastructure to improve connectivity, competitiveness, and economic growth. Sustainable transport solutions and innovative technologies are critical for Romania as it strives to close the gap with other EU countries and better integrate into the broader European market.*

1. INTRODUCTION

Transport infrastructure is a cornerstone of economic and social development, serving as the backbone for the mobility of people and goods. A well-functioning transport system promotes economic growth by facilitating trade, enhancing accessibility to markets, boosting tourism, and contributing to regional development. In today's globalized world, efficient transportation is not merely a domestic priority but a key factor in a country's competitiveness on the international stage. The quality and efficiency of transport systems directly influence the cost of goods and services, the attractiveness of a country for foreign direct investment, and its overall economic dynamism. Additionally, transport infrastructure plays a critical role in achieving societal goals such as social inclusion by ensuring that remote and disadvantaged regions remain connected to national and international markets.

The European Union (EU) recognizes the critical importance of transport infrastructure in its economic integration agenda. As one of the core components of the EU's single market, the seamless and sustainable movement of people and goods across member states underpins the functioning of the entire EU economy. The EU has prioritized the development of a cohesive and resilient transport network through initiatives like the Trans-European Transport Network (TEN-T) policy. The aim is to close the infrastructure gap among member states, particularly in Eastern Europe, to promote connectivity and ensure the smooth flow of commerce. However, despite these overarching efforts, disparities persist across the region, particularly in countries such as Romania, which continues to face significant challenges in modernizing its transport infrastructure.

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Romania, the seventh-largest country in the EU by population, holds a strategic position in Europe as a bridge between Western Europe and the Black Sea region, and by extension, the Middle East and Asia. This geographic position should, in theory, provide Romania with a significant competitive advantage in international trade. However, Romania's transport infrastructure has lagged behind that of other EU countries, particularly Western European nations. This underdevelopment is a result of historical underinvestment, systemic governance inefficiencies, and regulatory challenges that have hampered progress. The inadequate state of Romania's transport infrastructure not only affects domestic mobility but also limits the country's potential to fully integrate into the EU's broader economic framework.

The road transport sector, which is the most common mode of transportation in Romania, suffers from poor road quality, limited highway networks, and high accident rates, which are the worst in the EU. Similarly, Romania's rail system, which holds potential as an energy-efficient alternative to road transport, is characterized by aging infrastructure, low-speed trains, and limited electrification. Maritime and inland waterway transport, despite Romania's advantageous position on the Danube River and its access to the Black Sea, remains underutilized due to infrastructural and environmental challenges. Although Romania's air transport sector has seen growth, it too faces sustainability challenges, particularly in meeting the EU's ambitious carbon reduction targets.

This paper will investigate the current state of Romania's transport infrastructure, compare it with other EU countries, and explore innovative and sustainable solutions to bridge the gap. By examining various transport modes—road, rail, maritime, and air—this analysis will highlight Romania's strengths and weaknesses in the sector while proposing strategies for improvement. The goal is to suggest ways in which Romania can modernize its transport infrastructure to foster economic growth, increase regional connectivity, and contribute to the EU's sustainability objectives.

2. THEORETICAL FRAMEWORK AND POLICY CONTEXT

Transport infrastructure is widely recognized as a critical driver of economic development, regional integration, and competitiveness. The efficient movement of goods, services, and people forms the backbone of any modern economy, directly influencing trade, productivity, and market accessibility. In the context of the European Union (EU), transport infrastructure plays an even more pivotal role, given the emphasis on creating a unified internal market where physical borders between member states are minimized. This interconnectedness is facilitated by robust infrastructure networks, which ensure that goods and people can move freely and efficiently across national boundaries, driving economic integration and cohesion among member states.

From a theoretical perspective, transport infrastructure is often seen through the lens of economic geography and regional development theories, which suggest that well-developed transport networks reduce transaction costs, enhance economies of scale, and increase the spatial competitiveness of regions. This is particularly important in the EU, where disparities in transport infrastructure can exacerbate regional inequalities, leaving some countries or regions less integrated into the single market. Countries with underdeveloped infrastructure, such as Romania, face higher transportation costs, slower mobility, and reduced competitiveness, which hinder their economic potential.

At the policy level, the EU has long recognized the need to address infrastructure disparities between member states. The Trans-European Transport Network (TEN-T) policy, launched by the European Commission, is designed to address these challenges by developing a comprehensive, cross-border infrastructure network that spans the entire EU. The TEN-T policy aims to remove bottlenecks, fill missing infrastructure links, and promote the use of environmentally friendly

transport modes. This initiative is particularly relevant for Romania, which stands to benefit significantly from increased connectivity to Western Europe and other key EU markets. However, while Romania is a major beneficiary of TEN-T funding, the country's infrastructure development has been slower than anticipated, partly due to governance and regulatory challenges.

One of the most critical policy shifts in recent years has been the introduction of the European Green Deal, which aims to make the EU climate-neutral by 2050. The Green Deal highlights the transport sector as a key area for emissions reductions, given that transportation accounts for approximately 25% of the EU's total greenhouse gas emissions (European Commission, 2020). In this context, sustainable transport infrastructure development is not just an economic necessity but also an environmental imperative.

The European Climate Law, which was adopted in 2021, legally enshrines the EU's goal of achieving climate neutrality by 2050 and includes binding targets for reducing greenhouse gas emissions by 55% by 2030 (compared to 1990 levels). This law has far-reaching implications for Romania's transport sector, as it requires the country to overhaul its infrastructure to meet these ambitious targets. Romania, like other member states, must submit detailed national plans outlining how it intends to reduce emissions in sectors such as transport, energy, and industry. Given the transport sector's significant share of emissions, Romania's infrastructure development must be aligned with the goals of decarbonization, including the promotion of electric and hydrogen-powered vehicles, increased use of public transport, and greater investment in rail infrastructure.

Furthermore, the EU's Sustainable and Smart Mobility Strategy, launched in 2020, complements the Green Deal by outlining a comprehensive roadmap for achieving a more sustainable, digitalized, and resilient transport system by 2050. The strategy includes goals such as increasing the use of rail for long-distance travel and freight, promoting urban mobility solutions, and developing intelligent transport systems (ITS). Romania faces the dual challenge of modernizing its transport infrastructure while also integrating the digital and sustainable innovations outlined in this strategy. While countries like Germany, the Netherlands, and France are leading the way in implementing smart mobility solutions, Romania must accelerate its adoption of these technologies to keep pace with the rest of the EU.

Romania's specific governance challenges are compounded by structural issues, such as underinvestment in transport infrastructure and a lack of strategic foresight in project planning and execution. For example, despite receiving substantial funding from the EU's Cohesion Fund and Connecting Europe Facility (CEF), which are aimed at reducing infrastructure gaps between member states, Romania has struggled to absorb and effectively utilize these funds due to its inefficient public administration and complex regulatory environment. The slow pace of project approval and implementation has further delayed the modernization of critical transport infrastructure, such as highways and rail networks.

3. METHODOLOGY

This paper employs a mixed-methods approach to analyze Romania's transport infrastructure in comparison with other EU countries. Secondary data from various sources such as Eurostat, the European Environment Agency (EEA), and Romanian government reports are utilized to assess the state of Romania's transport systems. Comparative analysis is conducted to identify the gaps between Romania and its EU counterparts, while qualitative document analysis provides insights into policy approaches and best practices.

The paper also incorporates innovative solutions to address these gaps. For instance, hydrogen-powered transport and smart transit systems are evaluated as potential game-changers for Romania, particularly in the rail and maritime sectors. Case studies from other EU member states serve as examples of best practices, offering valuable lessons for Romania's transport policies and infrastructure development.

4. COMPARATIVE ANALYSIS OF ROMANIAN TRANSPORT INFRASTRUCTURE

4.1. Road Transport

Romania's road transport sector is underdeveloped compared to other EU member states. Despite being the most common mode of transportation, Romania ranks 16th in the EU regarding highway length. The country has only 486 kilometers of highways per million inhabitants, a figure significantly lower than Hungary, which boasts 1936 kilometers per million. This lack of adequate road infrastructure contributes to significant traffic congestion, particularly in urban areas, and results in unsafe road conditions, especially in rural regions. The underdevelopment is also reflected in the country's road safety record.

Romania has the highest road accident fatality rate in the EU, with 93 deaths per 100,000 inhabitants in 2021, largely due to poorly maintained roads and reckless driving (Eurostat, 2023).

The situation is exacerbated by the fact that Romania relies heavily on road transport for freight and passenger movement, contributing to high carbon emissions.

This reliance on an inefficient road network has also hindered the country's ability to meet its European Green Deal obligations. The Romanian government, through its National Recovery and Resilience Plan (PNRR), has recognized the need for substantial investments in new highways and road modernization projects. However, progress has been slow, and more aggressive measures are needed to meet EU standards (Romanian Ministry of Transport, 2022).

4.2. Rail Transport

Rail transport in Romania has the potential to play a significant role in reducing congestion on roads and lowering carbon emissions, particularly for freight transportation. Rail systems are inherently more energy-efficient than road transport, and the EU has emphasized shifting freight traffic from roads to rail as part of its environmental and transport objectives (European Commission, 2021). Romania ranks sixth in the EU in terms of rail network length, with approximately 10,500 kilometers of railways. Despite this, the country's rail infrastructure is in poor condition, with frequent delays, low speeds, and unreliable services (Romanian Court of Auditors, 2021).

Countries like Germany and France have heavily invested in high-speed rail networks, boosting freight and passenger transport efficiency. In contrast, Romania's rail freight sector has seen little improvement, with average freight speeds of only 40 km/h, one of the lowest in the EU. The limited electrification of the network, outdated rolling stock, and poor maintenance have further hindered the growth of rail transport in Romania. As Romania seeks to align with EU sustainability goals, electrification and modernization of the rail system must become priorities for the government (Stoian & Burduja, 2018).

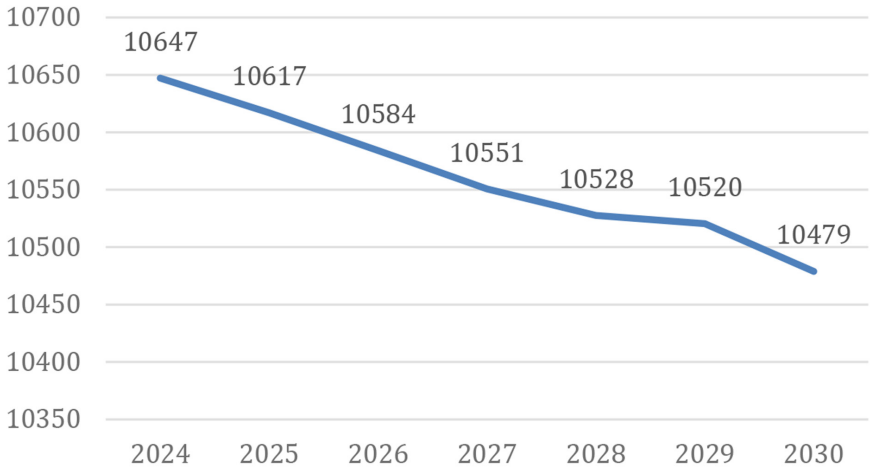

Figure 1. Estimates of the length of railways in operation in Romania from 2024 to 2030
Source: Own processing of data from National Institute of Statistics (n.d.)

4.3. Inland Waterway and Maritime Transport

Romania's strategic location along the Danube River and access to the Black Sea provide it with significant opportunities in maritime and inland waterway transport. These sectors are essential for Romania's trade, particularly in the transport of bulk goods such as coal, steel, and agricultural products. However, inland waterway transport remains underutilized, as the infrastructure along the Danube requires significant upgrades, including dredging and modernization of port facilities.

The Port of Constanța, one of the largest in the Black Sea region, plays a vital role in Romania's external trade. However, maritime transport's environmental impact is becoming a growing concern, with shipping in the Black Sea contributing to underwater noise pollution and greenhouse gas emissions (European Maritime Safety Agency, 2022).

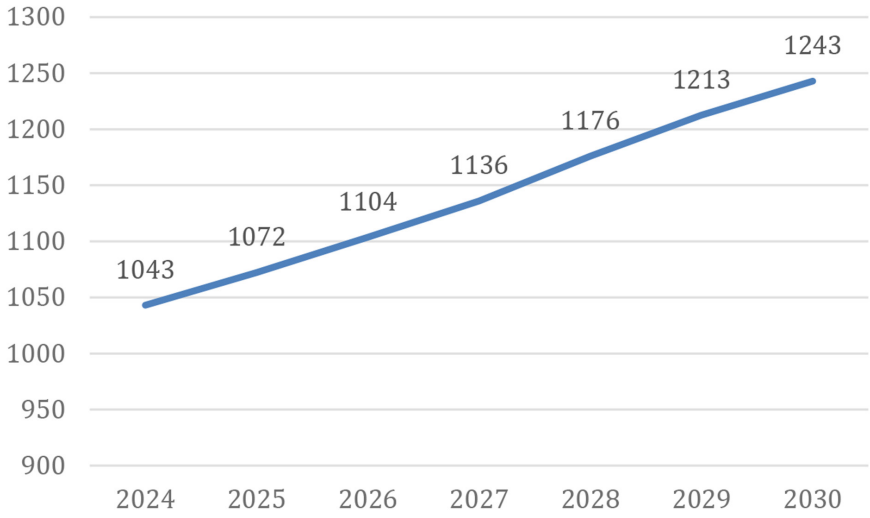

Figure 2. Forecasts regarding the length of highways in Romania 2024-2030
Source: Own processing of data from Eurostat (2023)

Romania must adopt greener technologies such as hydrogen-powered ships to mitigate these environmental impacts and align with EU maritime sustainability goals (European Maritime Safety Agency, 2022).

4.4. Air Transport

Romania's air transport sector has grown substantially in recent years, driven by increased investment in airport modernization, much of it funded by the EU. Low-cost carriers have also contributed to the growth of air traffic, facilitating greater mobility for passengers and stimulating tourism and business opportunities. Despite this, the environmental impact of air travel cannot be overlooked. Carbon emissions from aviation are on the rise, and Romania, like other EU countries, faces pressure to adopt more sustainable aviation practices.

The International Civil Aviation Organization (ICAO) has recommended the use of sustainable aviation fuels (SAF) and improved air traffic management systems to reduce emissions. Romania needs to integrate these sustainable practices to meet EU climate targets and ensure the long-term viability of its growing aviation sector (ICAO, 2020).

5. PROPOSED INNOVATIONS AND SUSTAINABLE SOLUTIONS

5.1. Electrification and Hydrogen-Powered Transport

A key strategy for reducing carbon emissions in Romania's transport sector is electrification. Romania has made some progress in electrifying its railways, but only 37% of its network is currently electrified, well below the EU average. Countries such as Germany and the Netherlands have electrified over 60% of their networks, demonstrating the gap Romania needs to close (Eurostat, 2023).

Hydrogen-powered transport presents another opportunity, particularly in regions where electrification is not feasible (International Energy Agency, 2021). Hydrogen-powered ships, such as those developed by the Compagnie Maritime Belge, have also shown promise in reducing emissions in the maritime sector (Compagnie Maritime Belge, 2022).

5.2. Smart Transit Systems

Smart transit systems, which integrate digital technologies into transport infrastructure, offer significant potential for improving transport efficiency and sustainability. The use of real-time data, intelligent traffic management systems, and multimodal transport hubs can greatly enhance Romania's connectivity, particularly in facilitating trade between Europe and Asia. Smart transit systems would also help reduce congestion, improve road safety, and lower carbon emissions.

Investment in smart technologies, such as automated traffic management systems and integrated public transport platforms, is critical for the modernization of Romania's transport infrastructure. These innovations could help Romania optimize its transport networks and create a more seamless and sustainable system that meets both national and EU mobility needs (OECD, 2020).

6. COMPARATIVE PERFORMANCE OF ROMANIA'S TRANSPORT SECTOR IN THE EU

6.1. Highway and Road Safety Metrics

Romania continues to lag behind its EU peers in road infrastructure development and safety metrics. While countries like Spain, Germany, and France have invested in well-developed highway systems, Romania's highway network is far smaller, with slow progress in expansion. The

country's road safety record is also among the worst in the EU, indicating an urgent need for reforms, including improved enforcement of traffic regulations, better road design, and public safety campaigns (European Commission, 2021).

6.2. Rail Freight Transport

In rail freight transport, Romania underperforms compared to other EU countries. Germany and Poland, for example, transport significantly more freight by rail, benefiting from modern, high-speed networks and efficient logistics hubs. Romania, by contrast, suffers from aging infrastructure and a lack of investment, resulting in poor service quality and low competitiveness in the rail freight market. To improve its standing, Romania must focus on modernizing its rail infrastructure and liberalizing the rail market to encourage private investment and innovation (Romanian National Railway Authority, 2021).

7. FUTURE OUTLOOK AND FORECASTS FOR 2024-2030

7.1. Road and Rail Expansion

Projections for 2024-2030 suggest a gradual expansion of Romania's highway network. However, the pace of development is insufficient to meet both national mobility needs and the EU's ambitious infrastructure targets. The government needs to accelerate investments and streamline regulatory processes to ensure that road projects are completed on time (European Investment Bank, 2022).

In the rail sector, forecasts indicate that Romania may see a decline in the operational length of its railway network due to continued underinvestment. Without decisive action, Romania risks falling further behind other EU countries in rail freight transport and overall competitiveness (Eurostat, 2023).

8. FORECASTS FOR ROMANIA (2024-2030)

Between 2024 and 2030, Romania's transport sector will face significant challenges and opportunities. The country needs to modernize its road and rail infrastructure to meet both national mobility demands and EU sustainability goals. While gradual expansion of the highway network is expected, the pace of development may not be enough to close the gap with other EU countries. Romania also faces high road accident rates, and without substantial investments in road safety and infrastructure, this issue is likely to persist. On the rail side, underinvestment and outdated infrastructure are expected to continue slowing down the sector's growth. Electrification and modernization of the rail network are crucial if Romania is to align with EU environmental targets and shift more freight and passenger traffic from roads to rail, a more sustainable mode of transport.

The adoption of innovative solutions like electric and hydrogen-powered vehicles, as well as smart transit systems, will not only improve domestic connectivity but also enhance Romania's integration into the broader EU market, contributing to economic growth and helping the country meet its 2050 climate-neutrality goals.

9. CONCLUSION AND PROPOSALS

The future of transport in Romania between 2024 and 2030 is shaped by a critical need for modernization and alignment with European Union sustainability goals. Romania's transport infrastructure, particularly in the road and rail sectors, requires urgent investment and innovation to

close the gap with more developed EU countries. Although some progress is anticipated, such as the gradual expansion of the highway network, the current pace of development is insufficient to meet both national mobility demands and the ambitious EU targets. Without accelerated efforts to improve road safety, expand the highway network, and modernize rail infrastructure, Romania risks falling further behind its European counterparts. The rail sector, in particular, faces challenges due to aging infrastructure and low electrification, hindering its potential as a sustainable alternative to road transport. Significant investment in electrification and modernization is crucial for increasing efficiency and reducing carbon emissions.

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Does the EU Ecolabel Reduce the Information Asymmetry in Croatia?

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Abstract: *The information asymmetry creates numerous distortions and reduces the efficiency of the real markets. The fact that real product attributes are not observable by a consumer may demotivate some producers although their production would lead to an increase in the social welfare. This is a well-studied phenomenon by economists, but still its empirical testing represents a significant challenge due to its intangible nature.*

Information asymmetry is often present in the exchange of eco-friendly products since very usually the related production materials and techniques are not verifiable by a consumer. This causes the lack of such products in the economy while the brown products prevail. However, the real-world examples show that there exist mechanisms that restore those markets by reducing the information asymmetry, by increasing the trust, or by changing the profile of buyers. One of them elaborated in this paper is the EU Ecolabel in Croatia.

The first part of the research is dedicated to the analysis of adverse selection and the overview of the mechanisms that partly or fully resolve it. The research proceeds with the analysis of the role of the EU Ecolabel as an example of a mechanism that serves to reduce information asymmetry and to restore the markets for eco-friendly products. The previously developed models are applied to analyze Flash Eurobarometer data in order to shed light on the role of the EU Ecolabel in the market for eco-friendly products in Croatia. The empirical findings lead to critical reflection on the existing theoretical frameworks and to an improved understanding of complex empirical testing of information asymmetry models.

1. INTRODUCTION

The global environmental concerns show that the existing relationships between producers and consumers need to be improved to strengthen their markets for environmentally friendly products. The root causes can be searched in the fundamental market anomalies among which are information asymmetries.

This paper takes a closer look at the EU Ecolabel from the perspective of economic models of information asymmetry and by analyzing Flash Eurobarometer 535 data for Croatia dedicated to consumer attitudes about EU Ecolabel. EU Ecolabel is one of the tools for resolving information asymmetry in markets for commodities with unobservable characteristics. The empirical results show that the knowledge about EU Ecolabel, as well the care about the environmental impact of the products, as well as the trust in Ecolabel, might link to the frequency of purchase of the products with EU Ecolabel. Such findings suggest efforts to increase knowledge and trust in third-party certification might be suitable tools to tackle information asymmetry in the markets.

The second section presents the hidden action and hidden information, as well as adverse selection and moral hazard, followed by the overview of the literature on the mechanisms that can diminish the relevant problems. The third section is dedicated to the literature that studies information

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asymmetry problems in the markets for eco-friendly products. The fourth chapter presents the results of the empirical analysis based on Flash Eurobarometer 535 for Croatia, which is followed by a discussion and conclusion in the fifth and seventh chapters respectively.

2. INFORMATION ASYMMETRY PROBLEMS

The main properties of the free market setting are numerous buyers and sellers, homogeneous divisible goods, complete mobility of the product inputs and final products as well as complete information of all market players. However, Mas-Collel et al. (1995) group information asymmetry problems as hidden action and hidden information elaborated in this paper.

Milgrom and Roberts (1987) discuss the usefulness and the role of information asymmetry games. They differentiate complete information, incomplete information and information asymmetry games. Information asymmetry is a type of incomplete information market situation. However, some incomplete information situations do not involve asymmetry. In other words, all the market agents have the same knowledge, i.e. they are equally informed. It is important to note that puzzling situations occur not in all but in some cases of information asymmetry. Furthermore, two types of information asymmetry can be distinguished, hidden information and hidden action problems elaborated further.

2.1. Hidden Information

Hidden information is a type of information asymmetry where important properties of a product are known to a seller but are hidden from a buyer. A simple case of hidden information is modeled as follows.

For the matter of tractability, suppose that there is one producer and one consumer in the market. They exchange a product of a given quality θ with the expected quality $E\{\theta\}$. While the $E\{\theta\}$ is common knowledge, the exact product quality θ is known by the producer, but unknown to the consumer. If the consumer is a rational agent he will choose to buy the product only if the expected quality $E\{\theta\}$ is not lower than a product price p, that is, if $E\{\theta\} \geq p$.

On the other hand, a fully rational producer buys the product only if its price is not lower than the costs. It is worth mentioning that the costs also include opportunity costs. In this type of model the costs are used to be modeled as an increasing function of quality $C = f(\theta)$ with $f'(\theta) > 0$.

The adverse selection problem initially elaborated by Akerloff (1970) in the market for "lemons" appears as a market anomaly where the market party or fully may disappear since the market price is lower than the producer costs. Thus, if for some θ' market price $p \leq C(\theta')$, then the producer rejects to sell the product since the revenues are lower than the costs. Since the costs are increasing function of quality, such a situation appears in the case of high-quality products. The market price is not sufficiently high to motivate the producer to sell his product. The consumers as rational agents may adapt their quality expectations accordingly such that the expected quality is $E[\theta | c(\theta) \leq p]$. Let's suppose that the costs monotonically increase with quality, i.e. $C = c\theta$, while θ can take a value from 0 to 1 with the same probability. The maximum quality that can be exchanged in the market θ_M must meet condition $c\theta_M \leq p \leq \theta_M/2$, i.e. $c\theta_M \leq \theta_M/2$. If $c \leq 0,5$, the condition holds for every θ, the market transactions are not affected by information asymmetry. Otherwise, if $c > 0,5$, then an adverse selection problem is present and there is no market exchange of such a good.

2.2. Hidden Action

Instead, hidden action occurs when the property of the product is not given, and when it can be chosen by a producer. The consumer does not know the producer's choice or action relevant to the transaction. Let's suppose that product quality θ can vary from *0* to *1*. It is not given but it is chosen by the producer. The cost function is $C=c\theta$. In a one-shot game, the best response of the producer is to provide quality 0 if it is not observable by the consumer. Therefore, the expected quality 0. This mechanism leads to a market failure called a moral hazard problem.

2.3. Information Asymmetry: Solutions

Previous sections present market failures resulting from information asymmetries, that is, from the fact that not all the market players have the same information. In this section, the typical solutions are overviewed.

Lewis (2011) investigates the role of disclosure costs in e-Bay Motors. If the information disclosed is free, all the sellers are willing to disclose the information. However, if the information disclosed is infinitely costly, no information will be disclosed. The author shows how rich media such as photos and videos together with appropriate institutional contract enforcement may resolve adverse selection problems, such as in the case of the market for used cars.

On the other hand, Saeedi (2019) examines the role of reputation mechanisms in online markets. It is shown by an analysis of the counterfactuals that in a case of removing reputation mechanisms market players' surpluses would significantly drop, as well as the total market size. It is concluded that warranties significantly contribute to the resolution of adverse selection in such markets.

Lanz and Reins (2021) investigate the information asymmetry in the markets for energy efficiency which is treated as a credence good such that its real quality is not observed by buyers even after purchase. The possible solutions they review are labeling and certificates, independent energy audits, third-party reimbursements and subsidies, and reputation and repeated interaction.

Pooling and separating equilibria may be identified in information asymmetry games. Different mechanisms that solve adverse selection lead to the emergence of separating equilibria and quality signaling. On the other hand, Cabral (2005, p. 6) explains how repeated interactions can contribute to solving moral hazard present in hidden action models. He presents the model of trust where transactions are maintained even if hidden action is present due to repeated interactions. If the seller is sufficiently patient compared to the costs of providing high quality, the trust is maintained and high quality is provided in the equilibrium.

Neudeck and Podczeck (1996) Study how government regulation may restore the health insurance market affected by adverse selection problem, while Biswas and Koufopoulos (2022) demonstrate how regulation affects adverse selection in the banking sector.

3. INFORMATION ASYMMETRY IN THE MARKETS FOR ECO-FRIENDLY PRODUCTS

Eco-friendly products compared to the standard ones produce lower negative or even positive effects on the environment. However, their production is usually associated with higher production costs. In many cases, the exact technology and product properties are not observable to buyers, and there may exist information asymmetry concerning the eco-friendly properties of the products. Since

the buyer cannot distinguish eco-friendly products from the standard ones the profit-maximizing producer will misreport its type and pool with the eco-friendly producers. If the technology choice is endogenous, such a market situation results in no eco-friendly producers in the equilibrium. Thus, the information asymmetry may be detrimental in the markets for eco-friendly products.

A systematic approach to this problem is provided by McCluskey (2000) who differentiates cases of experience and credence good in markets for organic products. A study by Ikhsan et al. (2024) suggest that the presence of information asymmetry in the markets for green products leads to improved online review quality that further increases trust, and supports the purchase of such products.

Zhu et al. (2024) investigate applying a signaling game to analyse the role of third-party certificates in a market for green bonds. They find that incentives for green bond issuers to adopt third-party certificates can induce the emergence of the separating equilibrium so that third-party certification enables the separation of greenwashing issuers from non-greenwashing bond issuers.

Haas and Kempa (2023) analyse a principal-agent model with adverse where firms can be skilled or unskilled, and high or low polluting. Pigouvian taxation, interest rate subsidies and lean grantees are considered as possible policy tools. In a setting with Pogouvian taxation, only the skilled high-polluting firms apply clean technology. However, under given conditions "without emission tax and with an interest subsidy and a loan guarantee all firms use the clean technology (Haas & Kempa, 2023, p. 122). Sun et al. (2024) further recognize ESG as a suitable tool for firms to reduce information asymmetry in the green market.

Hamilton and Zilberman (2006) find that costly environmental certification may be efficient in reducing equilibrium fraud and contribute to the welfare effect in the markets for environmentally friendly products. Also, the results depend on the market structure. Finally, Sengupta (2012) demonstrates how government regulation in the markets for eco-friendly products may add to the signaling of eco-friendly firms and may present as well a solution to adverse selection problems. Sengupta (2024) investigates the incentives of clean firms to adopt eco-certificates and corresponding market outcomes.

4. THE ATTITUDE OF THE CONSUMERS TOWARDS THE EU ECOLABEL IN CROATIA

Flash Eurobarometer 535 (European Commission, 2023) dataset for Croatia was studied in order to add to the understanding of the environmental labels in general, and of the EU Ecolabel more specifically. The dataset was collected in the period September 5-13, 2023 and it contains the answers to the questions that examine attitudes of the EU citizens about the environmental impact of the products, about environmental labels and the EU Ecolable specifically. This study narrows to the subset of data collected in Croatia analyzed by Excel and STATA.

The attitudes of the respondents towards to environmental impact of the products were compared concerning gender (Table 1 and Figure 1). The relevant survey question is "*How important are the following aspect when making a decision on what products (goods or services) to buy? The impact on the environment of the product.*"

Kruskal-Wallis tests if the two subsamples (male and female) are from the same population. Kruskal–Wallis equality-of-populations rank test. The results are: Chi2(1)= 11 083 with Prob = 0,0009 and Chi2(1) with ties = 13 388 with Prob = 0,0003 and lead to the conclusion that the null-hypothesis that

male and female subsamples with respect to the importance of environmental impact of products are the same, needs to be rejected.

On the other hand, answers to the question about the familiarity with the EU Ecolabel logo show no difference with respect to gender (Table 2 and Figure 2). The relevant question was: *"Please take a close look at the logo shown below. Have you seen this logo before?"*

Table 1. The importance of the environmental impact of the product

gender	very important	rather important	rather no important	not important at all	Don't know	total
male	68	253	128	29	13	491
female	102	296	95	15	19	527
total	170	549	223	44	32	1028

Source: Own research based on European Commission (2023)

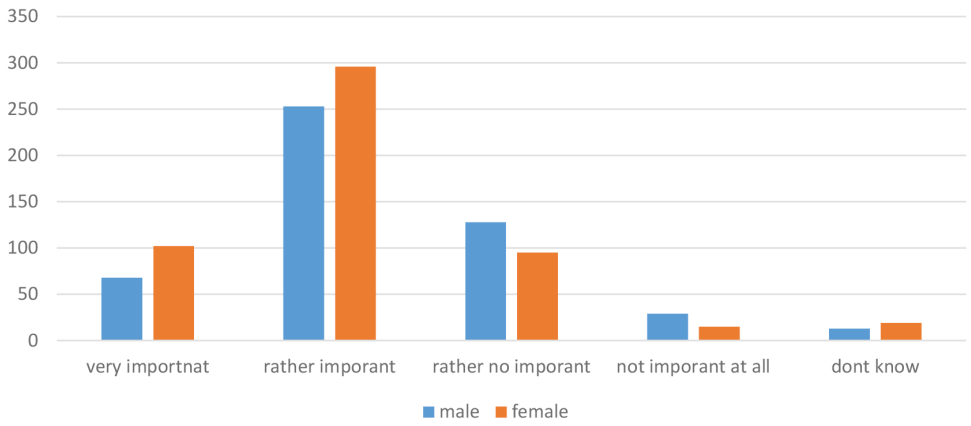

Figure 1. The importance of the environmental impact of the product

Source: Own research based on European Commission (2023)

Table 2. Familiarity with the EU Ecolabel

	yes	no	don't know	total
Male	136	269	86	491
Female	167	238	122	527
Total	303	507	208	1018

Source: Own research based on European Commission (2023)

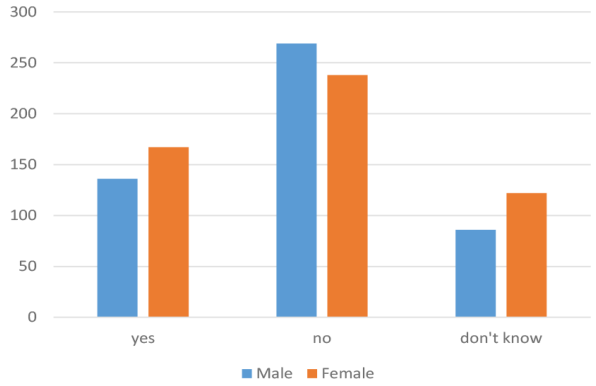

Figure 2. Familiarity with the EU Ecolabel

Source: Own research based on European Commission (2023)

Kruskal-Wallis tests on the answers to question on the familiarity with the EU Ecolabel show no statistically significant difference with respect to gender (Chi2(1)=0,047; Prob = 0,8289; Chi2(1) with ties = 0,055; Prob = 0,0003).

The respondents also expressed their knowledge about the EU Ecolabel by answering four true/false statements (*"The EU Ecolabel is awarded to products with a lower environmental impact than similar products on the market. The EU Ecolabel is independently verified label that companies can decide to display on their products to show that they are environmentally friendly. The EU Ecolabel is the EU label for environmental excellence. To get the EU Ecolabel, products have to comply with strict environmental criteria"*, Flash Eurobarometer 535, question number Q2) presented in Table 3 and while the frequency of buying products with environmental labels is presented in Table 4.

Table 3. Knowledge about the EU ecolabel

Number of correct answers	0	1	2	3	4
Frequency	8	4	19	117	408

Source: Own research based on European Commission (2023)

Table 4. The frequency of buying products with environmental labels

How often do you…	Often (label 1)	Sometimes (label 2)	Rarely (label 3)	Never (label 4)	Don't know
By product with environmental label	161	560	204	36	57
By products with the EU Ecolabel	48	327	204	94	345

Source: Own research based on European Commission (2023)

Kruskal-Wallis tests which compares how often respondent buy products with environmental labels taking into consideration the knowledge about the EU Ecolabel turns suggests that there is no difference between subsamples (null-hypothesis not rejected (probabilities 0,1753 and 0,1029). However, Kruskal-Wallis tests which compares how often respondent buy products with the EU ecolabel taking into consideration the knowledge about the EU Ecolabel turns suggests that there are differences across subsamples (null-hypothesis rejected (probabilities 0,0475 and 0,0310<0,05).

These results are also consistent with the corresponding correlation coefficients that take the value 0,023 between knowledge of the EU Ecolabel and the frequency of purchase of products with environmental labels. On the other hand, the correlation coefficient between knowledge and purchase of the products with the EU Ecolabel is -0,0349 which indicates the presence of a moderate correlation.

Also, Kruskal-Wallis tests which compare how often respondents buy products with the EU ecolabel with respect to the importance of the impact on the environment of the product Ecolabel suggests that there are differences across subsamples (null-hypothesis rejected (probabilities 0,0001 <0,05).

Finally, a very important variable for the discussion about the environmental certification of the products in the context of information asymmetry and hidden information is trust. The relevant true/false statement from the survey is *"I trust that products with the EU Ecolabel truly have a lower environmental impact than similar products on the market"* (Table 5).

There are no significant differences in trust across genders while most of the respondents (above 50%) somewhat agree with the relevant statement on trust in the EU Ecolabel.

Both Kruskal-Wallis tests which compare how often respondents buy products with environmental, and with the EU Ecolabel, with respect to trust in the EU Ecolabel, suggest that there is a significant difference in frequency of purchase across the subsamples since the probabilities take value of 0,0001<0,05. It can be concluded that trust plays a significant role in consumer decisions about the purchase of the product with environmental labels.

Table 5. Trust in product with the EU Ecolabel

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Don't know	Total
Male	141	246	49	23	32	491
Female	171	267	35	14	40	527
Total	312	513	84	37	72	1 018

Kwallis probabilities: 0,1262 and 0,09957

Source: Own research based on European Commission (2023)

5. DISCUSSION

The EU Ecolabel is a third-party environmental certificate that indicates a reduced negative environmental impact of a product. Looking from the perspective of the theoretical and empirical literature on information asymmetry in the markets, environmental certificates represent a type of mechanisms that reduce information asymmetry. In this case, the information asymmetry is reduced by conveying information by a third party (the state) which should be trusted by consumers. The theory of hidden action shows that repeated actions may resolve the hidden action problem. In the case of the EU Ecolabel, the repeated interactions in the first place occur between a consumer and the state so that the consumer gives the rust to such a scheme.

The majority of respondents at least sometimes buy products with environmental labels with a somewhat lower frequency in the case of the products with the EU Ecolabel since a significant number of respondents could not answer the relevant question. Kruskal-Wallis test indicates that the propensity to buy the product with the EU Ecolabel could vary with the attitude/knowledge of the consumers about this label. Finally, the results about the trust in and purchase of the products with the environmental labels in general and the EU Ecolabel indicate that trust might be an important determinant of the purchase of such products. Such findings further imply that the government needs to invest efforts to increase the trust in the EU Ecolabel to support the purchase of environmentally friendly products.

6. CONCLUSION

The first part of this work demonstrates complex mechanisms that drive markets for products with unobservable characteristics. One of those characteristics is the environmental impact of the product. The research demonstrates how such markets may disappear, and thus several mechanisms that resolve information asymmetry are investigated. Environmental certificates are a type of such mechanism. However, their reliability and effectiveness were scrutinized.

The Flesh Eurobarometer 535 enriches the insights into the consumer perception of the EU Ecolabel. The data are analyzed and demonstrate that the knowledge, but also more importantly trust in the EU Ecolabel might be related to more frequent purchase of products with environmental labels such as the EU Ecolabel. Such results for the Croatian sample imply that the EU Ecolabel is an efficient tool in reducing the information asymmetry present in the market of the products with the reduced environmental impact. However, further investigation of the relationship would be required to improve the robustness of the findings.

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Socio-Economic Development and Tuberculosis Mortality in Italy: A Historical Analysis (1887-1955)

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Abstract: *This paper analyzes tuberculosis mortality in Italy (1887–1955) in its correlation with industrialization. The geographical distribution of pulmonary tuberculosis and the effects of regional industrialization are examined using epidemiological data and official mortality statistics. The results show a significant relationship between industrialization and pulmonary tuberculosis mortality, especially in the northern regions during the early stages of industrial development (1891–1911). Over time, mortality declined significantly across the country due to improvements in health care and better living conditions. Furthermore, this study highlights the impact of socioeconomic change on public health and emphasises the need for further research on the socioeconomic factors that historically influenced the spread of tuberculosis.*

1. INTRODUCTION

In the nineteenth and early twentieth centuries, tuberculosis was one of the main causes of death in Europe. It is estimated that a quarter of the adult population fell victim to this disease (Daniel, 2006). It reached its peak during the Industrial Revolution, with respiratory disease accounting for 10 to 25 per cent of deaths in cities such as London, Paris, The Hague and Stockholm (Mackenbach, 2020). Rapid urbanization and overcrowded living conditions favoured the spread of the disease (Dormandy, 1999). Over time, improvements in nutritional standards, and in housing and public health policies, together with herd immunity, contributed to a gradual decline in tuberculosis mortality in the first half of the 20th century (McKeown, 1976). During the world wars, however, there was a resurgence. With the introduction of streptomycin in 1944 and other antibiotics, mortality was further reduced (McKeown, 1976; Livi-Bacci, 1997).

In Italy, tuberculosis began to spread rapidly before the mid-1800s, somewhat later than in other European countries such as Great Britain, France and Belgium where industrialization started earlier (Tognotti, 2012). It is estimated that the highest mortality rate was reached between 1870 and 1882, the period of Italian state building and early industrialization (Tognotti, 2012). Mortality was high, especially in the industrialized and urban areas of the North, where overcrowding, poor health standards, malnutrition and hard factory work favoured the spread of the disease. After the 1880s, mortality rates began to decline, although rates for the pulmonary form of tuberculosis remained stable at a high level until the 1920s (Saporiti, 1984).

This paper examines the relationship between tuberculosis mortality and industrialization across Italian regions. Data on mortality rates from pulmonary tuberculosis were taken from the "Statistica delle Cause di Morte", which reported the causes of death in Italy from 1887 onward. Regional industrialization levels are computed based on the shares of employees in the manufacturing sector, taken from Daniele and Malanima (2014).

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The results show how industrialization rates were related to tuberculosis mortality. Given the territorial differences in industrialization, the northern regions were most affected by the disease.

The paper is divided into five sections. Section 2 examines the geographical distribution of tuberculosis; section 3 analyses the relationship between mortality from pulmonary tuberculosis and the degree of industrialization; section 4 outlines future research directions. Section 5 contains a discussion of the results.

2. THE TUBERCULOSIS IN ITALY, 1887-1955

2.1. The National Trend

The mortality rate, measured by the number of deaths per ten thousand people, is a parameter that provides important information about the health and well-being of a population. Figure 1 shows its trend in Italy over the period 1887-1955. In 1891, around 800,000 deaths were recorded out of a population of 30 million, corresponding to a mortality rate of around 260 deaths per 10,000 inhabitants. On the eve of the First World War, mortality had fallen to 188 deaths per 10,000 inhabitants thanks to the decline in deaths from infectious diseases, particularly exanthematic diseases. However, pulmonary tuberculosis in the North, and gastrointestinal diseases in the South, slowed down the process of health transition towards a modern nosological framework The mortality rate, measured as the number of deaths per ten thousand people, is a parameter that provides important information about the health and well-being of a population. Figure 1 shows its trend in Italy in the period 1887-1955. In 1891, around 800,000 deaths were recorded out of a population of 30 million, which corresponds to a mortality rate of around 260 deaths per 10,000 inhabitants. On the eve of the First World War, mortality had fallen to 188 deaths per 10,000 inhabitants thanks to the decline in deaths from infectious diseases, particularly exanthematic diseases. However, pulmonary tuberculosis in the North and gastrointestinal diseases in the South slowed down the process of health transition and the development towards a modern nosological framework (Tognotti, 2012).

In 1918, mainly due to the Spanish influenza pandemic which caused between 540,000 and 600,000 victims (Mortara, 1925), the mortality rate reached a peak of 330 deaths per 10,000 inhabitants, and then rapidly decreased to 127 in 1939. With the outbreak of the Second World War, mortality rose again, reaching 144 deaths per 10,000 inhabitants in 1944. After the war, considerable improvements in health care contributed to the steady decline in the mortality rate. These improvements, together with socio-economic development, led to a decline in the mortality rate to around 88 deaths per 10,000 inhabitants in 1955.

Tuberculosis mortality followed an analogous trend (Figure 1). Between 1887 and 1955, the number of deaths from tuberculosis decreased by about 80 per cent, from approximately 61,000 to less than 11,000 deaths. In 1887, this disease accounted for about 62,000 deaths out of 829,000, half of which were attributable to the pulmonary form, with an average of 82 deaths per day, with a loss of human lives, especially among the younger and more productive classes (Tognotti, 2012).

Tuberculosis mortality was lower in Italy than in other European countries, thanks in part to the mild climate, which made it possible to live outdoors for much of the year, and the predominantly agricultural population, who were less affected by the disease because they worked outdoors and often in solitude (Bizzozero, 1899; L'Eltore, 1947).

Before the outbreak of the Second World War, Italy had already entered the endemic phase of the tuberculosis epidemiological cycle; it had reached what the hygienist and epidemiologist Adolf Gottstein called the "critical point", beyond which further progress depended on improvements in general living conditions and control measures as well as on the adoption of all available therapeutic options (L'Eltore, 1947).

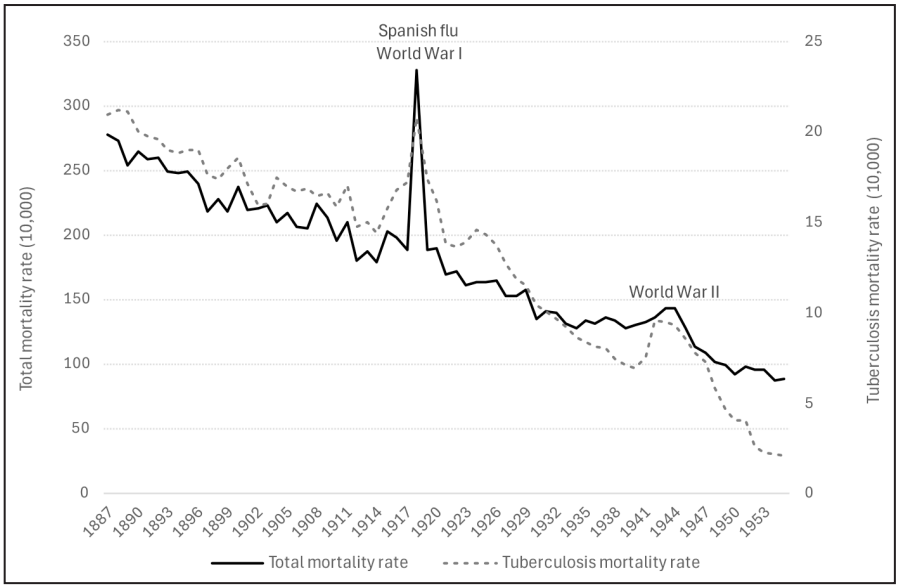

Figure 1. Overall and tuberculosis mortality rate in Italy, 1887-1955
Source: Own calculations on data ISTAT (1958, 1965)

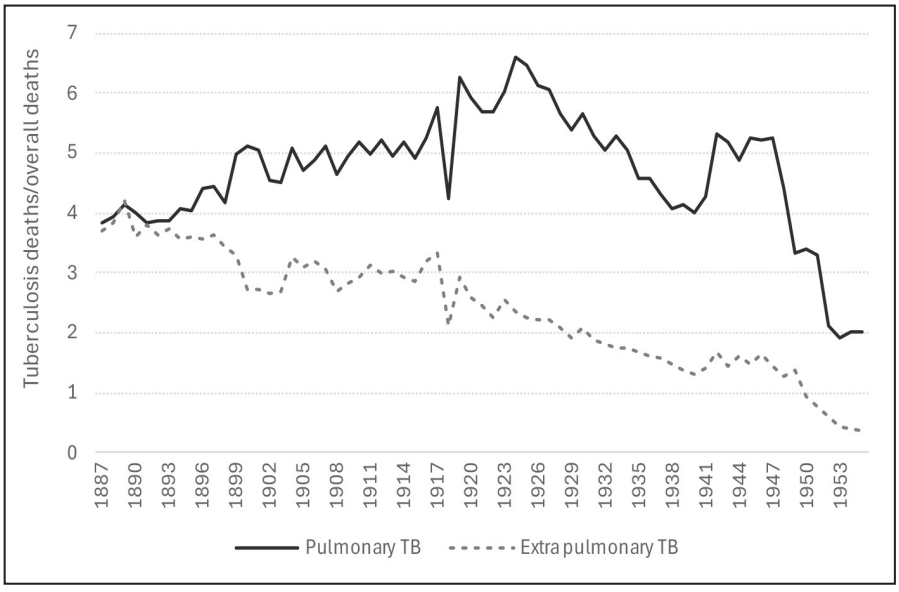

Figure 2. Incidence of tuberculosis on overall mortality in Italy, 1887-1955
Source: own calculations on data ISTAT (1958, 1965)

The incidence of tuberculosis on overall mortality is shown in Figure 2. Mortality for pulmonary tuberculosis rose from 3.8 per 100 in 1891 to 6.6 in 1924, while it halved for the other forms in the same period. Only the mortality rates for the pulmonary form – closely linked to the industrialization process – remained stable until the 1920s (Saporiti, 1984). Between 1887 and the First World War, the period in which the process of modern industrialization began in Italy, there was a

massive migration from the countryside to the cities. During this period, improvements in living conditions and advances in public sanitation were partially offset by the expansion of industry and transportation infrastructure which, by reducing the isolation of many municipalities, facilitated the spread of the disease into previously not affected areas. The Italian railway network rose from 12,102 kilometres in 1886 to 17,375 kilometres in 1912. Furthermore, the number of travellers increased from 64 million in 1906 to 94 million in 1914 (L'Eltore, 1947).

After 1924, excluding the years of the Second World War tuberculosis mortality declined. While the endemic phase was already underway, urban regeneration, social labour protection policies and the distributional effects of economic growth significantly improved the living conditions and levels of health and well-being of the most vulnerable sections of society.

2.2. Regional and Macroregional Disparities

The incidence of tuberculosis mortality, distinguished in pulmonary and extra-pulmonary forms, between the macro-areas of the Italian peninsula was very different (Table 1). The northern regions recorded higher mortality rates for pulmonary tuberculosis, the levels were intermediate in the central regions and lower in the southern ones.

In 1891, about 13 deaths per 10,000 inhabitants were recorded in the North-West, followed by 11.2 in the North-East, 11.6 in the Centre, 6.8 in the South and 7.4 in the islands. This distribution was similar to that of industry, which at the time was relatively concentrated in the North-Western regions, the so-called "Industrial triangle" area (Romeo, 1972; Fenoaltea, 2001, 2006). In the first decade of the twentieth century, economic policies encouraged industrialization. This period was characterised by significant economic and social changes, the expansion of the manufacturing and mining sectors, and the development of infrastructure and transport, which may have facilitated the spread of the disease.

Table 1. Tuberculosis mortality by macro-area in the census years, (x 10,000 inhabitants)

	1891		1911		1936		1951	
	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary	Pulmonary	Extra pulmonary
North-West	12.9	9.3	13.6	6.4	7.3	2.1	4.1	0.7
North-East	11.2	11.2	11.5	8.0	6.8	2.8	3.5	0.7
Centre	11.6	10.0	11.5	6.9	6.8	2.3	3.4	0.7
South	6.8	11.0	7.4	6.3	4.9	2.0	2.7	0.9
Isles	7.4	7.5	8.3	5.4	6.0	2.2	3.0	1.0

Source: Own calculations on data ISTAT (1958, 1965)

By 1911, pulmonary tuberculosis mortality had risen to almost 14 deaths per 10,000 inhabitants in the North-West, while rates stood at 7.4 in the South and 8.3 in the Islands. Mortality levels in the North-East and Centre remained almost unchanged. Between 1911 and 1936, tuberculosis mortality declined across all macro-areas, with the most substantial reduction in the North-West (-46 per cent), followed by the North-East and Centre (-41 per cent), and a smaller decrease in the South (-28 per cent). In 1951 the quotients were halved everywhere and the differences between areas remained very limited.

About the extra-pulmonary group, slight differences were observed. At the beginning of the period under review, mortality was highest in the South and North-East. Lower values were recorded

in the North-West and especially in the Islands. By 1911, there was a clear nationwide reduction, and by 1936, mortality rates had nearly equalized across macro-areas, averaging around 2.5 per 10,000 in the North, 2.3 in the Centre, and 2.1 in the South. In 1951 the quotients were less than 1 in the North and Centre (0.7) and equal to 1 in the South.

The regional distribution of deaths from pulmonary tuberculosis is shown in Table 2. In 1891, half of the deaths from pulmonary tuberculosis were concentrated in the northern regions. Liguria, Tuscany, Lombardy and Piedmont had particularly high mortality rates, ranging between 12.71 and 14.29 deaths per 10,000 inhabitants. On the contrary, the lowest values were recorded in the southern regions, with Basilicata and Calabria among the least affected. In 1911, around 20,000 people died of pulmonary tuberculosis in the North alone. Except for Sardinia[2], which recorded a significant increase in mortality compared to 1891, the most affected regions remained unchanged. Since 1936, a general decline in tuberculosis mortality has been observed throughout the country. Mortality rates decreased significantly in all regions, reaching much lower values in 1951, ranging between 1.41 deaths per 10,000 inhabitants in Basilicata and 4.46 in Liguria.

Table 2. Number of deaths and mortality rate for pulmonary tuberculosis in Italian regions in some census years, (x 10,000 inhabitants)

	1891		1911		1936		1951	
	Deaths	Mortality	Deaths	Mortality	Deaths	Mortality	Deaths	Mortality
Piedmont and Aosta V.	3,935	12.71	4,343	12.70	2,557	7.26	1,387	3.87
Lombardy	5,095	12.79	6,536	13.69	4,062	7.00	2,775	4.26
Veneto	3,104	8.24	4,322	9.49	2,994	5.58	1,592	2.73
Liguria	1,449	14.29	1,900	15.75	1,144	7.71	693	4.46
Emilia-Romagna	2,732	11.65	2,840	10.33	2,118	6.37	982	2.79
Tuscany	3,245	13.98	3,629	13.79	2,344	7.90	1,242	3.96
Umbria	537	10.06	633	10.67	410	5.69	173	2.17
Marche	769	7.76	805	7.37	628	4.98	346	2.56
Latium	1,344	8.89	1,555	8.98	1,733	6.46	1,227	3.70
Abruzzi	842	6.50	974	7.07	702	4.51	368	2.20
Campania	2,218	8.28	2,528	8.39	1,888	5.13	1,400	3.25
Puglia	1,422	7.69	1,874	8.71	1,507	5.70	976	3.05
Basilicata	217	4.74	258	5.44	175	3.25	88	1.41
Calabria	665	5.20	846	6.03	660	3.79	358	1.76
Sicily	2,318	7.03	2,658	7.24	2,043	5.14	1,221	2.74
Sardinia	668	9.03	1,117	13.09	934	9.02	495	3.91
Italy	*30,560*	*9.81*	*36,818*	*10.31*	*25,899*	*6.12*	*15,323*	*3.25*

Source: Own calculations on data ISTAT (1958, 1965)

3. INDUSTRIALIZATION AND TUBERCULOSIS MORTALITY

Tuberculosis is considered the archetypal disease of the industrialization process (Vögele, 2000). The incidence of tuberculosis, particularly in its pulmonary form, is thought to have increased in industrialized countries between the 18th and 19th centuries, with peaks varying from country to country, from the mid-18th century in Britain to the early decades of the 19th century in Japan (Lönnroth et al., 2009). This growth seems to be related to the rapid industrialization and urbanization of the time. The industrial cities, with their rapid population growth, high population density and poor living conditions and often unhealthy working environments, provided a fertile

[2] According to Collari (1934), the increase in mortality from tuberculosis in Sardinia was due to various factors, including: the lack of an effective anti-tuberculosis strategy, the insufficiency or absence of health and social assistance, overcrowding, poor hygienic conditions in homes, the return of the seriously ill to their homes, poor nutrition, terrible working conditions and the development of the mining industry.

ground for the transmission of diseases. In addition, malnutrition and other risk factors increased the likelihood of tuberculosis infection spreading, especially, among the poorer classes (Aparicio et al., 2002; Grundy, 2005; Shimao, 2003; Hanashima & Tomobe, 2012).

In Italy, modern industrialization began at the end of the 19th century. This first phase marked a period of profound economic and social change, characterized by the expansion of manufacturing industry, the rapid growth of the urban population and the spread of pulmonary tuberculosis.

Employment in manufacturing increased significantly, reaching 26 per cent in the North in 1911, compared to around 20 per cent in the South (Daniele & Malanima, 2014). Initially, this process involved the three regions of the North-West, which formed the 'Industrial triangle', the 'epicentre' of Italian industrial development (Fenoaltea, 2001, 2006). About half of the industrial workforce was concentrated in these regions (Zamagni, 1978). In Lombardy, industrial employment already exceeded 35 per cent, in Liguria 32 per cent, in Tuscany 27.8 per cent and in Piedmont 26.4 per cent. In addition to the differences in industrial employment, there were also differences in structure and production capacity between the North and the South (Daniele & Samà, 2024). Only 10 per cent of companies in the South used motive power, compared to 19 per cent in the central regions and 29 per cent in the northern regions (SVIMEZ, 1961). The concentration of industry in the North continued to increase between the First and Second World Wars, while it declined slightly in the South. The data thus point to an unbalanced geographical distribution of industrialization, which was strongly in favour of the northern regions, a process that intensified between the two world wars and was further consolidated in the post-war period.

Table 3. Percentage of the industrial labour force per region out of the total labour force

	1891	1911	1936	1951		1891	1911	1936	1951
Piedmont	20.5	26.4	31.7	41.4	**Campania**	19.0	23.6	22.6	27.0
Lombardy	28.3	35.6	42.2	49.2	**Basilicata**	8.6	12.1	11.9	15.0
Veneto	18.2	20.5	23.3	31.1	**Puglia**	13.6	20.1	24.9	22.0
Liguria	22.6	32.0	33.7	38.6	**Calabria**	13.1	20.0	15.0	20.1
Emilia	16.9	21.9	18.8	24.3	**Sicily**	18.5	22.9	21.5	22.7
Tuscany	21.5	27.8	25.5	31.9	**Sardinia**	17.1	21.0	19.9	23.5
Umbria	12.9	15.9	17.1	22.5					
Marche	14.6	17.5	16.5	21.5	**Italy**	19.0	24.2	25.6	31.0
Latium	15.6	20.0	20.8	25.2	**North**	20.6	26.0	28.1	34.9
Abruzzi	10.2	11.9	11.3	19.8	**South**	15.6	20.3	19.8	22.7

Source: Daniele and Malanima (2014)

In 1891, the geographical distribution of pulmonary tuberculosis was already clear: in Piedmont, Liguria, Lombardy and Tuscany there were about 14-17 deaths from pulmonary tuberculosis per 10,000 inhabitants; in the other northern regions the quotient was lower (10-12). In the South, the rate was even lower (4-8). In 1911, the mortality rate rose particularly in Liguria and Lombardy, where it was 15.8 and 13.7 deaths per 10,000 inhabitants respectively.

In the late 1880s and early 1900s, the disease affected northern Italy with greater intensity, concentrating mainly on the lower-skilled and poorly paid workers who were at the root of the country's industrialization process and economic development. The spread of the disease was favored by the poor hygienic conditions both in the workplaces, particularly in textile factories, and in the overcrowded and unhealthy living quarters. Thus, tuberculosis was not a disease related solely to the profession, but a social disease brought about by physiological poverty, unhealthy working environments and poor living conditions (Tognotti, 2012). From 1936, due to improvements in health care and better living conditions, there was a general decline in tuberculosis mortality throughout the country.

The relationships between industrialization and pulmonary tuberculosis mortality in 1891 and 1911 are shown in Figures 3 and 4. The degree of industrialization is measured as the proportion of workers in the industrial sector to the total population of the region.

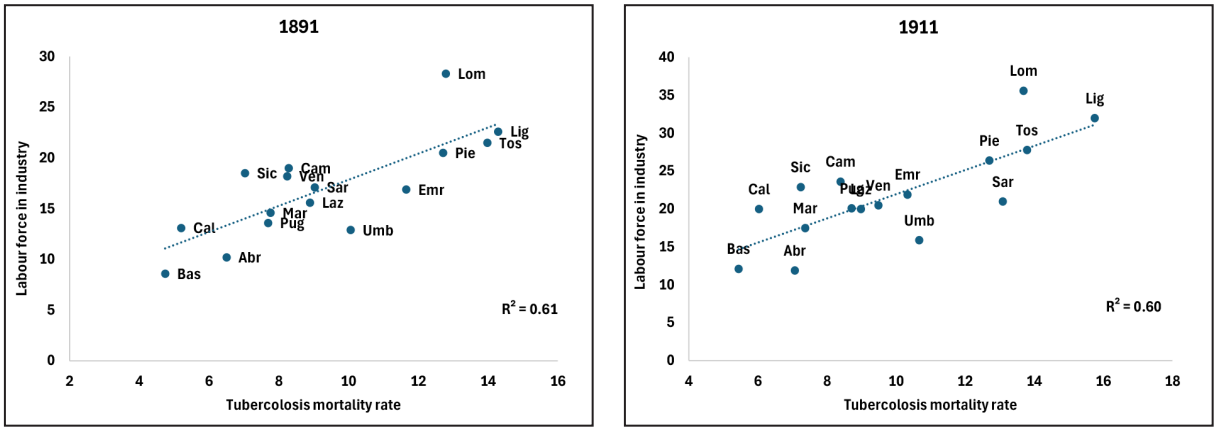

Figure 3. Industrialization and pulmonary tuberculosis mortality in Italian regions in 1891 and 1911

Source: Own processing on data MAIC (1894, 1913)

In 1891 and 1911, the relationship was positive and particularly high. In fact, about 60 per cent of the variance in mortality from pulmonary tuberculosis was explained by the share of industrial workers.

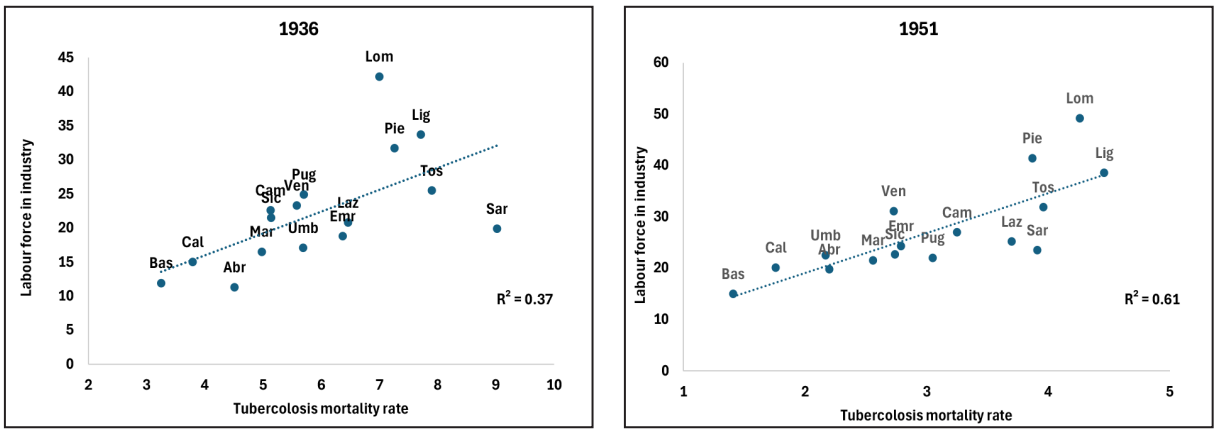

Figure 4. Industrialization and pulmonary tuberculosis mortality in Italian regions in 1936 and 1951

Source: own processing on data MAIC (1937, 1953)

In 1936, the relationship between tuberculosis and industrialization was still positive but much weaker than before. Although pulmonary tuberculosis mortality was certainly influenced by other factors, the level of industrialization was an important determinant. Moreover, the incidence of mortality had now declined throughout the country. In 1951, the relationship is strong again, although TB mortality has continued to decline.

4. FUTURE RESEARCH DIRECTIONS

This paper examines the relationship between tuberculosis and industrialization from a descriptive perspective. The results show a relationship between the two variables and are consistent with the findings of economic and epidemiological studies. However, the analysis deserves further

investigation, which could be carried out using provincial data and regressions to take into account not only the relative level of industrialization of the regions/provinces, but also other socioeconomic variables that may influence the health status of the population and tuberculosis mortality.

This would lead to a more in-depth analysis of the regional distribution and trends in tuberculosis mortality in Italy, and could also offer indications for comparisons with other countries.

5. CONCLUSION

In this study, epidemiological data and official cause of death statistics were used to analyse the regional distribution of pulmonary tuberculosis mortality in Italy, in the period 1887-1955, in relationship with industrialization.

The results show a significant correlation between industrialization levels and pulmonary tuberculosis mortality. In the industrialized northern regions, mortality rates, especially between 1891 and 1911, were notably higher than in the less developed central and southern regions country. When, over time, economic, nutritional and sanitary conditions improved, all over the country mortality rates declined.

As a latecomer to industrialization, Italy has followed a similar pattern to other countries, such as the UK, Germany, Japan and Norway, where mortality rates were initially higher in industrial areas, but were later reduced by advances in sanitation and infrastructure.

In summary, this study highlights the crucial role of industrialization in shaping the regional distribution of pulmonary tuberculosis mortality and slowing its decline during the transition period. However, the impact of other factors such as urbanization and specific geographical conditions, which may have significantly influenced the dynamics of tuberculosis mortality in Italy, needs to be further investigated.

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Considerations on the Knowledge Integration Management (KIM) in the Knowledge-Based Society/Economy (KBS/E)

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Abstract: *The paper proposes a transdisciplinary approach to knowledge integration within the knowledge-based society and economy (KBS/E), positioning universities as ideal spaces for the synergy of education, research, and industry. Emphasizing a "global village" perspective, it highlights the university's role in fostering sustainable development by integrating diverse disciplines and deep research in specialized fields. Practical examples of transdisciplinary spaces include Technopolis centers, knowledge factories, and mobile mechatronic platforms, which serve as innovative clusters for knowledge creation, transfer, and application. The Knowledge Integration (KIM) paradigm underpins this process, enabling the efficient exploration of ideas and advancing expertise as wisdom and skills. This approach breaks traditional academic boundaries, encouraging rational debate, problem-solving, and lifelong learning in a sustainable, integrative framework.*

1. INTRODUCTION

The global community engages in a collective effort aimed at addressing fundamental issues tied to common economic principles and guidelines within the knowledge-based societal and economic framework (KBS/E) (Arnold Stuart, 2008; Adamsson, 2007). Challenges in overcoming these issues primarily arise due to the multifaceted and complex nature of global economic growth. Addressing these types of challenges demands moving *"beyond that is known"*, particularly given the emergence of innovative integrative approaches, including multidisciplinary, interdisciplinary, and transdisciplinary methods (Nicolescu, 2006; Berte, 2004; Ertas, 2010). Addressing the challenges presented by an evolving global business context requires shifting perspectives to more thoroughly understand foundational integrative knowledge (Calantone et al., 2002). Within this context, knowledge management is increasingly becoming a central and significant topic in contemporary discussions (Nonaka & Takeuchi, 1994; Berends et al, 2007; Jashapara, 2011).

For the informergical society (information acting as intentionality incorporated in mattergical intelligent products), as the knowledge-based society/economy (KBS/E) was stated, the main question is the way the advanced knowledge is produced, shared and implemented (Zeleny, 1987). Given that data is plentiful and essential, innovative methods must be applied to transform it effectively into valuable insights, through synergistic communication, as contextual messages in education, as top-down approach, and in practice as bottom-up perspective in sustainable all life teaching/learning processes, to achieve the final goal, expertise as wisdom and skills (Pop & Soritau, 2022). Advanced knowledge, defined as the understanding of facts, truths, or principles acquired through research or study, relies on the semiophysical contextual message model, where each stage of attaining knowledge is examined using a synergistic and systemic perspective through the knowledge paradigm consisting of seven guiding questions: where, when, who,

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with whom, what, how, and why (Pop & Soritau, 2022). The framework for understanding the knowledge-based society/economy (KBS/E) is established by the space-wise-spatial participative sequence (where, who, with whom), time-wise-temporal connective sequence (when, who, with whom) and act-wise-interactive actionable sequence, (who, with whom, what, how and why) (Pop, 2008; Šlaus & Jacobs, 2001).

2. TRANSDISCIPLINARITY AND INFORMERGIC INTEGRATION OF KNOWLEDGE

The image of the World as the Whole is the basis for the holistic world outlook, but in the light of the transdisciplinarity of "the One World", the world's economy is perceived and understood as *"the one orderly medium"* in which national economies, as components of the specific societies, are considered to work as an aggregate of its natural fragments (Arnold, 2008; Pop et al., 2021). In this sense it is important to understand the intricate nature of the society grounded in advanced knowledge, as a natural part of this medium, working in an integrative informergic pattern (information as intentional information embedded in mattergy as energy and matter) of what is the rational "by doing" and relational "by being". The image of the transdisciplinary "One World" will help to form the very "new viewpoint" in order to define the direction for creative thinking in solving the problem of designing a new order of global economic relationships (Nicolescu, 2008). From this point of view, it's essential to identify human needs alongside the products and services that meet those needs. Equally important is defining global standards for how goods are produced, exchanged, and distributed. These processes should be guided by the understanding that people are organic to the world, they are interconnected, and play a vital, living role in the shared global system (Nicolescu, 2008). The updated model of a knowledge-based society and economy (KBS/E) proposes a different perspective. It introduces an alternative path that complements existing ones, with its foundational principles and specific boundaries for where and how it can be applied. Within epistemology, certain academic disciplines appear closely related. Others, however, are viewed as more distant, marked by a clearly defined epistemological separation/distance.

A discipline, when approached in depth, represents a field of knowledge, education, or inquiry that is unified by a common epistemological foundation. This foundation consists of shared beliefs about the nature of knowledge and distinct methodological boundaries. These methods are accepted as valid means for producing and accumulating knowledge (Nicolescu, 2008). Disciplines tend to group based on *epistemological distance*—how closely they align in terms of foundational assumptions. These groups, or knowledge subsystems, often include fields such as the natural sciences (e.g., physics, biology, chemistry), social sciences (e.g., psychology, sociology, economics), and the humanities (e.g., languages, visual arts, music). Some rely on quantitative approaches, others on qualitative ones. Disciplines within the same subsystem are typically more connected. Those from different subsystems are generally more distant. The disciplinary structure of knowledge operates at a thematic and curricular level. At this level, it may be embedded in predisciplinary, mono-disciplinary, or codisciplinary settings. In contrast, academic programs and research collectives often follow a multidisciplinary or pluri-disciplinary structure, primarily at the methodological level. These are not confined to traditional disciplines and sometimes span multiple knowledge subsystems. Such approaches function at a synergistic level, facilitating structural interdisciplinarity, functional cross-disciplinarity, and generative transdisciplinarity. This reflects a *multiple disciplinary thinking perspective on knowledge* (Pop & Soritau, 2022).

The transdisciplinary approach demands a change in the attitude of all the actors from the position of co-evolutionary development (Nicolescu, 2006), providing the opportunity for fundamental changes in the economic relationships (Brazell et al., 2009). Identifying a problem is often seen

as more critical than finding its solution. Re-examining existing issues from a fresh perspective requires creativity and is regarded as a genuine scientific achievement. In order to become competitive, companies must develop new technologies to design and manufacture their products, as a rapid reaction to change, for products with new smart properties in shortened product cycles (Arnold, 2008). The transdisciplinary method offers fresh viewpoints on development. It continuously incorporates new ideas that aim to improve how we act and adapt to the changing world. This is especially relevant in today's complex environment, where needs evolve rapidly. Innovations and technologies must constantly be refined to keep pace with these fast-moving changes.

A key focus in knowledge management is how knowledge can or cannot be measured, stored, and made explicit. To examine how tacit knowledge can be transformed into a usable format, traditional methods are often employed. This happens through transdisciplinary integration processes that include various stages: hands-on (passive knowledge), hands-in (a mix of passive and active), and hands-off (fully active knowledge). It's essential to distinguish between different types of knowledge. For instance, *know-what* involves selecting the right content to communicate. *Know-how*, on the other hand, refers to how this content is encoded and shared. This is considered implicit knowledge (Berends et al., 2007; Pop, 2008). Such procedures become formalized and serve as structured ways of guiding people through specific tasks. Organizational knowledge, especially the kind that feels like shared understanding or tacit communion, goes beyond just knowing *what*. It is about developing true *know-how*—the actual ability to apply what is known in practice (Gomes et al., 2003; Hildreth & Kimble, 2004).

To build knowledge through interaction within a specific setting—where learning is initiated, supported, and sustained—people must operate in a well-structured environment (Wenger & Snyder, 2000; Hildreth & Kimble, 2004). This approach enables new ways of thinking, with greater chances of successful outcomes. It also allows for better management and application of knowledge, as well as faster development of useful concepts. Moreover, communication with other knowledge domains becomes more effective. In this context, the main objectives of the new economy revolve around client satisfaction and market relevance (Arnold, 2008).

Understanding how knowledge works in real-world settings requires a broader view. One must examine how information spreads within large, interconnected systems. Real practices tie together things, people, and events that may seem unrelated or only partly aligned. This is important because such practices make room for both stability and transformation, helping to manage change and disorder while preserving continuity. To enable knowledge growth through collaboration, individuals must engage in environments where learning is actively created and maintained. Such environments must be purposefully designed to support these processes (Wenger & Snyder, 2000; Hildreth & Kimble, 2004).

Within this kind of setting, we find what is called *transactive knowledge*—a form of organizational self-awareness (knowing what one knows). There is also *resource knowledge*, which refers to knowing who possesses specific information. Together, they emphasize the importance of understanding the *knowledge landscape of an organization*—that is, who knows what and why, and how that knowledge is connected (Hildreth & Kimble, 2004).

In a knowledge-driven society and economy (KBS/E), education and training rely on a transdisciplinary strategy. This approach is essential in today's educational landscape, offering a pathway to success. It encourages active participation, adaptability, and context-specific flexibility. With this mindset, even challenges can be turned into opportunities (Berte, 2004; Pop & Mătieș, 2010).

Transdisciplinarity emphasizes both doing and being. It views learning as an ongoing process where those involved in education play an active role—similar to a *teaching factory* (Alptekin, 1996). The goal is to help learners understand and apply information, question it, or even reshape and adapt it as needed. To remain competitive, organizations must continually create new products and refine their manufacturing processes. This allows them to keep up with fast-changing demands and shortened product cycles. These cycles now align with a broader concept of sustainable, lifelong learning systems—*"all life learning systems" (long life learning, wide life learning and learning for life*) (Arnold, 2008). The transdisciplinary approach brings fresh insights to development. It draws in a growing number of ideas aimed at improving how we act and adapt in a constantly shifting world. In a context full of complexity and change, new technologies must be improved and developed rapidly (Pop & Mătieş, 2010).

The integrated models discussed here show that *informergy*—the energy of knowledge—relies on a transdisciplinary understanding of learning within a knowledge-based society. This is grounded in a semiophysical communication model that answers "What? How? Why?"—a method for achieving the advanced knowledge. Transdisciplinary models offer a richer perspective than traditional teaching-learning systems. They center on identity as synergy and view learning as a thematic and generative process. These models help explain how different disciplines can be connected. They support codisciplinary and multidisciplinary collaboration, as well as interdisciplinary and transdisciplinary blending. This approach seeks to balance the external (practical and observable knowledge) and the internal (reactive and intuitive knowledge) dimensions of learning. It supports rational understanding through active engagement ("doing") and relational insight ("being"). Ultimately, advanced knowledge can only be achieved through transdisciplinary practice—an open, integrative system for understanding the world.

The transdisciplinary approach to exploring knowledge introduces a new research paradigm. It operates by integrating both top-down and bottom-up streams of knowledge in a complementary way. In this model, the teacher—seen as a mentor—typically guides from a top-down angle, while learners contribute insights from the bottom up. Rather than maintaining rigid hierarchies, the roles of teacher and learner shift within a balanced and cooperative dynamic. This fluid interaction adapts based on the context of synergy between participants. The goal is to prevent conflict, encourage mutual understanding, and create meaningful links across different viewpoints. This model promotes bridge-building, breaks down barriers, and supports collaboration in learning and living environments. It reflects a vision of humans as constantly connected—not only with each other but also with intelligent systems, technologies, and the products they engage with.

It is proposed to introduce a new transdisciplinary perspective on the informergical integration of knowledge in the context of the new framework, knowledge based-society. This new perspective to explain the achieving of knowledge, giving the openness to a better understanding of the world, through *informergy*, which refers to purposeful action and information (*informaction*) combined with *mattergy*—energy that is embedded within matter. This approach provides multiple ways to comprehend, transfer, and embed knowledge within the framework of an informergical, knowledge-based society. The multi-layered transdisciplinary model integrates informergically—meaning it blends intentional action with embodied energy (*mattergy*)—the dimensions of creativity (both adaptability and innovation), performance (through competition and outcomes), and authenticity (involving character and capability). All of this is accomplished through active engagement and collaborative learning, viewed as *apprenticeship in communion*. Within this updated methodological approach, the "knowledge search window" helps to clarify the interaction between bottom-up and top-down learning processes. These mechanisms are central to the integration of knowledge

within teaching and learning frameworks, especially in fields such as mechatronics. This entire process is interpreted through a transdisciplinary lens (Pop & Mătieş, 2008).

Disciplinary research, which focuses on *depth*, and transdisciplinary research, which emphasizes *breadth*, are not in conflict with each other. Instead, they function as complementary strategies—described as working through a model of *"breadth through depth."* This model supports a renewed perspective in the pursuit of knowledge. The concept of *informergy* offers a range of integrative methods to explore how knowledge can be gained, shared, and embedded within the framework of a knowledge-based society. It promotes a synergistic approach to understanding that combines two key elements: rational knowledge (gained through action—*by doing*) and relational understanding (developed through presence and meaning—*by being*). Together, these form the dual paths of the informergic learning process. To meet the growing need for high-level expertise, it is essential to rethink vocational education. New training systems must reflect the demands of an evolving, knowledge-driven world. This includes combining theoretical learning (a top-down approach) with practical experience (a bottom-up approach). Through this blend, learners gain essential skills and continuously improve through a lifelong learning mindset. To reach long-term goals, three complementary strategies are proposed: *raising the expertise to an advanced knowledge level (as wisdom and skill achievement)*; *sustainable strategies as "all life learning" educational process* (*lifelong learning, wide life learning and learning for life), and the knowledge triangle for creativity (education, research and innovation)* (Pop, 2009).

Informergic professionals—whether engineers, managers, technicians, or others—demonstrate strong motivation and capability across diverse technological domains. They work across disciplinary lines and apply a *multi-disciplinary mindset* to identify and apply the right mix of technologies to address complex challenges. This approach leads to more suitable and effective solutions and supports alternative strategies for problem-solving. The goal of this emerging methodology is to support informergic learning. It encourages individuals to gain skills through a process of learning, understanding, and practicing. This process is *active-reactive,* meaning it can occur either through intentional effort or spontaneously. It allows learners to engage deeply with knowledge—managing information, questioning it, reorganizing or adapting it, and even deciding to reject it if needed. It is also essential to develop a conceptual framework for working with dynamic systems. This framework should span both naturally occurring systems and intentionally designed ones. Understanding how to apply these models effectively—especially within layered, vertically structured systems—helps create harmony between theoretical understanding and practical application. This balance is achieved through a *included-middle approach* to knowledge integration.

3. INNOVATION NETWORKING AND KNOWLEDGE BASED SOCIETY / ECONOMY (KBS/E)

The transdisciplinary informergical framework integrates a rational mode of acquiring knowledge (*by doing*) with a relational way of being (*by being*). It relies on collaboration, creativity, and clearly defining and shaping problems. This model is especially relevant in contexts that involve uncertainty, change, and distributed intelligence across different cultures, disciplines, and technological tools. In this context, educational programs should aim to cultivate transdisciplinary abilities. These competencies are essential for helping individuals lead meaningful and productive lives in a world shaped by complexity and integration (Derry & Fischer, 2005; Nicolescu, 2006).

Informergical education is centered on equipping learners with practical expertise in areas such as smart systems integration, design, and maintenance. The newer educational strategies

emphasize concurrent creative processes throughout system development (Pop et al., 2018). It is also important to help learners strike a balance between top-down instruction and bottom-up engagement. This balance lies at the core of transdisciplinary knowledge development. Students must explore technological fields in depth while applying this knowledge in hands-on settings. The goal is to support modern vocational education that functions like a *knowledge factory*—bridging theoretical understanding with practical implementation (Pop, 2009). The perspectives of the research in the field are related to the creativity centres in the process of the eco-economical implementation of intelligent products, for sustainable development of an integrated and continuously integrative society, through transdisciplinary technopolis centres, the educational platforms being an original system for achieving, transferring and implementing knowledge in intelligent products, technologies and systems (Papoutsidakis et al., 2008). The transdisciplinary perspective in informergical education is built on encouraging original thinking, making reasoned decisions, solving complex problems, and fostering responsible dialogue. It promotes a learning process that goes beyond the constraints of conventional academic norms (Nicolescu, 2008). In this view, hands-on experience is vital and cannot be replaced by simulations alone. Instead, a combined use of virtual tools—such as design software, modeling, simulations—and real-world representations, like prototypes and smart systems, is necessary (Mândru et al., 2008).

Rather than being seen as conflicting forces, tradition and innovation are treated as complementary. The most creative individuals are those who, through a transdisciplinary lens, go beyond established frameworks. They are capable of recognizing and expressing entirely new concepts that push beyond current structures (Berte, 2007). To truly innovate, creative systems must detect new ideas and explore them using intelligent strategies. These systems help shift smoothly between different potential solutions or knowledge states. Since knowledge is rooted in human interaction rather than in objects or documents, it becomes essential to recognize the spiritual side of learning. This is often understood through the concept of "being"—a key idea in the informergical and integrative knowledge paradigm (Reason, 1998; Pop, 2009). Today's learner is seen as an active participant in the process of acquiring knowledge. This involves balancing rational understanding (by doing) with meaningful relationships and reflection (by being), in order to make sense of the world (Nicolescu, 2008; Pop, 2008). The evolving knowledge landscape calls for a transformation in education. This includes identifying and supporting essential changes, acknowledging innovation critically and creatively, and addressing new educational priorities. These priorities now require rethinking the curriculum within a more creative and future-oriented context (Boden, 1994).

In order to reconfigure the traditional monodisciplinary learning space in a new sustainable educational pattern, was introduced the all life learning principle – with its three components, lifelong learning, life wide learning and learning for life. These components support the continuous development of specialized professionals who gain new competencies through adaptive, real-world engagement. This involves learning that responds to contextual needs and takes place in collaborative, transdisciplinary environments where integrated knowledge is processed through networking. Informergy serves as a model of generative, synergistic synthesis within this framework. It combines *Scientia*—a symbol of new educational transdisciplinary thinking (a fresh epistemology)—with *Techne*, which represents practical, integrative design methods. Together with *Praxis*—reflecting meaningful action—this model shapes the emerging economy centered on intelligent products, grounded in the concept of *mattergy*, where energy and information are embedded into matter. This is supported by a newly developed system of thought and behavior, rooted in social interaction and aligned with an updated ontological perspective. The resulting knowledge environment is seen as a *metacognitive space*—a platform where open, transdisciplinary

learning systems thrive. Within the interconnected worlds of education, research, and industry, the university is viewed as the most suitable environment for this kind of learning. It offers both structure and adaptability, which are essential in today's knowledge-based society and economy (KBS/E). This space allows for continuous evolution, where learners can develop highly specialized knowledge while also gaining a broad, interdisciplinary understanding. Achieving this balance is essential for success in both academic and professional domains (Kaynak, 1996).

The proposed sustainable vision aims to apply developed knowledge within intelligent systems, technologies, and products. This vision is grounded in a transdisciplinary model that introduces new ways of thinking and fosters the adoption of innovative ideas. These ideas help refine how we live and work in an increasingly complex and rapidly evolving world. In this context, technological progress and innovation must keep pace with continuous change. Creative environments such as *transdisciplinary technopolis centers* (Albert & Lukas, 1999; Pop et al., 2018), *teaching factories* (Alptekin, 1996), *mobile educational platforms* (Papoutsidakis et al., 2008), and *reform-oriented schools* (Berte, 2007)— along with *entrepreneurial communities of practice* — are contributing to the emergence of integrated learning ecosystems. These models support the creation of a sustainable society where knowledge is both continuously generated and applied. Their role is to foster the ongoing development and implementation of informergical knowledge, positioning these environments as foundational to the future of transdisciplinary knowledge spaces. Informergical knowledge transcends standard methods, promoting a transdisciplinary identity that fosters new fields through flexible, real-world-relevant, co-disciplinary frameworks and adaptable curricula.

It is important to make a reevaluation by reshaping (Pop et al., 2024) or redefining (Prisac & Pop, 2023) sustainable development in permacrisis with the transdisciplinary approach integrating knowledge through Knowledge Integrating Management (KIM) in order to give contextual adequate solutions to our problems in a challenging troubling world. Innovation hubs are contributing to the sustainable advancement of a continuously evolving, integrated society. These centers enhance collaboration across various domains of knowledge. In the context of the emerging informergical society, the primary objective is to focus on product innovation and technology development aimed at fulfilling both customer and market demands. To maintain competitiveness, companies must innovate rapidly. This includes creating and producing new technologies that respond efficiently to change, ensuring products remain competitive and production cycles are reduced (Arnold, 2008). The transdisciplinary model introduces fresh insights into how development should evolve. It supports the integration of diverse ideas to improve everyday practices and adapt to shifting realities. In a world defined by constant transformation and increasing complexity, the need to update and refine technologies and innovations is more critical than ever (Pop & Mătieş, 2010).

To foster the creation, nurturing, and long-term sustainability of knowledge, a supportive environment must be established. This is often achieved through structured social interactions, particularly in Communities of Practice (CoPs). These groups are seen as emerging, creative hubs that function as centers of synergistic and generative activity. Within them, *transactive knowledge* (knowing what one knows within the organization) and *resource knowledge* (knowing who knows what) are especially centered on the organizational setting (Wenger & Snyder, 2000; Hildreth & Kimble, 2004). On the other side, it would be possible to approach entrepreneurial learning in the family business as a community of practice synergistic/generative transdisciplinary pattern working as a specific knowledge space. Within a knowledge-based society, education and training must be grounded in the principles of transdisciplinarity. This is essential in today's evolving educational

landscape, as it ensures the capacity to adapt, actively engage, and succeed in the future. A new mindset is required—one that embraces flexibility, context-awareness, and the potential to turn challenges into opportunities (Pop & Mătieş, 2010). In the transdisciplinary context, the main question is what creativity as novelty does bring innovation in the business life and activity for business people offering the path to determine whether the chosen type of activity is a major type, or it has to be changed, and how can this be done effectively (Jashapara, 2011).

4. CONCLUSION

The research has successfully fulfilled its proposed goals, presenting original contributions. Informergy is understood as a dynamic and integrative synthesis that combines multiple knowledge dimensions. It brings together *Scientia*, envisioned as a new educational paradigm rooted in transdisciplinary thinking; *Techne*, which reflects a creative approach to design; and Praxis, which signifies intelligent action in real-world contexts. Together, they support the development of a new economy centered on smart products and processes, grounded in the concept of *mattergy*—where energy and information merge. This framework is shaped by a socio-interactive system that integrates thought, behavior, and ontology. Within it lies a shared cognitive space—metacognitive and generative in nature—that supports open and transdisciplinary knowledge creation. Informergical knowledge, within this context, does not function as a traditional methodology. Instead, it uses synergistic synthesis approaches that go beyond multidisciplinarity or interdisciplinary overlap. It creates new fields of knowledge within a codisciplinary setting, guided by flexible, real-world-relevant curricula. The *all-life learning model*—consisting of lifelong learning, life-wide learning, and learning for life—enables the continual development of expert capabilities. It supports the adaptive evolution of competencies in response to real-world demands. This process unfolds in innovative environments such as *technopolis centers* and other transdisciplinary hubs, where learning is integrated, networked, and contextualized.

The sustainable strategies presented here offer a practical pathway for applying developed knowledge within intelligent products, technologies, and systems. This is made possible through a transdisciplinary approach that opens new directions for innovation. It enables the integration of an increasing number of ideas that contribute to better ways of working and living—especially in a world that is constantly evolving and facing complex challenges. In today's rapidly shifting environment, where technologies must continuously advance, creativity centers play a crucial role. These centers promote sustainable development within a continuously integrative society. Initiatives such as mobile education units, acting as networked teaching factories, exemplify how practical knowledge environments can function. Their mission is to support the transfer and application of informergical knowledge, serving as models for future knowledge spaces—such as technopolis centers—now also emerging in places like Romania. This inclusive and flexible approach provides a solid framework for turning theoretical knowledge into real-world impact. It ensures knowledge remains relevant and adaptable, regardless of how fast external conditions change. It enhances confidence in the steady growth of the business and strengthens the entrepreneur's expertise in strategic planning. This is achieved by using precise data on critical milestones and control points, enabling tailored recommendations for improving business operations, equipment and machinery use, marketing, and sales strategies. Understanding the business's orientation toward certain types of innovation is crucial, as it allows the entrepreneur to effectively adapt the original business concept—timely and accurately—while refining the core operational principles.

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On Some Quantitative Characteristics of Human Resources in Agricultural Enterprises in Slovakia

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Abstract: *Agriculture is one of the important sectors of the Slovak economy, the main goal of which is to provide food and food products for people. Business activities in the agricultural sector are linked to factors such as national culture, relationship to the soil, geographical conditions for growing crops, animal husbandry, and currently also reflect business ambitions. Human resources are a key component of any business, which is also valid for business in the agricultural sector. The main goal of the paper is to find out how selected characteristics of human resources in Slovak agriculture enterprises developed. The focus of the research was on the number of employees and their financial evaluation in conditions of the Slovak Republic in the period 2009-2022. Research data were taken from the database of the Statistical Office of the Slovak Republic. Analysis and synthesis methods were used, while the development of the variable was quantitatively evaluated using trend function modelling.*

1. INTRODUCTION

The structure of business entities changed significantly after 1990 because of privatization. Before 1990, cooperatives and state-owned properties existed in Slovakia within agriculture, but after 1990, new business entities were added, including trading companies, and independent farmers (Bandlerová, 2005). As Rumanovská et al. (2018) stated, in the period 2004-2013 the number of individual farmers decreased in Slovakia. Subsequently, after the economic crisis, the number of individual farmers was increasing in the Slovak regions with optimal conditions for agriculture.

Recruitment is one of the most important human resource management tools in the field of agriculture with reference to the current state of the labour market (Drahotová et al., 2020). Janecka et al. (2019) state that employees and the cost of employees have affected the performance of farms. The primary sector, especially agricultural companies, has long been struggling with labour shortages and demographic trends as well as with the negative age structure of employees (Urbancová & Vrabcová, 2020). The lack of workforce could be solved by immigrants or by automation, robotics, and digitization, which represent massive investments for farmers.

Gulyaeva et al. (2023) focused on research on human resource development in the agricultural economy sector in the digital transformation of agriculture, as changing business conditions lead to human capital becoming a leading and intensive factor in the development of the digital economy. Sadjadi and Fernández (2023) focus on the challenges and opportunities of the digitalization of

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agriculture in Spain. They identify the opportunities that digitalization can bring that will allow professionals in the sector to adapt to this intense change.

Age management is potentially another way of utilising human potential to maintain and enhance the organisation's performance with respect to future demographic trends (Chand & Markova, 2019). Slovak agricultural and forestry organizations are affected by a gender imbalance in the workplace. Women are usually in the positions of white-collar workers; however, it is only 17% of the total number of employees in this job position (Green Report, 2021).

The age of employees in agriculture increases; this also applies to the upper management of farms (Iorga & Dobre, 2018) and the younger generation of farmers is not sufficiently interested in working in the primary sector. Based on the results of Machova et al. (2022), the most popular motivational tools proved to be financial incentives in the form of salary increases or bonuses. The motivation of employees is an essential influence on employee performance. It is not only a psychological aspect, but also an economic one, while both are equal from the point of view of importance (Hitka et al., 2022). Employee motivation affects job performance (from an economic point of view as well as a mental point of view), overall success, and economic development of the entire enterprise (Uka & Prendi, 2021).

2. MATERIAL AND METHODS

The presented article examines the issue of the development of selected quantitative characteristics of human resources in agricultural enterprises in the Slovak Republic, namely:

- Development of the number of employees in the Slovak agriculture,
- Percentage share of employees in the Agriculture, Forestry, and Fishing sectors in the total number of employees in the Slovak Republic,
- Development of the number of employees working under the contract in agriculture,
- Development of wages of employees in agriculture.

The main goal of this paper is to find out how observed characteristics of human resources in the Slovak agriculture sector have developed. The underlying data were drawn from official statistical information of the Slovak Republic for the period 2009-2022 (DATAcube, 2024). The methods of comparison, analysis and synthesis, regression analysis, and estimation using trend functions were used in the study of selected indicators.

3. RESULTS

The primary part of the food vertical is agriculture, which has a crucial link to the food industry. Until 1990, agriculture, in addition to its production function, also fulfilled a significant social function, especially in employment in the Slovak countryside. The situation changed after 1990 when there was a significant decrease in the workforce (employees) in the first years of the transformation of agriculture and later due to mechanization within the framework of subsidy aid. The impact of globalization can be seen in the example of agriculture in Slovakia. The introduction of new technological procedures and the interconnection of processes between countries are leading to changes in the workforce (Širá & Dúbravská, 2020).

As Chrastinová et al. (2019) stated the development of agricultural employment is characterized not only by a significant decrease in employment but also by a proportional change in the professional categories of the workforce. With a general decrease in manual and managerial workers,

the dynamics of the reduction of manual workers was higher than the dynamics of the decrease of managerial and administrative workers. The reduction of the workforce in agriculture is a concomitant phenomenon of the continuous restructuring of the agrarian sector (Buchta, 2013).

The analysed data are from 2009-2022, with the end of the period under review marked by the COVID-19 pandemic. At the beginning of 2022, a pandemic situation persisted in Slovakia, and a state of emergency with limited freedom of movement of residents was in effect until February 23, 2022. By the end of the first half of the year, the situation gradually improved and the transmission of the disease was suppressed. The assumption that the Slovak economy would restart was threatened due to the war in Ukraine. Food prices grew rapidly, contributing significantly to inflation.

The development of employment in agriculture has had a decreasing trend since 2009, from 35,023 people in 2009 to 1,874 in 2022 (Figure 1). The linear trend has a negative slope (k = -1061.5) and coefficient of determination R^2 = 0.97.

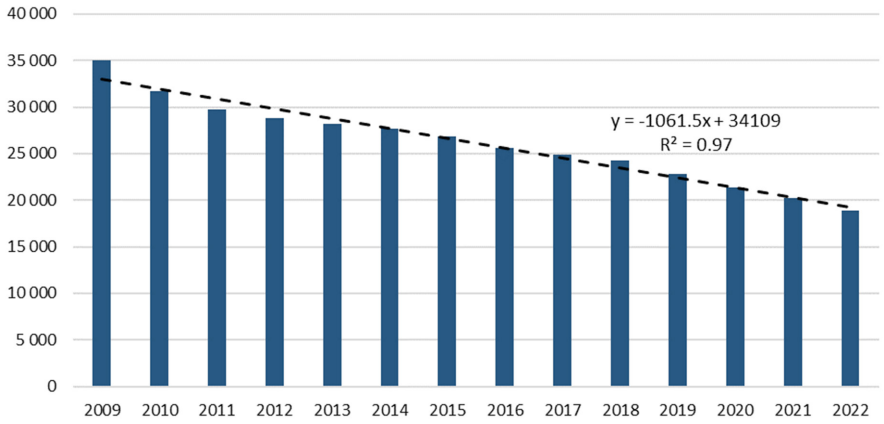

Figure 1. Development of the number of permanent employees in agriculture (total)

Source: DATAcube (2024), Own processing

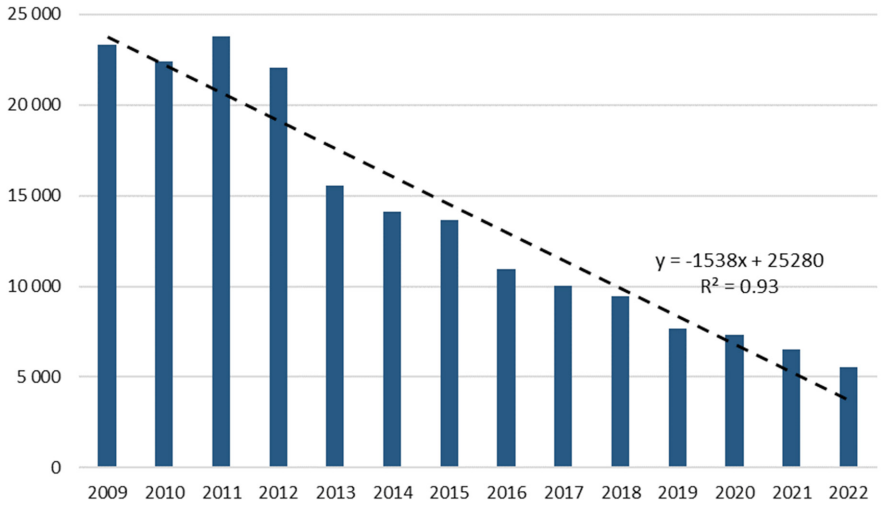

Figure 2. Development of the number of persons working under the contract in agro-enterprises

Source: DATAcube (2024), Own processing

Similar development is presented for persons working under the contract in agro-enterprises (Figure 2). The estimation model is linear with a negative slope (k = -1538) and coefficient of

determination $R^2 = 0.93$. These employees are in the agricultural sector mainly during seasonal work, e.g. during harvest. Some enterprises offer self-harvest when there is a large harvest and a lack of workers, so residents collect products themselves in the fields for minimal prices, e.g. various kinds of fruit.

In Table 1 there are summarized descriptive statistics data about employees in the agro-sector.

Table 1. Descriptive statistics of employees in agriculture

Total permanent employees		*Persons working under contract*	
Mean	26147.64	Mean	13744.71
Standard Error	1204.85	Standard Error	1780.15
Median	26228	Median	12321.5
Standard Deviation	4508.15	Standard Deviation	6660.69
Sample Variance	20323439.02	Sample Variance	44364875.45
Kurtosis	-0.26	Kurtosis	-1.37
Skewness	0.19	Skewness	0.47
Range	16149	Range	18226
Minimum	18874	Minimum	5546
Maximum	35023	Maximum	23772
Sum	366067	Sum	192426
Count	14	Count	14
Confidence Level (95.0%)	2602.93	Confidence Level (95.0%)	3845.77

Source: Own calculations

The development of the number of employees in animal and plant production is displayed in Figure 3. There is an obvious decline in both sectors, but the decline in animal production is much faster. Enterprises with animal breeding gradually stopped production in Slovakia, which was caused by intense competition in prices within the EU and world production.

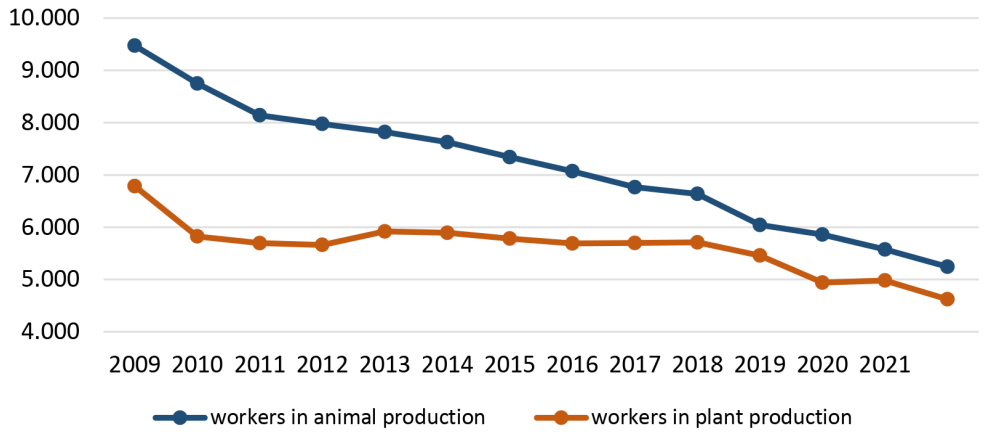

Figure 3. Development of the number of employees in the animal and plant production
Source: DATAcube (2024), Own processing

Changes in the share of employees in the Slovak agricultural sector in the total number of employees (in percentage) are presented in Figure 4. The decrease in the share of employees in the period 2019-2022 was replaced by an increase in the years 2023-2024. The situation reflects the restart of the economy after the global pandemic crisis in 2020-2022.

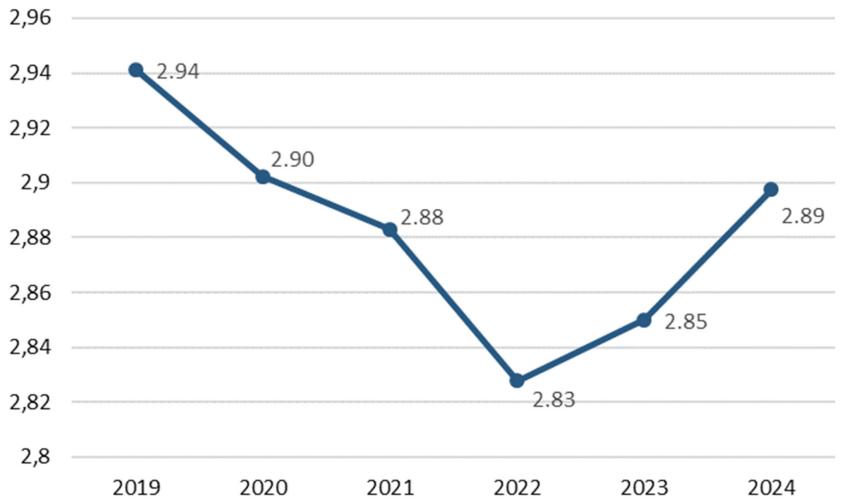

Figure 4. Share of employees in the Slovak agricultural sector in the total number of employees (%)

Source: DATAcube (2024), Own processing

Compared to other sectors of the national economy, the appreciation of the work of employees in agriculture is still lower. Employees in agriculture belong, according to the average monthly wage, to a socially weaker group of employees. Average wages in agriculture have been at the level of 74% of the average wages in the national economy.

The development of the average annual wage in the Slovak agro-sector is presented in Figure 5. Data are approximated by a linear model, which has an increasing trend with a positive slope (k = 549.44) and coefficient of determination $R^2 = 0.96$.). The robotization of agriculture will require educated employees with an adequate financial evaluation of their work.

Faskhutdinova et al. (2020) identified the main problems that hinder the rapid digitalization of agriculture, namely the lack of highly qualified IT specialists in the industry; weak development of digital infrastructure in rural areas; insufficient financial resources for the implementation of modern information and communication technologies in rural areas; high percentage of digital illiteracy in rural areas; etc.

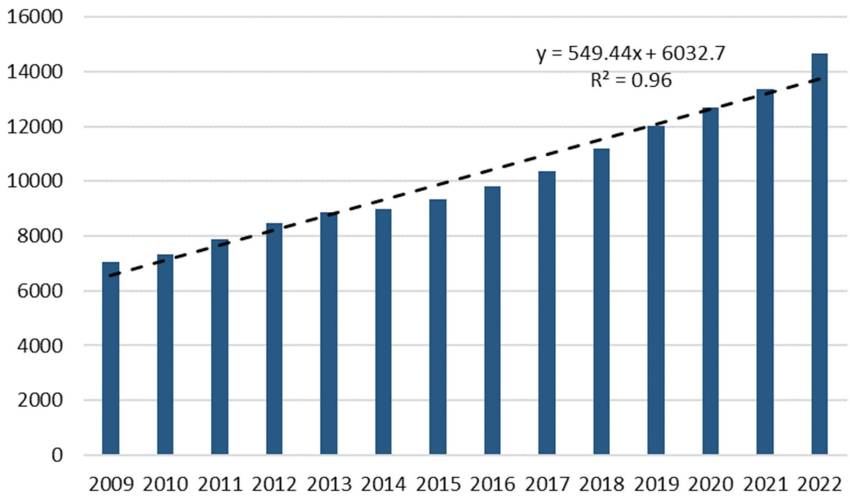

Figure 5. The development of the average annual wage in the Slovak agro-sector

Source: DATAcube (2024), Own processing

Urbancová and Vrabcová (2020) were concerned with identifying the benefits and strategies of human resource management that will help ensure generational change in agricultural enterprises. Vávra et al. (2021) found seven basic motivational factors, i.e. safety at work, fair remuneration, social security, and benefits, work climate, basic rights and freedoms, corporate image, and equal opportunity.

Agriculture and rural development are among the decisive factors in the quality, diversity and environment of Slovakia. The Green Report (2022) contains recommendations aimed at increasing the food security of the Slovak Republic. In the context of the issue addressed, the following recommendations are important:

- stabilize or expand agricultural and food production, thereby supporting employment by expanding local or regional sales of products, local and regional markets,
- increase the volume of support for livestock production and create better conditions for stabilizing livestock populations,
- intensify support for cultivation and processing in the fruit and vegetable sector to expand domestic production and processing to increase employment, and consumption and reduce imports.

4. FUTURE RESEARCH DIRECTIONS

The potential of human resources is also constantly changing and developing, which is the result of various economic effects, common agricultural policy, and globalization tendencies after Slovakia acceded to the EU. Human capital has a direct impact on agricultural productivity, as it influences and determines the procedures and efficient use of inputs to agricultural production.

Agriculture is also affected by changes in the global environment, which must respond (among other things) to climate change. The adverse impact of climate is subsequently reflected in the economic outputs of agriculture. In the agricultural sector, there are current challenges in the areas of management, innovation, and the application of innovative technologies, which will reflect the requirements for low-cost and efficient methods. Technological innovations require educated employees who will be able to implement new methods and use their potential in agriculture.

5. CONCLUSION

In the context of global population growth and climate change, the role of the agricultural sector is becoming even more important. The paper aimed to investigate how selected human resource characteristics in Slovak agriculture enterprises have developed in the period 2009-2022. The development of selected indicators confirmed that the agricultural sector responds sensitively to overall changes in the national economy. The analysis confirmed a long-term decline in the number of workers in the agro-sector, whether in permanent positions or during seasonal work. The share of workers in agriculture fluctuates depending on the overall economic situation in individual sectors of the economy. Manual work requires modern technical equipment for farmers to resolve the lack of interest of the younger generation in this type of work. The financial evaluation of employees in the agro-sector is improving, but it has not yet reached the level of average wages in the national economy.

Analyses and research studies show that the average age of farmers is gradually increasing. Generational change in the agricultural sector can slow down rural depopulation and start the modernization of the agricultural sector. Various forms of support for young farmers and financial

subsidies at the state or EU level are among the factors that can improve the situation in Slovak agriculture. The starting point for the decrease in the number of employees in agriculture is the modernization of farmers' technical equipment, where robots will perform manual work. Qualified employees in the field of robotization and automation will be needed to operate the software in agricultural machines. The above changes would contribute to reducing prices for end consumers.

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Career Development of Nurses and Technicians in Hyperbaric Medicine*

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Abstract: *The management of human resources in healthcare is defined through documents of national guidelines of set strategic goals and places emphasis on stronger professions through continuous education and general qualitative development. Special emphasis is placed on human resources management for nurses and technicians as the most numerous group of health workers. The goal of this research is to differentiate the development of individual branches in medicine with a focus on the career development of nurses and technicians as part of a strategic reflection that will inductively reflect on general positive trends. The trend in the EU is to direct nurses and technicians to further education in order to expand their scope of duties and responsibilities, so the focus is on lower career development, which is the next logical step in the development of the profession. This paper analyzes the career development of nurses and technicians in the field of hyperbaric medicine in Croatia through the perception of the attitudes of the nurses and technicians themselves and the head of the bracoroom. The scientific contribution of this research is the expansion of knowledge about the development of human resources at work in pressure chambers. The research methodology is a survey questionnaire and an in-depth interview with the heads of centers for hyberbaric medicine in the Republic of Croatia.*

1. INTRODUCTION

Human resources in healthcare have a continuous tendency to grow, while external factors affecting the healthcare sector tend to decrease. These factors are: the natural increase and migration balance of the population, which has been negative for decades, the resources of the number of hospital institutions in healthcare have been equal to the trend of the pair for years, while the number of beds, hospital days, which tends to decrease. Croatia has always been a country with a small number of medical staff, which has maintained and maintained that salary class among the highest paid, ie the workplace coefficient is high. The number of employees in healthcare is continuously growing, and the majority are employed in the hospital sector, where there were 50,592 employees in 2022, and 47,392 in 2018 (Fina, 2024). The National Health Development Plan for the period from 2021 to 2027 aims to establish a human resources management system, and the advantages of the health system are listed as professional and dedicated health workers and a developed network of high-quality medical faculties and health polytechnics and schools, while through medium-term development needs state models of development and expansion of the competences of health workers to compensate for the shortage of health professionals. In the EU, the trend is to develop the competencies, knowledge and skills of nurses and technicians in order to take on a larger volume of work and more demanding tasks. Educational policy strategically strengthened. Statistics support the fact that there are more

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and more employees in this sector and that they are more and more educated (Vizjak & Perić Kaselj, 2023). Human resources in healthcare tend to grow, while spatial resources have a slight tendency to decrease in the last decade, and the number of days, as well as cases of hospital treatment and the total number of beds, is in a significant decrease. From this, it follows that the volume of work and work capacities is decreasing, while human ones in terms of employees are growing, which will be reflected in the price of work, as a reflection of the legality of supply and demand. A resource that has many prices falls to it, while one that lacks price can be manipulated. When comparing the statistics of the total number of high, higher, middle and lower levels of education in the health system and the capacities of jobs and enrollment quotas, it is clear that human resources greatly exceed the needs of the labor market. Enrollment quotas will result in an even greater disparity between the supply of jobs and the demand for human resources in the health system.

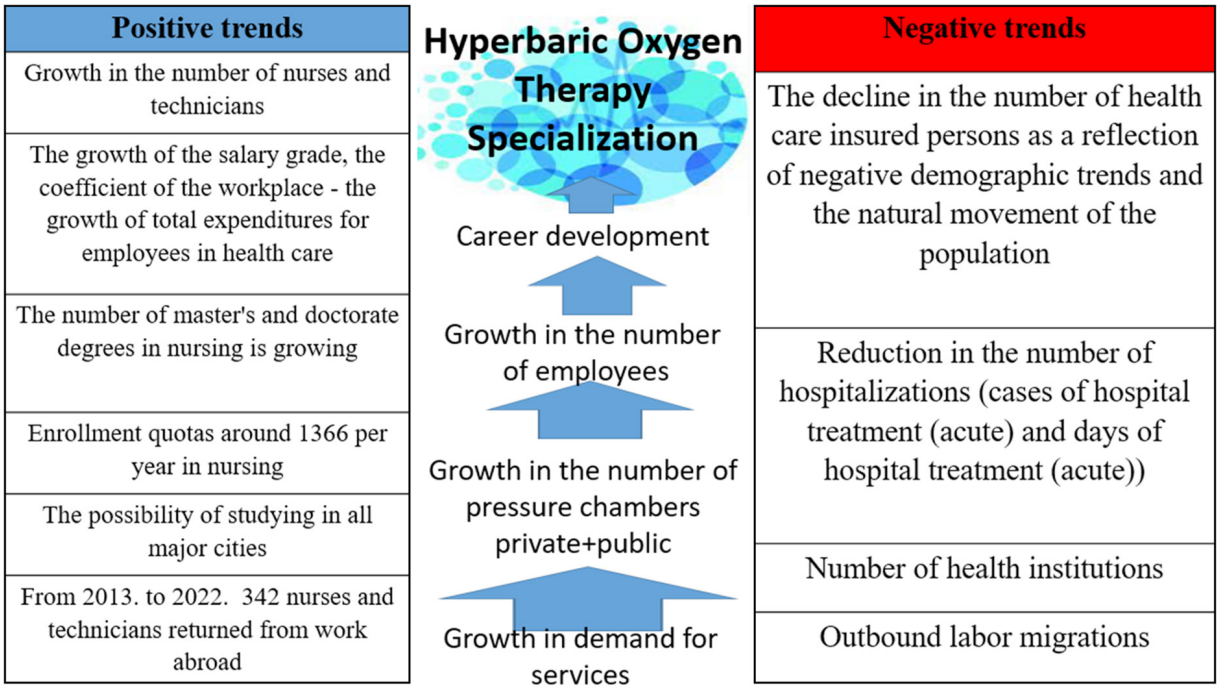

Figure 1. Presentation of trends in healthcare through the aspect of the development of the nursing profession

Source: Own research

2. METHODOLOGY

The methodology of empirical part of the research was done using a survey method using a Google form questionnaire on a sample of nurses and technicians employed in a barochamber, as well as survey research and semi-structured interviews with managers of private and public barochambers in Croatia. In the first sample, the answers of 22 nurses and technicians employed in jobs related to working with patients who are provided with health care in Barokmora are analyzed. In the second sample, the answers of 8 barochamber leaders are analyzed. Hyperbaric centers where research was conducted: Polyclinic Oxy, Zagreb, Crikvenica and Pula branches, Polyclinic Marija in Zagreb, Polyclinic Slavonija in Osijek, Department of Hyperbaric and Underwater Medicine at KBC Rijeka and Department of Maritime Medicine in Split. The research was conducted from March to July 2024.

3. RESEARCH RESULTS

The largest number of respondents in the part of the research carried out with nurses and technicians in the barochamber fully agree with the statement that specialized training would improve the knowledge and skills of the scope of work and the need to introduce a mandatory course on working in hyperbaric medicine. The self-assessment of the level of education for the provision of quality health care to patients in a pressure chamber is satisfactory, and they fully agree with the statement about the need to meet regularly once a year with other employees employed in pressure chambers in Croatia in order to share knowledge and experience (in the form of a congress).

Table 1. Results of the Likert scale of the survey part of the research conducted with nurses and technicians in the pressure chamber

	1 (Completely disagree)	2	3	4	5 (Completely agree)
I consider my level of education sufficient to provide quality health care to a patient (in a pressure chamber).	1		1	3	17
I consider that specialist training would improve the knowledge and skills of my work scope (in the barochamber).		1	4	3	14
I consider that a mandatory course on working in hyperbaric medicine should be introduced during the nursing undergraduate/ graduate studies.	1	4	5	2	10
I consider that there should be a regular one-year meeting with other employees employed in barometric chambers in Croatia in order to share knowledge and experience (in the form of a congress).			2	3	17

Source: Own research

The statements with which the largest number of respondents fully agree are about the assessment of competence and the level of education of nurses and technicians who work in the pressure chamber, and that further specialist training of nurses/technicians would contribute to the development of the quality of health care provision.

Table 2. Results of the Likert scale of the survey part of the research conducted with the heads of barochambers

	1 (Completely disagree)	2	3	4	5 (Completely agree)
I consider that the current competences and level of education of the nurses and technicians working in the pressure chamber are adequate for providing quality healthcare.		1	1	3	3
I consider that further specialist training of nurses and technicians who work in the barochamber would contribute to the development of the quality of health care provision.			2	2	4

Source: Own research

The views of 8 barochamber managers expressed in a semi-structured interview emphasize the importance of including the topics of hyperbaric medicine in the regular curriculum of health-oriented studies and the need for further specialist training of nurses and technicians working in the barochamber. He also states the need to strengthen the cooperation of all health institutions that provide the service of hyperbaric oxygen therapy, as well as Clinics and Institutes as well as University scientific and research centers. Through a good organization of congresses and education for nurses and technicians, knowledge and experience would be actively exchanged with meticulous documentation of all observations, analysis and presentation of treatment outcomes.

Table 3. Summary analysis of the attitudes of nurses and technicians and head of the pressure chamber

	Attitudes of nurses and technicians working in the barochamber	Attitudes of the leader of the barochamber
Arguments about the competences and level of education of the nurses/ technicians who work in the pressure chamber are adequate for the provision of quality health care.	Through the survey, they highlighted their satisfaction with the level of competence	Through the survey, they highlighted the adequacy of competences and the level of education of nurses/technicians in the pressure chamber
The argument about further specialist training of nurses/technicians who work in the barochamber to develop the quality of health care provision.	Through the survey, they emphasized the importance of further specialist training	Through the survey, they emphasized the importance of further specialist training
Argument about the importance of introducing a mandatory course on hyperbaric medicine during undergraduate/graduate studies in nursing	Through the survey, they pointed out extremely important	Through a semi-structured interview, they expressed their views on exceptional importance

Source: Own research

The largest number of respondents of the part of the research carried out with nurses and technicians in the barochamber fully agree with the statement that specialist training would improve the knowledge and skills of the scope of work and the need to introduce a mandatory course on working in hyperbaric medicine. The self-assessment of the level of education for the provision of quality health care to patients in a pressure chamber is satisfactory, and they fully agree with the statement about the need to meet regularly once a year with other employees employed in pressure chambers in Croatia in order to share knowledge and experience (in the form of a congress).

The statistical package SPSS 23 was used in the further analysis. Spearman's correlation coefficients were calculated between the selected statements and the variables of age, gender, seniority, years of experience and workplace (private or public institution). The results are shown in the following table.

Table 4. Presentation of the correlation between selected statements and the variables of age, gender, length of service, years of experience and workplace of the survey of nurses and technicians

Variable	1	2	3	4	5	6	7	8
1 Sex	-							
2 Age	-.37	-						
3 Seniority	.08	.30	-					
4 Level of education	.20	.06	.48*	-				
5 Workplace	-.23	-0.06	-.07	-.51*	-			
6 The role of specialist training	-,07	-.06	-.43*	-.23	.00	-		
7 The role of subsequent specialist training	.26	-.08	-.14	-.07	-.11	.72**	-	
8 Mandatory course on hyperbaric chamber	.52*	-45*	.08	.50*	-44*	..08	.34	-

*p<.05. **p<.01.

Source: Own research

According to the results, there is a statistically significant correlation between the opinion that specialist training would improve the knowledge and skills of the scope of work on the length of service variable (r=-.43, p<.05). There is also a statistically significant relationship between the opinion that subsequent specialist training is important and the opinion variable that specialized training would improve the knowledge and skills of the scope of work (r=.72, p<.01). The opinion

that a compulsory course on working in a hyperbaric chamber is required during studies is statistically significantly positively correlated with the variables of gender (r=52, p<.05) and level of education (r=50, p<.05) and statistically significantly negatively correlated with the variables of age (r=-.45, p<.05) and type of workplace (r=-.44, p<.05).

Table 5. Presentation of correlations between variables in the head of the barochamber

Variable	1	2	3	4	5	6	7
1 Sex	-						
2 Age	-,49	-					
3 Seniority	,47	,29	-				
4 Level of education	-,47	,49	,07	-			
5 Workplace	-,15	,11	-,08	-,53	-		
6 The role of specialist training	-,15	.11	-,08	-,53	.43	-	
7 The need for a center of excellence and bases for specialist training	-,29	,14	-,29	,29	,43	,43	-

*p<.05. **p<.01.

Source: Own research

No statistically significant correlations between the variables were observed in the head of the barochamber.

4. NUMBER AND DISPERSION OF NURSES AND TECHNICIANS IN CROATIA

Nurses and technicians are the most numerous group of health workers, numbering 32,464, which is 43.0% (table 6) of the total number of employed health workers, and they play a central role in the provision of health care and are a key element of any patient-oriented health system. In the structure of the total number of employed health care workers, the largest share is those with an intermediate level of professional education, 43.6%, the share of those with a high level of professional education is 34.6%, higher education 20.8% and lower level professional education 1.0%. In Croatia, there is an increase from about 4.5 to 6.8 nurses per 1,000 inhabitants, while a negative natural increase and external migration balance are recorded in the same observed period. Table 9 shows the number of health workers with professional education in the system in the period from 1995. to 2023. and the total number by county in 2023. in Table 8, which shows that the number of employees with secondary vocational education stagnates, since a large part decides to continue their education, while the number of those with a university degree has equaled the number of doctors, which was 15,863 in 2022, and 16,374 in 2023 (Croatian health - statistical yearbook).

Table 6. Total number of healthcare professionals employed in state and private healthcare institutions

Year	2023.	2020.	2010.	2000.	1995.
High vocational education	2 760	2 127	1079	760	725
Higher vocational education	16 769	14 169	9051	6 681	6 159
Secondary vocational education	32 620	33 150	32925	28 164	25 030
Lower vocational education	830	699	460	648	717
TOTAL healthcare workers	76 872	72 929	63 143	51 682	47 735
Number of inhabitants per 1 healthcare worker	50	55	70	38	101
Number of inhabitants per 1 employee with secondary education	118	122	135	152	192

*Fixed and indefinite contracts.

Source: Author's analysis based on Croatian Institute for Public Health (1995, 2000, 2010, 2020, 2023)

Table 7. Number of nurses and technicians employed in healthcare institutions

Degree of professional education	1995	2000.	2010.	2015.	2020.	2021.	2022.	2023.
High				256	373	436	565	718
Higher	3 258	3 139	3 789	6 161	8 554	9 230	9 501	10 016
Medium	15 707	15 529	17 702	25 060	24 774	24 472	24 084	23 672
TOTAL	18 959	18 668	21 491	31 701	33 701	34 138	34 150	34 406

Source: Author's analysis based on Croatian Institute for Public Health (1995, 2000, 2010, 2015, 2020, 2021, 2022, 2023)

Spatial distribution, i.e. the shares of graduates and masters of nurses and technicians by county, is expected according to the number of health institutions in the observed locations. The largest number is in the city of Zagreb, which has 13 hospital institutions and a total of 546 healthcare institutions, the Osijek-Baranja County has 2 hospitals and a total of 160, the Primorje-Gorski Kotar County has 7 hospitals and a total of 171, the Split-Dalmatia County has 2 hospitals and 297. the county is distinguished by a high number of graduates and masters of nurses and technicians since it has 2 hospitals and a total of 94 healthcare institutions.

Table 8. Presentation of the number of graduates, masters and university masters in nursing by county June, 2023

	Graduation nurses and technicians	Master of Nursing	University Master of Nursing	In total
Bjelovar-Bilogora County	6	43	5	54
Brod-Posavina County	6	121	14	142
Dubrovnik-Neretva County	19	44	3	68
City of Zagreb	178	880	160	1218
County of Istria	13	56	20	89
Karlovac County	6	68	15	89
Koprivnica-Križevac County	2	50	7	59
Koprivnica-Križevac County	25	61	11	97
Lika-Senj County	2	14		16
Međimurje County		78	14	92
Osijek-Baranja County	5	278	22	305
Požega-Slavonia County	4	77	4	85
Primorje-Gorski Kotar County	9	207	24	240
Sisak-Moslavina County	15	72	12	99
Split-Dalmatia County	10	129	20	159
Sibenik-Knin County	4	41	9	54
Varaždin County	18	121	19	158
Virovitica-Podravka County	5	29	10	44
Vukovar-Srijem County	5	72	11	88
Zadar County	9	52	23	84
Zagreb County	8	45	6	59

Source: Author's analysis based on data obtained from the Chamber of Nurses (2023)

5. EDUCATION OF NURSES AND TECHNICIANS

Career development opportunities for nurses and technicians can be through professional education organized by the employees' home institutions, by professional associations or nursing chambers, and at academic institutions such as faculties of health studies, university departments and health polytechnics in all major cities in Croatia (table 10). There are 25 high schools in Croatia (table 9), nursing studies used to be part of medical faculties, and the first faculty for the education of non-medical health personnel is the Faculty of Health Studies in Rijeka, founded

in 2014. There is an online course in nursing at the University of Health in Zagreb. University studies include the Faculty of Health Studies in Rijeka, the Faculty of Dental Medicine and Healthcare in Osijek, the Department of Health Studies in Zadar, the University Department of Health Studies in Split and the Croatian Catholic University in Zagreb. Private polytechnics are the Polytechnic in Bjelovar, Ivanić-Grad and the Croatian Catholic University in Zagreb. Enrollment quotas are 1366 places per year, of which 500 are regular, 866 are extraordinary, and the diaspora quota is 4. In 2024, 19 PhDs, 866 and 5 Masters of Science in Nursing were recorded in the register of the Chamber of Nurses.

Table 9. High schools for nurses in Croatia

High schools for nurses	**City**
School for nurses Vrapče	Zagreb
School for nurses Mlinarska	Zagreb
Vinogradska Nursing School	Zagreb
Bjelovar Medical School	Bjelovar
Dubrovnik Medical School	Dubrovnik
Medical school	Karlovac
Technical school Virovotica	Virovitica
Pula Medical School	Pula
Slavonski Brod Medical School	Slavonski Brod
Medical school	Šibenik
Varaždin Medical School	Varaždin
Ante Kuzmanić Medical School	Zadar
Health and veterinary school dr. Andrije Stampar	Vinkovci
Medical school Rijeka Rijeka	Rijeka
Split Health School	Split
Osijek Medical School	Osijek
Secondary school Čakovec	Čakovec
Secondary school Čakovec separate location county hospital Čakovec	Čakovec
Secondary school Bedekovčina	Bedekovčina
Secondary school in Maruševac with public rights	Maruševec
Secondary school Pregrada	Pregrada
Viktorovac High School	Sisak
Secondary school Koprivnica	Koprivnica
Vocational school Gospić	Gospić
Secondary school Pakrac	Pakrac
Ban Josip Jelačić Secondary Vocational School	Sinj

Source: Author's analysis according to Ministry of Science, Education and Youth (2024)

Specialist training is regulated by the ordinance *On specialist training of nurses and technicians* of 2009 based on Article 139, paragraph 2 and Article 140, paragraph 6 of the Health Care Act (Official Gazette, No. 150/08). Specialization or narrower specialization is a form of professional training. Specializations in the field of health care in nursing are: nurse - medical technician, specialist in emergency medical care, specialist in internal medicine, specialist in intensive care, specialist in surgery, specialist in pediatrics, specialist in psychiatry. Narrower specializations in the field of health care in nursing are: nurse - medical technician specialist in dialysis, specialist in oncology-hematology, surgery specialist, specialist in anesthesia and specialist in pediatric surgery. Specialization and various trainings in the domain of hyperbaric medicine are usually not carried out as basic but as additional education or sub-specialization.

Table 10. Representation of nursing study programs at Universities in Croatia

	Enrollment quotas - regular	Enrollment quotas - extraordinary	Croats abroad
University of Health in Zagreb	95	320	
Croatian Catholic University	41	45	1
Faculty of Health Studies - Rijeka	30	45	
Faculty of Health Studies - Karlovac		30	
Polytechnic in Šibenik	20	40	
University of Split	60	50	
Faculty of Dental Medicine in Osijek - Josip Juraj Strossmayer University in Osijek	20		
Faculty of Dental Medicine in Nova Gradiška - Josip Juraj Strossmayer University in Osijek		60	
Faculty of Dental Medicine in Pregrada Josip Juraj Strossmayer University in Osijek		60	
University of the North	60	40	2
Jurja Dobril University in Pula - MedPu	53	30	
University of Dubrovnik – Department of Professional Studies		25	1
Department of Health Studies, University of Zadar	54		
Polytechnic in Bjelovar	42	90	
Polytechnic Ivanić - Grad	22	30	

Source: Author's analysis according to Agency for Science and Higher Education (n.d.)

6. SALARY OF NURSES AND TECHNICIANS

Cumulatively, healthcare employees are among the best-paid professions, along with the finance and IT sectors. Despite the continuous increase in the number of employees in the system, the price of labor is still not falling. In the increases at the beginning of 2024, the growth of coefficients in healthcare is recorded. Table 11 shows the total number of jobs of workers with high, higher, middle and lower levels of professional education in the health care system with the associated job coefficients and the calculation of salary in euros.

Table 11. Presentation of the total number of jobs with associated job coefficients and calculation of salaries of nurses and technicians, in euros (March 2024)

Professional preparation	Workplace	Number of employees	Workplace coefficient	Salary
High vocational education	Ch. med nurse/teh clinic, clinical institute of unified emergency hospital admission	95	2,80	2 651
	Ch. med sister/the institution	236	2,68	2 537
	Ch. nurse/tech in organizational unit in clinical institution 1	1 623	2,10	1 988
	Ch. nurse of the unified emergency hospital admission service	17	2,68	2 537
	Ch. nurse/tech in the organizational unit in the clinical institution 2	32	1,95	1 846
	Master of Nursing in prevention, control and control of hospital infections	39	2,40	2 272
	Master of Nursing in Quality Assurance and Improvement zd. protection	55	2,40	2 272
	Master's degree in nursing in the field of invasive and specific diagnostic and therapeutic procedures	196	2,40	2 272
	Master of Nursing in the duties of the team leader of the operating block	18	2,40	2 272
	Master's degree in nursing in coordination of palliative care	32	2,40	2 272
	TOTAL	2 343		

Higher vocational education	Health care worker - bachelor's degree in hospital 1	10 126	1,90	1 799
	Health care worker - bachelor's degree in hospital 2	680	1,82	1 723
	Health worker - bachelor's degree in polyclinic	240	1,78	1 682
	Health worker - bachelor's degree in primary health care	2 069	1,78	1 443
	Health worker - bachelor's degree in public health	706	1,78	1 685
	TOTAL	13 821		
Secondary education	Nurse/tech specialist in emergency medicine	3	2,20	2 083
	Health associates 1	67	1,78	1 685
	Healthcare workers working with open sources of radiation	383	1,78	1 685
	Healthcare workers preparing antineoplastic drugs	403	1,78	1 685
	Health workers in the field of AIDS treatment	20	1,78	1 685
	Healthcare workers in the intensive care unit in surgery	6 497	1,78	1 685
	Health workers in the hospital 2	9 497	1,70	1 609
	Health workers in home care	248	1,63	1 543
	Healthcare workers in primary health care	3 409	1,53	1 448
	Health workers in polyclinics	347	1,53	1 448
	Health workers in public health	734	1,53	1 448
	TOTAL	18 199		
Lower vocational education	Caregiver	794	1,33	1 259
	Paramedic	439	1,33	1 259
	TOTAL	1 233		

Source: Author's analysis according to Vlada Republike Hrvatske (2024)

When comparing the job coefficient, it can be seen that a much higher level of education is needed in science than in healthcare for a better-paid job. For example, a position that requires a PhD, such as a senior assistant position, is similar to a position with a master's degree in nursing.

7. HUMAN RESOURCES IN HYPERBARIC MEDICINE

In Croatia, medicine is divided into basic medical sciences and clinical medical sciences. Hyperbaric medicine is not recognized as a special branch of medicine in Croatia, and the possible reasons are the regulatory framework or standards adopted by the Ministry of Health and the lack of specialists specializing in the branch, which is a direct consequence of the unavailability of education and insufficient popularization. Baro chambers in Croatia can be found in all regions, either privately in polyclinics or as part of KBC: Dubrava Clinical Hospital in Zagreb, KBC Rijeka has the most modern baro chamber in the region that operates as part of the Institute for Underwater and Hyperbaric Medicine, the Institute for Maritime Medicine in Split operates in cooperation with the Ministry of Defense and it was closed for a long time. Tables 12 and 13 show the number of human resources in hyperbaric medicine in public and private institutions. Some of the private polyclinics offer the possibility of using them with a referral from the HZZO, and almost all of them record an increase in the number of employees, so we conclude that it is a profitable activity with satisfactory demand.

Table 12. Presentation of human resources in public institutes for hyperbaric medicine

	Number of human resources
Dubrava Clinical Hospital	6
Institute for Underwater and Hyperbaric Medicine within KBC Rijeka	10-13
Institute of Maritime Medicine Split	10

Source: Own research

Specialization in hyperbaric medicine is globally carried out after completing formal higher education at medical faculties or through specialized programs in hospitals and medical centers within hospital

institutions and by professional associations and associations. The Croatian Society for Hyperbaric Medicine of the Croatian Medical Association was founded in Zagreb in 2016 and aims to develop and improve hyperbaric medicine in Croatia. The company provides guidelines for the work of all those in Croatia who deal with or want to deal with the application of Hyperbaric Oxygen Therapy in patient care based on the principles of good clinical practice and a high level of safety. On April 5, 2024, the Institute for Underwater and Hyperbaric Medicine of the Rijeka Clinical Hospital Center, in cooperation with the Croatian Society of Anesthesia, Reanimation, Intensive Care and Transfusion Nurses, which includes the Committee for Hyperbaric Medicine and the Faculty of Health Studies of the University of Rijeka, organized 1 Symposium of hyperbaric nurses and technicians.

Table 13. Presentation of human resources in private institutions for hyperbaric medicine

	2019	2020	2021	2022	2023	Possibility via HZZO referral
Polyclinic OXY	14	12	13	16	18	Yes
Polyclinic of Hollister	2	3	5	9	10	Not
Polyclinic Marin Med	35	43	45	60	49	Not
Polyclinic Slavonija Osijek	15	12	16	19	22	Yes
Polyclinic Rakovac	3	5	5	6	6	Not
Polyclinic Marija	13	10	9	11	10	Yes
EO2 Polyclinic	No employees					Not

Source: Author's analysis according to Fina (2024)

8. CONCLUSION

Personnel management in healthcare with an emphasis on the career development of nurses and technicians is based on strategic documents. The career development of nurses and technicians is a continuous lifelong education that should be developed with a focus on professional development in certain branches, i.e. areas in medicine, in order to strengthen efficiency. The products of the development strategies have made it possible for the offer of jobs in healthcare to be satisfactory and the number of employees to continuously grow, described by the high coefficients of jobs that are accompanied by income growth as well as many educational opportunities at all universities in Croatia. Development in a qualitative approach such as specialization in hyperbaric medicine imposes the next logical step in the advancement of the profession. Hyperbaric medicine offers wide possibilities of application in the treatment process that are not yet sufficiently developed in our country, which is an argument for shaping specialization to develop specific skills and knowledge. Specialist training of barochamber staff is important for ensuring high-quality patient care and efficient management of hyperbaric treatments. The specialist training of barochamber workers will contribute to the further development of the area for which all studies as well as the empirical research of this paper indicate a great potential for development and expansion of application possibilities in treatment approaches. Specialist training of nurses and technicians in hyperbaric medicine will have an impact on the effectiveness of the observed segment in healthcare.

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The Impact of Migration on the Labor Force, Case of Albania

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Keywords:
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Abstract: *Migration is a normal human activity that affects the population of a country. The rate of emigration in Albania after 1990, in relation to the total population, has been the highest in Europe, while the flow of returned migrants has been limited.*

This study deals with the impact of migration on the labor force. For this, secondary data have been collected from official data institutions related to migration and labor forces (INSTAT, EUROSTAT, WORLD BANK, OECD, etc.).

In this paper it is shown that the unemployment rate by age group is generally decreasing. Meanwhile, an increase in the rate of migration is observed in recent years. As a result of the study, it was found that the majority of Albanians intend to migrate to countries such as Germany, Italy, Great Britain, the United States of America, the Nordic countries, Switzerland, France, Spain, Belgium, etc. In previous years, Albanians have been inclined to migrate to neighboring countries such as Italy and Greece, and the main reason for migration has been the financial situation they were in, so mainly economic factors. In recent years, there has been a trend of younger age groups to migrate, and mainly individuals that are qualified in the fields of medicine, IT, economy, etc. At this moment, this has a positive impact on the workforce as the unemployment rate in Albania is decreasing, but on the other hand, it is expected that in the near future there will be shortages in the labor market for these two important areas, if the flow of migration will continue at the same rate.

1. INTRODUCTION

Migration is a normal, human activity, which significantly affects the population and economy of a country. Every year, millions of people leave their homes and migrate to other countries to find a better job and to ensure a better and safer future for their families.

Higher wages and better opportunities are some of the reasons for many individuals to migrate, but many others are forced to migrate due to famine, natural disasters, persecution or simply the lack of decent work in their home country.

Like other countries, Albania is also affected by this phenomenon. Since the beginning of the transition, a high intensity of migration was observed, which has brought an imbalance in the population and especially in the labor force, even though the remittances of immigrants have made a substantial contribution to the GDP structure and have provided support great for the survival and progress of many Albanian families.

Labor migration has a significant impact on the national economy of a country. Labor force is the most important resource of any country. The economy of a country cannot grow and develop without labor force (Arbidane & Markevica, 2016).

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After the 1990s, the rate of migration in relation to the Albanian population has been the highest in Europe, while the flow of returned migrants has been limited. Migration was mainly to neighboring countries such as Italy and Greece, as the two easiest places to reach through the land and sea borders. Later, migration spread to other countries such as Canada, USA, Germany, France, England and many other countries.

Based on the 2011 census, INSTAT (Institute of Official Statistics in Albania) calculated a net emigration of 481,000 Albanians for the decade 2001–2011, and from the 2023 census, the net migration outside Albania for the decade 2012-2022 is 457,038 (table 1).

Table 1. Net Migration in Albania (2012-2022)

	Emigrants	Immigrants	Net Migration
2012	52.307	32.534	-19.773
2013	49.425	28.624	-20.801
2014	46.525	24.74	-21.785
2015	41.443	20.843	-20.6
2016	32.533	23.06	-9.473
2017	39.905	25.003	-14.902
2018	38.703	23.673	-15.03
2019	43.835	20.753	-23.082
2020	23.854	7.17	-16.684
2021	42.048	9.195	-32.853
2022	46.460	13.963	-32.497
Total	457.038	229.558	-227.48

Source: INSTAT (2023a)

A joint study conducted by INSTAT & IOM (2020) estimated that net migration outside Albania was 364,034 people in the period 2011–2019.

According to an article published in 2004, (Barjaba, 2004) the main driving factors that influence migratory decisions and experiences are unemployment and poverty. Table 2 shows the labor force participation rate and unemployment rate by age groups, for years 2018-2023. From the table, it is shown that young people are an important part of the labor force, and also it is shown that the unemployment rate for this category is too high.

Table 2. Labor force participation and Unemployment rate by age group

	Labour Force participation rate						Unemployment rate					
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
15+	59,4	60,4	59,5	59,8	62,4	64,1	12,3	11,5	11,7	11,5	10,9	10,7
15-64	68,3	69,6	69,1	69,3	73,2	75,7	12,8	12,0	12,2	12,0	11,3	11,2
15-24	35,8	36,7	35,8	36,3	38,6	39,3	28,3	27,2	26,5	27,1	24,9	25,6
25-54	83,0	83,9	83,0	82,1	85,1	87,8	11,2	10,6	11,4	10,3	10,1	10,3
55-64	63,7	65,2	64,6	66,3	73,2	75,5	8,6	7,4	6,7	9,6	7,9	7,1
65+	14,5	15,6	15,1	17,2	15,5	16,6	1,0	1,0	0,9	2,4	4,4	1,5
20-64	74,8	75,9	75,3	75,1	79,1	81,7	12,4	11,6	12,0	11,7	11,1	11,0
25-29	78,3	82,0	81,1	80,6	84,1	86,3	18,4	16,7	16,6	16,0	17,5	19,6

Source: INSTAT (2023b)

Other driving factors on migration provided by existing literature include poor living conditions, lack of individual security and political security (De Soto et al., 2002). Conversely, hope for a better future and prospects in host countries are key pull factors influencing international migratory

experiences. The perspectives sought range from education, and employment, to the overall quality of life for the individual migrant and his or her family (King & Vullnetari, 2003; Barjaba, 2004).

Migration of young people, reproductively active age groups and brain drain is a concern. In recent years, there has been a significant increase in young people migrating to developed countries, especially those who are well-educated and qualified, mainly in the fields of medicine, IT, economics and engineering.

The purpose of this study is to highlight the current trend of migration of Albanians, where they migrate and how migration affects the labor force, to look at the relationship between migration, the unemployment rate and the migration of young individuals, an important part of the country's labor force.

2. LITERATURE REVIEW

Migration is a complex phenomenon that involves various factors such as economic opportunities, political instability, environmental changes, and human rights violations (Jana, 2019). Migration can affect the socio-economic integration of immigrants, potentially disrupting the socio-demographic balance experienced by native residents (Schmitt et al., 2023). The causes of migration are very complex and different social sciences explain them in their ways (Boyle et al., 1998; Massey, 1993). Economic studies only describe how migration has affected a specific division of the labor market, while literature reviews provide a general picture of the state of knowledge. What is needed now is an analysis of how specific labor markets affect migration, as well as an explanation of how migration affects these labor markets (Manoj Dias-Abey, 2021).

2.1. Migration in Albania

In Albania, before 1990, migration was strictly regulated. The transition period brought extraordinary waves of emigration and dynamic migratory movements which were influenced by economic, political and social factors (Vullnetari, 2014). During the 2000s, emigration was mostly towards Italy, and Greece, but also across the Atlantic, which was mainly related to family reunifications of families already settled in these countries before. During the years 2011-2020, again the factors related to the family but also the economic ones remained the main ones, although at a weaker level; but other factors came into play, such as children's education and the lack of prosperity in Albania. Thus, once again Italy and Greece are at the top of the list, but Germany, and the countries of the West and the USA are already target countries for Albanians. (Gëdeshi & King, 2018). Similar results have been achieved by a project developed at the Faculty of Economics, University of Tirana (during 2023-2024 academic year), for the perception of students on migration. They have mentioned as favorite destinations the Nordic countries, Spain, Switzerland, Belgium, Germany, USA, United Kingdom, Italy, Greece, etc. This shift in the migration territory has positive effects in socio-economic terms, but also negative effects in terms of the loss of human capital (Gëdeshi & King, 2018).

Since 2013-2014, the Albanian labor market has strengthened through increased labor force participation and employment rates, reducing unemployment. The increase in the number of migrants has impacted the country's unemployment rate, which is at high levels even though since the post-socialist transition period, it fell from 15.9% in 2013 to 11.3% in 2021. The number of over one million Albanian-born migrants living in the world means a large number of people have left the Albanian labor market. This, in addition to serving the aspirations of the migrants themselves,

has in turn reduced unemployment in the country. According to INSTAT publications and data from the "Labor Force Survey", it can be seen that during the years 2018-2022, the unemployment rate has decreased for all persons aged 15-29. The unemployment rate for the 15-29 age group during 2022 was 24.9%. Compared to the previous year, the unemployment rate for this age group decreased by 2.2 percentage points. During the third quarter of 2023, the labor force participation rate for young people aged 15-29 is 57.5%. This indicator has increased by 2.6 percentage points, compared to the third quarter of 2022, and has increased by 0.8 percentage points compared to the second quarter of 2023 (INSTAT, 2023a). Unemployment is significantly higher among young people who have completed higher education (32.5%), compared to those who have completed secondary education (24%) and primary education (21.5%) (INSTAT, 2022).

3. METHODOLOGY

The methodology in this study is divided into two parts. The first part is based on a thorough literature review of migration in general and migration as a phenomenon that affects the labor force. A special case in this study is the case of Albania, which has had increasing migration flows, both for employment reasons and for other reasons as they have transformed in recent years, to increase the standard of living in another country. In a study project developed during 2023 and completed in May 2024, at the Faculty of Economics, University of Tirana, regarding the tendency of young people to migrate, a questionnaire was designed for students, to precisely measure their perception of migration. The questionnaire was distributed to several public and private universities and the results of the questionnaire show that students of different study cycles tend to migrate abroad, and the main reasons for migration are mainly related to difficulties and inequalities in employment, education not of the right quality, in the destination countries they think that employment is easier and with better salaries, providing themselves and their families with better living conditions and standards. Also, concerning education, there are fields of study that are not applied in Albania, while in other countries they are, which pushes students to decide to migrate for education and qualification in these countries.

The second part of the methodology refers to the analysis of data obtained from the World Bank on Albanian migration, active labor force, unemployment, etc.

Regression models and correlation analysis between variables have been built. The variables considered are of interest for the study. Among them, we mention net migration, unemployment rate, active labor force and especially young age. Also, data from the OECD on Albanian migration to OECD countries have been used and the trend of their migration towards these countries has been analyzed.

4. ANALYSIS AND FUTURE RESEARCH DIRECTIONS

Based on INSTAT data on net migration (table 1), an increase in net migration is observed over the years. The exception is the year 2020, which corresponds to the COVID-19 pandemic, a period in which people were forced to limit their movements.

In the above-mentioned project, a project developed at the Faculty of Economics, University of Tirana, a questionnaire was distributed to analyze the expectations of Albanian students for the future, whether they want to migrate or not, where they want to migrate, why they want to migrate, etc. Most of the students surveyed expressed that they wanted to migrate outside the territories of Albania. These students were mainly students in the fields of IT, economics, and engineering. A

similar questionnaire was distributed in another work to students of the University of Medicine. The results are similar. Most of them again expressed that they want to migrate. The reasons are numerous, starting from education, inequality in the labor market, the inability to specialize in the desired field, the standard of living, etc. Developed countries are seen as preferred destinations for young Albanians. They believe that in these countries they will be able to find their space and opportunities to develop professionally, feel more secure in their lives, and also, they can find the job they want with a much better salary than in Albania.

On the one hand, this is a good thing for them and the host country. In many countries (like Germany) the labor market has labor shortages in some fields, such as medicine, engineering, IT, etc. If Albanians migrate to these countries, part of the labor force in these countries is filled. But, on the other hand, the damage caused to Albania is great. The current migration trend creates major demographic imbalances. Since young people migrate more, the birth rate is significantly reduced and as a result, after a few years there will be no more young people in Albania or there will be very few, and the population will be mainly elderly (Figure 1). Also, in terms of labor, after a few years, Albania is expected to have shortages in medicine, engineering, economics, IT, and more. There are also many other professions, manual labor, which also have obvious shortages.

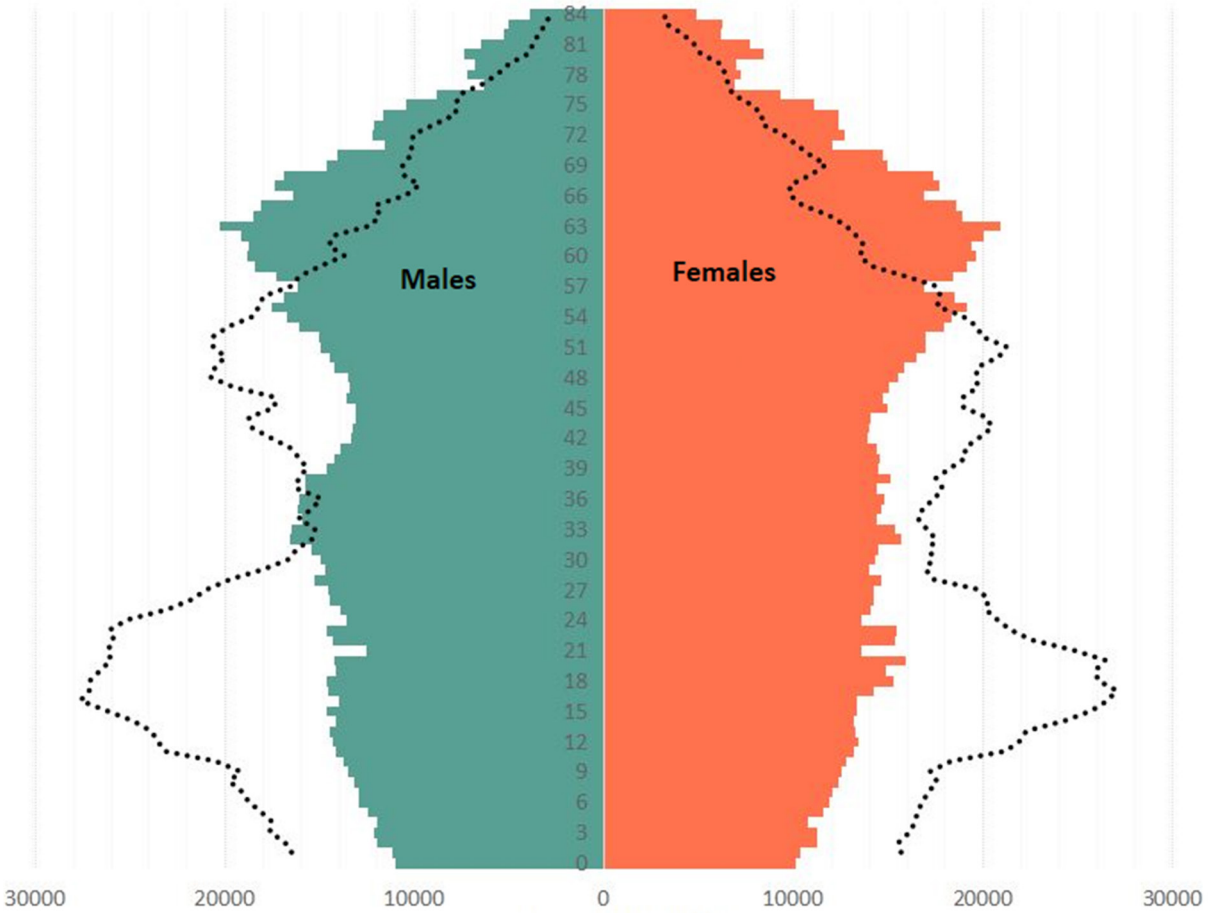
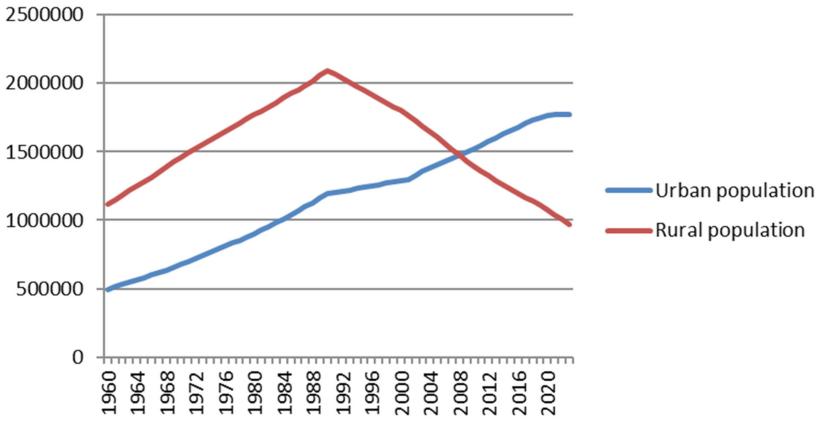


Figure 1. Population pyramid according to the 2023-2011 Census

Source: INSTAT (2023a)

Referring to the data on the official website of the World Bank, starting from 1960 until 2023 (Graph 1), it is noted that after the 1990s, the population in rural areas has been decreasing, this is because part of the population of these areas has moved to urban areas and part has emigrated abroad.



Graph 1. Population in urban and rural areas in Albania by year
Source: World Bank (2016)

Continuing with this trend of population movement, in many villages there are no more residents, or there are very few and they are mainly elderly, since the rest of the family members have moved to other places mainly for employment purposes.

Migration as a phenomenon in Albania can be seen in two aspects. On the one hand, the increase in the number of individuals who migrate brings population imbalances from a demographic point of view, since those who emigrate are mainly young, of reproductive age, but on the other hand it brings a decrease in unemployment in the country, since many individuals who have not been able to find a suitable job in Albania, have had the opportunity to find it outside the territory.

To see if there is any relationship between net migration and the unemployment rate in the country, a regression model was constructed:

$$\text{Net migration} = a \times \text{Unemployment} + b$$

According to the model analysis (tables 3 and 4), using a series of 33 data taken from the World Bank database (the data belong to the period from 1991 to 2023), a correlation coefficient of -0.56 results and the p-value for the significance of the regression model is 0.000703, less than 0.05. This means that the model is significant and there is a linear relationship between net migration and unemployment in the country. Since net migration is negative, since more individuals emigrate than immigrate to Albania, the correlation coefficient also results to be negative. Looking at the model coefficients, we can say that the increase in net migration brings a decrease in the unemployment level in Albania.

Table 3. Regression analysis of Net migration and Unemployment rate

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	12126.65775	13890.01	0.873049	0.389349
X Variable(Unemployment rate)	-3160.281008	839.9251	-3.76258	0.000703

Source: Own research

Table 4. Correlation between Net migration and Unemployment rate

	Net migration	**Unemployment rate**
Net migration	1	
Unemployment rate	-0.55992	1

Source: Own research

A significant relationship is also observed between net migration and the labor force rate of the 15-24 age group (table 5). Calculating a correlation coefficient for data from the period from 1991 to 2023, its value is -0.88872, very close to the number -1, which means that the relationship between these two variables is strong and in the negative direction. Therefore, the increase in net migration brings a decrease in the labor force at the younger age.

Table 5. Correlation between Net migration and Labor force participation rate for ages 15-24

	Net migration	Labor force participation rate for ages 15-24, total (%)
Net migration	1	
Labor force participation rate for ages 15-24, total (%)	-0.88872	1

Source: Own research

This result further reinforces the analyses carried out in other works by other authors, that the number of young people who are emigrating is increasing.

But where do these young people go? What are the preferred destinations of young people to emigrate?

Referring to data obtained from the OECD's International Migration Database, an increase in the number of Albanians emigrating to countries such as (excluding 2020, which corresponds to the period of the COVID-19 pandemic and mobility was limited) is noted: Austria, Belgium, Canada, USA, France, Germany, Italy, Switzerland, the Nordic countries, Luxembourg, Holland, etc.

5. CONCLUSION

Reviewing the literature, we see that the migration flow of Albanians increases year after year. This result is divided into two views, positive and negative. Positive because the departure of the unemployed has reduced the unemployment rate, and negative because many young and educated people have recently left, which will bring gaps in some professions but also a demographic imbalance in the population.

Preferred destinations for Albanians are countries like: Nordic countries, Spain, Switzerland, Belgium, Germany, USA, United Kingdom, Italy, Greece, etc.

There is a relationship between migration and unemployment rate, migration and labor force, unemployment rate and labor force. The increase of migration, decreases the unemployment rate and the labor force participation rate.

It should be noted that the results are not the same in other countries or using other time series. The literature suggests that unemployment in different countries or even for the same country but in different periods, may or may not be an important factor in migration.

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Tacit Triggers of Entrepreneurial Activity: Limitations of Current Theories

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Abstract: *Entrepreneurial activity is often influenced by tacit knowledge—unarticulated, experience-based insights—yet current theories primarily focus on rational decision-making models. This paper aims to address the limitations of these models by exploring the role of tacit triggers, such as intuition, cultural influences, and emotional factors, in entrepreneurial decision-making.*

The study reviews existing literature to identify key gaps, including an overemphasis on cognitive frameworks, insufficient consideration of social and cultural contexts, and a lack of focus on emotional and psychological triggers. Additionally, it examines the undervalued role of failure and the limited integration of technological change in existing theories.

Methods *include a critical review of key academic papers and books, drawing on insights from entrepreneurship theory, cognitive science, and knowledge management. The study synthesizes these perspectives to propose a more comprehensive understanding of tacit triggers in entrepreneurial activity.*

Results *show that current theories are overly reliant on rational models, which fail to account for the intuitive and non-cognitive dimensions of entrepreneurial action. The review highlights the need for greater attention to cross-cultural variations, emotional resilience, and the role of failure as a learning tool.*

Conclusion: *To better understand the complex nature of entrepreneurship, future research should expand beyond rational models to include the emotional, social, and cultural dimensions of tacit knowledge. Moreover, there is a need for further exploration of how digital tools and technological advancements are reshaping the way entrepreneurs acquire and utilize tacit knowledge.*

This paper calls for more interdisciplinary research that integrates psychological, cultural, and technological factors into theories of entrepreneurial decision-making.

1. INTRODUCTION

Entrepreneurship, broadly defined, involves the identification, evaluation, and exploitation of opportunities to create value through the establishment of new ventures or the expansion of existing ones. It is a process that combines innovation, resource mobilization, and risk-taking in the pursuit of profit or impact (Shane & Venkataraman, 2000; Kirzner, 1997). Central to this process is knowledge, both explicit and tacit. While explicit knowledge refers to codified information that can be easily communicated, tacit knowledge is personal, context-specific, and difficult to formalize (Polanyi, 1966; Nonaka, 1994). Tacit knowledge includes skills, insights, and experiences that individuals draw upon in entrepreneurial decision-making, often without conscious awareness (Grant, 1996; Spender, 1996).

A growing body of research highlights the importance of tacit knowledge in entrepreneurial activity, particularly in the process of opportunity recognition (Shane, 2000; Ardichvili, Cardozo, & Ray, 2003). However, what remains less understood are the specific mechanisms—referred to here as

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tacit triggers—that activate this knowledge and lead to entrepreneurial action. Tacit triggers are the subtle, often unconscious cues or insights that prompt individuals to recognize opportunities or make entrepreneurial decisions. These triggers may stem from past experiences, intuition, or an individual's unique interaction with their environment (Gaglio & Katz, 2001; Baron, 2006). Unlike explicit decision-making processes that can be easily articulated and modeled (Mihaylov, 2020; Mihaylova, 2023), tacit triggers operate in the background, influencing behavior in ways that are difficult to observe or measure.

Understanding tacit triggers is essential for a deeper comprehension of entrepreneurial decision-making. While much of the existing literature focuses on rational, explicit decision-making models, recent studies suggest that tacit factors play a significant role in shaping entrepreneurial behavior (Dimov, 2010; Kautonen et al., 2013). Research has demonstrated that entrepreneurs often rely on intuition or "gut feelings" when identifying opportunities, especially in uncertain environments where information is incomplete or ambiguous (Sadler-Smith, 2016; Dutta & Crossan, 2005). Despite this, current entrepreneurial theories provide limited explanations for how tacit knowledge and its triggers influence the entrepreneurial process.

This research gap is particularly evident in opportunity recognition models, which tend to emphasize the role of explicit knowledge and deliberate search processes (Shepherd & DeTienne, 2005; Sarasvathy, 2001). While these models have been instrumental in advancing our understanding of entrepreneurship, they do not adequately account for the more subtle, tacit factors that drive entrepreneurial action. Studies on entrepreneurial cognition have begun to address this limitation by examining the role of heuristics and mental shortcuts, but a more systematic exploration of tacit triggers is needed to fully understand the decision-making processes of entrepreneurs (Mitchell et al., 2002; Krueger, 2007).

In light of these limitations, this paper aims to explore the concept of tacit triggers and their role in entrepreneurial activity. Drawing on the work of Polanyi (1966) and Nonaka (1994), as well as recent advancements in entrepreneurial cognition research, it seeks to fill the gap in current theories by offering a more nuanced understanding of the entrepreneurial process. By integrating insights from both tacit knowledge and entrepreneurial decision-making, this paper will contribute to the ongoing development of a more comprehensive theory of entrepreneurship.

2. LITERATURE REVIEW

2.1. Tacit Knowledge in Entrepreneurial Activity

Tacit knowledge, originally conceptualized by Polanyi (1966), refers to unarticulated, experience-based knowledge that is difficult to formalize or communicate. In entrepreneurship, tacit knowledge plays a critical role in shaping decision-making processes, opportunity recognition, and innovation (Nonaka, 1994; Grant, 1996). Unlike explicit knowledge, which can be codified and transferred easily, tacit knowledge is deeply personal and often remains subconscious, influencing entrepreneurs' actions in ways that are not fully understood or captured by traditional theories (Spender, 1996; Sternberg et al., 1993).

A significant body of literature has explored the role of tacit knowledge in entrepreneurial activity. Entrepreneurs often rely on intuitive judgments, derived from experience and expertise, when making critical business decisions (Sadler-Smith, 2016; Dane & Pratt, 2007). These intuitive processes, while difficult to quantify, are central to entrepreneurship, where uncertainty and

ambiguity are the norms (Baron, 2006; Dimov, 2010). For instance, entrepreneurial decision-making in high-uncertainty contexts frequently draws on tacit knowledge, as explicit data or formal analysis may be insufficient to guide action (Shane, 2000; Sarasvathy, 2001). This tacit dimension helps entrepreneurs identify patterns and opportunities that are not immediately apparent through rational analysis alone (Gaglio & Katz, 2001; Ward, 2004).

One key area of focus in the literature is the contrast between tacit knowledge-based decision-making and traditional cognitive models. Cognitive models in entrepreneurship have traditionally emphasized deliberate, rational, and analytical processes for decision-making, rooted in explicit knowledge and conscious problem-solving (Mitchell et al., 2002; Krueger, 2007). However, studies have increasingly recognized that these models fail to capture the full spectrum of entrepreneurial cognition, particularly in situations requiring quick, instinctive responses (Corbett, 2005). Tacit knowledge often fills this gap by allowing entrepreneurs to act based on "gut feelings" or intuitive insights, which emerge from years of experience but are difficult to articulate or justify through conventional frameworks (Klein, 1998; Kautonen et al., 2013).

In entrepreneurial practice, tacit knowledge becomes particularly relevant in the identification of opportunities. While much of the opportunity recognition literature focuses on explicit knowledge and deliberate search processes (Shane & Venkataraman, 2000), there is a growing recognition of the role played by tacit knowledge in this process. Entrepreneurs often "connect the dots" based on personal experience, intuition, and contextual knowledge, which are all facets of tacit knowledge (Baron, 2006; Ardichvili et al., 2003). This ability to intuitively recognize opportunities is not always captured by traditional models, which tend to prioritize structured search and rational evaluation (Sarasvathy, 2001; Shepherd & DeTienne, 2005).

In light of these insights, it becomes clear that tacit knowledge is an essential but underexplored element of entrepreneurial decision-making. Current theories, while useful in explaining explicit knowledge processes, often overlook the intuitive, experience-driven aspects of entrepreneurship that arise from tacit knowledge (Dimov, 2010; Dutta & Thornhill, 2008). A more comprehensive understanding of entrepreneurship requires a closer examination of how tacit knowledge and its triggers influence decision-making, especially in uncertain and dynamic environments.

2.2. Triggers of Entrepreneurial Activity

Entrepreneurial behavior is influenced by a variety of factors, both external and internal, that collectively shape the decision-making process and drive entrepreneurial action. These factors include social networks, market gaps, mentorship, as well as cognitive and psychological dimensions that influence how entrepreneurs identify opportunities and take action.

2.2.1. Social Networks

Social networks play a critical role in entrepreneurship by providing access to information, resources, and opportunities that would otherwise be unavailable. The concept of weak ties, introduced by Granovetter (1973), emphasizes the importance of informal and distant connections in disseminating new information and creating entrepreneurial opportunities. Entrepreneurs leverage these social networks to identify gaps in the market, acquire resources, and form strategic partnerships (Aldrich & Zimmer, 1986; Burt, 2004). Networks provide access to both explicit knowledge and tacit insights from other individuals, facilitating the identification of opportunities and reducing uncertainty (Uzzi, 1997; Elfring & Hulsink, 2007).

Strong social networks can also offer emotional support, which helps entrepreneurs cope with the challenges and risks inherent in starting a new venture. The quality of these networks often determines an entrepreneur's access to critical resources and how quickly they can act on opportunities (Hoang & Antoncic, 2003; Jack, 2005). Additionally, networks offer a platform for social learning, where entrepreneurs observe the actions of others and adapt their own behaviors based on shared experiences (Burt, 1992; Stuart & Sorenson, 2007; Vunova, 2009).

2.2.2. Market Gaps

Entrepreneurs are often described as individuals who identify and exploit market gaps, defined as unmet or underserved needs within an industry or community (Shane & Venkataraman, 2000). Opportunity identification involves a combination of situational awareness, industry knowledge, and the ability to recognize patterns others may overlook (Gaglio & Katz, 2001). Theories of opportunity recognition suggest that entrepreneurs have an alertness to market gaps, informed by both tacit knowledge and explicit data (Kirzner, 1997; Baron, 2006).

Market gaps are often discovered through an entrepreneur's interaction with their environment, where experiential learning plays a significant role. By drawing on tacit knowledge accumulated over time, entrepreneurs are able to "connect the dots" between seemingly unrelated pieces of information to identify opportunities for innovation (Ardichvili et al., 2003; Sarasvathy, 2001). These insights often emerge from an individual's deep understanding of a particular market or sector, gained through immersion in industry-specific contexts (Shane, 2000).

2.2.3. Mentorship

Mentorship is another critical factor that influences entrepreneurial behavior. Mentors serve as role models, providing guidance, support, and access to both explicit and tacit knowledge (Deakins & Freel, 1998). Through direct interaction with mentors, entrepreneurs gain insight into industry-specific challenges, develop new skills, and receive feedback on their business strategies (St-Jean & Audet, 2012). Tacit knowledge is often transferred through mentorship, where experienced entrepreneurs impart practical wisdom that cannot easily be conveyed through formal education or training (Politis, 2005; Sullivan, 2000).

Mentors also play a crucial role in helping entrepreneurs navigate uncertainty, build resilience, and develop self-efficacy (Bosma et al., 2012). By observing and learning from the successes and failures of their mentors, entrepreneurs can refine their approaches to risk management and opportunity exploitation (Nabi et al., 2019).

2.2.4. Cognitive and Psychological Dimensions

While much of the existing research on entrepreneurial activity focuses on cognitive processes such as opportunity recognition and decision-making (Mitchell et al., 2002), there is a growing recognition of the importance of emotional and psychological triggers in entrepreneurial action. Factors such as risk tolerance, self-efficacy, and failure experiences are critical in shaping how entrepreneurs approach challenges and pursue opportunities (Krueger, 2007; Shepherd, 2003).

Risk tolerance refers to an individual's ability to accept and manage uncertainty and potential losses. Entrepreneurs are often characterized by a higher tolerance for risk, which enables them to take bold actions in pursuit of new ventures (Busenitz & Barney, 1997). Additionally, self-efficacy,

or the belief in one's ability to succeed, has been shown to significantly influence entrepreneurial intention and persistence (Bandura, 1997; Boyd & Vozikis, 1994). Entrepreneurs with high self-efficacy are more likely to engage in entrepreneurial activities, persist through challenges, and recover from setbacks (Chen et al., 1998).

Failure experiences also play a critical role in entrepreneurial development. Rather than discouraging future ventures, failure can enhance an entrepreneur's resilience and ability to adapt (Cope, 2011). Entrepreneurs who have experienced failure often develop a deeper understanding of risk, improved problem-solving skills, and a more refined sense of opportunity (McGrath, 1999). These psychological triggers—combined with mental models and intuition—are often grounded in tacit knowledge, allowing entrepreneurs to act decisively in the face of uncertainty (Dutta & Crossan, 2005).

Entrepreneurial activity is shaped by a complex interplay of factors, including social networks, market gaps, mentorship, and cognitive and psychological dimensions. While much of the existing literature focuses on explicit decision-making processes, it is clear that tacit knowledge, intuition, and emotional resilience are equally important in understanding entrepreneurial behavior. By recognizing the limitations of traditional cognitive models, future research can further explore how these tacit triggers influence entrepreneurial action.

3. LIMITATIONS OF CURRENT THEORIES

Entrepreneurship research has developed significantly over the years, with a focus on various cognitive and decision-making models. However, there remain notable gaps in understanding the tacit triggers that drive entrepreneurial activity. Below are the key limitations in current theories, which highlight the need for a more nuanced and holistic approach to entrepreneurship.

3.1. Overemphasis on Rational Decision-Making Models

Much of the literature on entrepreneurship has traditionally focused on rational decision-making models, such as opportunity recognition and resource allocation, often viewing entrepreneurs as rational actors making decisions based on available information (Shane & Venkataraman, 2000; Sarasvathy, 2001). These models emphasize explicit knowledge and logical reasoning, underplaying the role of intuition, experience, and tacit knowledge in entrepreneurial action (Busenitz & Barney, 1997; Mitchell et al., 2002).

However, in real-world entrepreneurial contexts, decisions are often made under conditions of uncertainty, where tacit knowledge, personal judgment, and intuition play a central role (Gigerenzer & Gaissmaier, 2011). Entrepreneurs frequently rely on "gut feelings" and experience-based insights that are difficult to quantify but essential for decision-making in ambiguous environments (Gaglio & Katz, 2001). Thus, the overemphasis on rational models fails to account for the complexity of human cognition in entrepreneurial activity (Dutta & Crossan, 2005).

3.2. Neglect of Social and Cultural Contexts

Current theories of entrepreneurship often overlook the social and cultural contexts that shape entrepreneurial behavior (Aldrich & Zimmer, 1986; Thornton et al., 2011). While network-based research highlights the role of social capital in providing access to resources and information (Burt, 1992; Granovetter, 1973), less attention has been paid to how tacit social knowledge—such as understanding cultural norms, interpersonal dynamics, and regional business practices—shapes entrepreneurial decisions (Jack & Anderson, 2002).

Entrepreneurs operate within specific cultural and societal frameworks, which influence how they perceive opportunities, take risks, and engage with stakeholders (Zahra et al., 2014). Social and cultural factors also affect the transfer of tacit knowledge, as entrepreneurs often learn from mentors, peers, and role models embedded within these contexts (Sullivan, 2000; Deakins & Freel, 1998). Neglecting these dimensions results in an incomplete understanding of entrepreneurial processes.

3.3. Emotional and Psychological Triggers

Entrepreneurial research has largely focused on cognitive aspects of decision-making, such as opportunity recognition and problem-solving while underplaying the significance of emotional and psychological triggers (Shepherd, 2003; Baron, 2008). Entrepreneurs frequently face high levels of uncertainty, stress, and risk, which require emotional resilience, risk tolerance, and self-efficacy (Krueger, 2007; Busenitz & Barney, 1997). The emotional states of entrepreneurs, such as passion, fear of failure, and psychological ownership, are crucial for understanding their motivations and actions (Cardon et al., 2009).

Additionally, the process of entrepreneurship is often deeply personal, with emotional experiences shaping the way entrepreneurs perceive opportunities and make decisions (Cope, 2011). Existing theories fail to adequately integrate these psychological and emotional dimensions, despite their clear importance in influencing entrepreneurial behavior and outcomes (Baron, 2008; Krueger, 2007).

3.4. Tacit Knowledge Transfer Mechanisms

The mechanisms through which tacit knowledge is transferred in entrepreneurial contexts are underexplored in current theories. While explicit knowledge can be easily documented and shared, tacit knowledge is inherently personal, experiential, and context-specific (Polanyi, 1966; Nonaka, 1994). It is often transferred informally through mentorship, observation, and direct experience, rather than through formal education or training programs (Politis, 2005).

Current entrepreneurial theories do not adequately address how tacit knowledge is exchanged within entrepreneurial ecosystems, such as through informal networks, apprenticeships, or immersive learning experiences (Sullivan, 2000; St-Jean & Audet, 2012). The reliance on formalized business models and cognitive frameworks overlooks the organic, unstructured ways in which entrepreneurs acquire and utilize tacit knowledge (Deakins & Freel, 1998).

3.5. Undervalued Role of Failure in Tacit Knowledge

Failure is an inherent part of the entrepreneurial process, yet its role in fostering tacit knowledge is often undervalued in existing theories (McGrath, 1999; Shepherd, 2003). Failure experiences can provide rich learning opportunities, helping entrepreneurs refine their mental models, enhance their problem-solving skills, and build resilience (Cope, 2011). The experiential knowledge gained through failure is often tacit, as entrepreneurs develop a more nuanced understanding of risk, timing, and market dynamics through trial and error (Sarasvathy, 2001).

Current models tend to focus on success factors and the traits of successful entrepreneurs, downplaying the iterative learning process that includes setbacks and failures (McGrath, 1999; Minniti & Bygrave, 2001). Recognizing the role of failure in tacit knowledge development is essential for a more comprehensive understanding of entrepreneurial learning.

3.6. Limited Integration of Technological Change

Technological change is a significant driver of entrepreneurial activity, yet its integration into entrepreneurial theories is often limited (Shane, 2000). While some theories acknowledge the role of innovation and technological disruption in creating new market opportunities, they often fail to explore how entrepreneurs develop tacit knowledge about emerging technologies (Sarasvathy, 2001). Entrepreneurs often build this knowledge through hands-on experimentation, tinkering, and engagement with technology, which is difficult to formalize or quantify (Von Hippel, 1994; Bower & Christensen, 1995).

The rapid pace of technological change means that entrepreneurs must constantly update their tacit knowledge to stay competitive, particularly in industries driven by digital transformation, artificial intelligence, and biotechnology (Autio et al., 2018). Current theories do not adequately address how entrepreneurs navigate these technological shifts and incorporate new tacit knowledge into their ventures (Audretsch, 1995).

The current theoretical landscape of entrepreneurship research presents several limitations, particularly in its treatment of tacit triggers. By focusing heavily on rational decision-making models and neglecting the emotional, social, and cultural dimensions of entrepreneurship, existing theories fail to capture the full complexity of entrepreneurial behavior. Additionally, the undervaluation of failure as a source of learning, the incomplete understanding of tacit knowledge transfer mechanisms, and the limited integration of technological change highlight key areas where future research is needed to advance the field.

4. DISCUSSION

Current entrepreneurial theories exhibit gaps in understanding the tacit triggers driving entrepreneurial activity. This discussion explores these limitations and proposes future research directions to deepen our comprehension of entrepreneurial processes.

Reassessing Rational Decision-Making Models. Traditional entrepreneurship models emphasize rational decision-making in opportunity recognition, resource allocation, and risk assessment (Shane & Venkataraman, 2000). However, they often overlook intuition and tacit knowledge, which are crucial in uncertain environments. Entrepreneurs rely on experience and subconscious insights to navigate incomplete information (Gigerenzer & Gaissmaier, 2011). Future research should focus on integrating these non-codifiable elements to better represent entrepreneurial cognition (Dutta & Crossan, 2005).

Incorporating Social and Cultural Contexts. Entrepreneurial action is shaped by social networks and cultural contexts, yet these influences are often downplayed in favor of individualistic models (Aldrich & Zimmer, 1986). Connections within communities transfer tacit knowledge, offering mentorship and informal learning opportunities (Sullivan, 2000). Scholars need to examine how cultural norms and social networks impact the perception and action on opportunities, enriching our understanding of entrepreneurship within a social framework (Jack & Anderson, 2002).

Addressing Emotional and Psychological Triggers. Entrepreneurs encounter high uncertainty, making emotional intelligence and resilience critical (Baron, 2008). Emotions such as fear, passion, and the experience of failure influence entrepreneurial persistence or withdrawal (Cardon et al., 2009). Recognizing these as tacit aspects of decision-making could provide a fuller view of entrepreneurial behavior (Cope, 2011).

Exploring Tacit Knowledge Transfer Mechanisms. Tacit knowledge is challenging to formalize and typically passed through mentorship and hands-on experience (Polanyi, 1966; Politis, 2005). Current theories inadequately explain these informal learning methods. Future research should investigate how tacit knowledge is organically transferred in entrepreneurial settings to improve education programs that foster such skills (Sullivan, 2000).

Recognizing the Role of Failure in Tacit Knowledge Development. Failure, while often stigmatized, is essential for tacit knowledge development, as it forces entrepreneurs to reassess strategies and assumptions (McGrath, 1999). Future models could better incorporate failure-based learning to capture a holistic view of entrepreneurial knowledge (Cope, 2011).

Integrating Technological Change and Tacit Knowledge. Technological change requires entrepreneurs to gain tacit knowledge through continuous adaptation. However, theories rarely address how entrepreneurs develop insights into emerging technologies (Von Hippel, 1994). Emphasizing tacit learning in tech-driven contexts can enhance entrepreneurial theories and aid in understanding adaptation to disruptive innovations (Bower & Christensen, 1995).

In sum, to fully understand entrepreneurial activity, future research must address these gaps, especially regarding tacit triggers. Embracing social, emotional, and failure-based learning, along with technological advancements, offers a pathway to more holistic entrepreneurial models.

5. CONCLUSION

The exploration of tacit triggers in entrepreneurial activity has revealed significant limitations within current theoretical frameworks. Traditional entrepreneurship models, which emphasize rational decision-making, cognitive processes, and explicit knowledge, do not fully account for the complexities of how entrepreneurs navigate uncertainty, make decisions, and respond to dynamic environments. Tacit knowledge—derived from personal experiences, intuition, and social interactions—plays a crucial role in entrepreneurial action but remains underexplored in much of the existing research.

Key areas that require further investigation include the emotional and psychological dimensions of entrepreneurship, the social and cultural contexts that shape entrepreneurial behavior, and the mechanisms through which tacit knowledge is transferred, particularly through mentorship and failure. Additionally, the integration of technological change into entrepreneurial theory offers a promising avenue for understanding how entrepreneurs adapt to innovation and disruption through experiential learning and trial-and-error processes.

Recognizing the limitations of current theories allows for a more holistic understanding of entrepreneurship that goes beyond explicit knowledge and cognitive models. Future research should aim to incorporate the tacit dimensions of entrepreneurial activity, considering how intuition, emotional resilience, and social embeddedness contribute to entrepreneurial success. By addressing these gaps, scholars can develop more comprehensive theories that better reflect the realities of entrepreneurial decision-making in today's rapidly evolving business landscape.

In conclusion, understanding the tacit triggers of entrepreneurship requires a shift away from purely rational models towards a more nuanced framework that integrates both the explicit and implicit aspects of entrepreneurial action. This shift will enable researchers and practitioners to better support entrepreneurs in their decision-making processes and enhance their capacity to thrive in complex and uncertain environments.

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The Situation of Women in Leadership Positions in Slovenian Police

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Abstract: *This paper researches the position of women in leadership roles within the Slovenian Police. The authors research the current status of women in leadership positions and which leadership style is the most appropriate for law enforcement agencies. The purpose of this paper is to gather theoretical knowledge from the field of leadership in law enforcement and to determine whether women can lead just as effectively as men in this environment. While writing, multiple different methods were used, including the normative-dogmatic method, descriptive method and synthesis method. What the authors found out was that women are extraordinarily rare in Slovenian police leadership. They still face some troubles when going for promotion. Gender equality as stated under the Equal Opportunities for Women and Men Act is nowhere near achieved. It was also confirmed that women are just as capable and successful leaders in law enforcement as men are.*

1. INTRODUCTION

The Slovenian police is an independent body within the Ministry of Interior. It operates at three levels: the state level, the regional level and the local level. Organisationally this means Slovenian police is composed of General Police Directorate on the state level, of Police Directorates on the local levels and of Police stations on the local level. Slovenian police is led by the Director General of the Police. He or she also leads the General Police Directorate (Police a, n.d.). According to data published on the Slovenian Police website, as of 31 December 2023, the police employ a total of 8,162 people, of whom 2,252 are women. Out of the total 8,162 people, 7,083 are categorised as 'police officer', of whom 1,366 are women (Police b, n.d.; Čas & Podnar, 2024, p. 24).

The Slovenian legal order guarantees equality before the law through the Constitution of the Republic of Slovenia (URS). Discrimination on the grounds of sex is prohibited (URS, 1991, Art. 14). No one, not even the authorities, can or should interfere with human rights and fundamental freedoms arbitrarily and without legal justification (Pozderec & Kotnik, 2022, p. 191). The Constitution does dictate that how human rights and fundamental freedoms are exercised may be prescribed by law where the Constitution so provides or where the very nature of a particular right or freedom makes it necessary (Pozderec & Božjak, 2023, p. 8). However, the right to equality before the law should not be understood as an absolute equality of all persons, as this would be contrary to the general principles of justice (Strojan, 2005, p. 99). Taking into account our legal order, the police should be the first to respect all human rights and act against discrimination. Police officers must comply with the legal provisions in their work, so that the tasks are carried out professionally and legally (Pozderec & Čas, 2024, pp. 218 – 224). Following the above, Slovenian police should by its nature actively work to ensure equal treatment of its employees.

Although women do police a little differently than men, they do it successfully. They rely more on their communication skills rather than on their physical strength. They have many good qualities

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that help them to do police work well. Women are tactful in their work and people trust them. They are also a good reflection of the police organization as a whole, as they receive fewer complaints about their work from citizens. There is a need for women in the police (Flanagan, 2009, p. 14). This is particularly true in management or leadership structures, where the average number of female leaders is only between 1 and 3%. Such low representation creates a power dynamic that provides male police leaders with access and opportunities that are not necessarily available to female leaders. The difference between male and female leaders in this context lies in the dominance of men and in the common belief that men are better leaders than women. This automatically leads to a lack of respect for female leaders in the police (Gregory, 2023, p. 2, 3, 11, 12.). In her research, Podnar found that the Slovenian police employ around 18% female police officers, but they occupy only 3.6% of leadership positions (Podnar, 2024, p. 71). The Slovenian police itself states that the number of women working in police organisations is slowly increasing over time, while they are still significantly under-represented in certain areas of work (Police c, n.d.). Equality is guaranteed by law, but social reality does not always follow (Podnar, 2024, p. 9).

Article 5 of the Law on Equal Opportunities for Women and Men (ZEMŽM) defines two forms of discrimination, namely direct and indirect. Direct discrimination on grounds of sex exists when a person has been, is or could be treated less favourably than a person of the opposite sex in the same or similar circumstances because of his or her sex. Indirect discrimination on grounds of sex exists where, in similar or identical circumstances, apparently neutral provisions, practices or criteria place persons of one sex in a less favourable position, except where they are necessary, appropriate and justified based on objective facts unrelated to sex (ZEMŽM, 2002, Art. 5.). This law sets out specific and general measures to prevent discrimination and its consequences. The measures also aim to create equal opportunities in areas where the sexes are unequally represented. Under this law, the sexes are unequally represented when the representation of one sex in a particular field is less than 40%. (ZEMŽM, 2002, Art. 7; Čas & Podnar, 2024, p. 27). If we compare the 40% with the 18% of female police officers in the Slovenian police, we realise that there is still a long way to go to achieve gender balance in Slovenian police. It is no longer a way to achieve gender balance in police management positions, even if we count 18% as balanced (as Podnar did in her study).

2. LEADERSHIP IN LAW ENFORCEMENT

The leaders in law enforcement today are encountering one of the most challenging periods in policing history. From a broad perspective, organizations are under heightened pressure to reassess their methods while navigating a constantly evolving cultural, technological, and social environment. On the other hand, new police officers are entering the profession with different expectations regarding their roles and the leadership they seek. Some believe that leadership is an inherent trait rather than a skill that can be acquired through education, experience, and mentorship. Fortunately for law enforcement agencies nationwide and globally, police leaders are discovering that the competencies required for effective leadership are continuously evolving. The field of policing is, by its very nature, a discipline that must adapt to progress—police leadership follows suit (Fritsvold, n.d.).

Theory recognises many different leadership styles. It is also true that each leader leads in his or her own way. Among the most common are the transformational and transactional leadership styles (Motsamai, 2023, p. 2096). According to Kurt Lewin's theory, there are three main styles of leadership, namely authoritarian or autocratic, inclusive or democratic (also transformational), and passive or laissez-faire (Lewin et al., 1939, p. 272).

The autocratic style is characterized by no feedback and no discussion. Such leaders make all decisions themselves and demand that they be accepted and followed. This style of leading was most common in police organizations in the past. Still today, it can be very useful in certain situations police deal with, however, most of the time a leadership style that includes employees more, leads to better results. The democratic leadership style enables leaders to involve others in the decision-making process. It is very effective for problem-solving and in environments where people work in teams. That being said, a police leader needs to be able to switch up his or her leadership style according to the situation he or she is in and depending on the person he or she is communicating with. It means that a good leader will be very adaptable and will also be willing to leave the comfort zone of his or her "default" leadership style, to broaden his or her perspective through others (Scism, n.d.).

Sarver and Miller's 2013 study found that the three leadership styles - transformational, passive and transactional - are used by male leaders in roughly equal proportions. The survey did not also identify the use of the authoritarian style. Women, on the other hand, prefer the transformational style to a greater extent. They also found that transformational leaders receive fewer formal and informal complaints than leaders who use transactional or passive leadership styles (Sarver & Miller, 2014, pp. 133 – 134).

Durić conducted a survey of the Slovenian police in which he found out which leadership styles are presented at different organisational levels of the police and what is the relationship between the leadership style and its outcome. He found that compared to the transactional leadership style, the transformational style is represented in a higher proportion in the Slovenian police. The higher the organisational level of an individual, the more likely he or she is to use a transformational style (or to perceive him or herself as a transformational leader). At the local level, there is a strong correlation between transformational leadership, effectiveness and extra effort. The study found that leaders at different organisational levels see the link between leadership style and the results it delivers differently. In particular, they understand and perceive the link between contingent rewards and leadership outcomes better than between elements of transformational leadership and leadership outcomes. Durić notes that a transformational leadership style can add a great deal to police effectiveness (Durić, 2011, pp. 204 – 205).

Žužman emphasises that leadership in the police is specific and cannot be equated with leadership in other civilian organisations. Police officers are confronted daily with the bureaucratisation of the system, with an often "military style" management and with internal politics, while at the same time trying to meet the conflicting interests of the public. In addition to legal and professional knowledge, police managers need organisational, psychological, logistical and IT skills. The success of a police organisation also depends on the personality of the leaders and their behavioural habits. Managers have a major influence on employee satisfaction. A good relationship with police officers must therefore be actively pursued (Žužman, 2014, p. 13). Leadership in law enforcement requires a sense of empowerment. A good leader should motivate his officers while providing them with freedom to take initiative and have discretion in making their own judgements. They should also be provided with training opportunities and a chance for professional improvement. Mentorship programs and promotion chances add to the feeling of job satisfaction and community (Motsamai, 2023, p. 2101).

In 2023, the Slovenian Police published the Police Competency Assessment and Development Manual, which serves as a source of information for related HR processes and enables the identification of talent, potential and successors for a wide range of positions. The handbook lists and

describes in detail the competences that a police officer or a police manager should have. The leadership competences, which apply to all positions within the police force comprise the five core competences that every police officer should have, plus four additional competences. The first five, which a leader should possess at a higher level than police officers, are a commitment to professionalism, proactive action, handling challenging situations, working with the community and acting responsibly. The other four are organizational skills, being goal-oriented, fostering good relationships and caring for officer's professional development (Juričko et al., 2023, p. 15, 23).

3. WOMEN AND LEADERSHIP

It is clearly expressed and confirmed in literature that there are barriers, prejudices and stereotypes against women within police organisations, which hinder the integration and advancement or promotion of women in the police. Police managers and leaders have the greatest role and responsibility in addressing such a culture in the workplace (Rubio et al., 2021, pp. 15 – 18).

Still, successful women leaders have shown that successful leadership is not necessarily the result of a single, chiseled leadership style, and that the command-and-control style favoured by men is not the only path to success. It is true that the first female leaders most often modelled the way male leaders behave, because it has been proven to be successful. Later, however, women found their own way and style of leadership and became successful in management positions not in spite of their feminine qualities, but because of them. While men are more inclined to use transactional leadership and to rely on the power of their position and formal authority, women are more likely to use transformational leadership style. They rely more on interpersonal relationships with employees and hard work rather than on organisational structure. They make a conscious effort to make interactions with employees enjoyable, share information, encourage collaboration, and improve the view employees have of themselves. All of this allows employees to be involved and to feel empowered and important, which makes management easier and is good for the efficiency of the work process. Rosener described this as interactive leadership, the essence of which is to promote inclusion. When engagement tactics don't work, they change their approach to a more unilateral way of communicating, which is more typical of leadership. (Rosener, 1990, pp. 119 – 125).

Literature also suggests that women are better androgynous leaders than men. The outcomes of women's leadership tend to be more compassionate, benevolent and ethical (Lakshimi Chaluvadi, 2015, p. 11).

4. WOMEN'S SITUATION IN SLOVENIAN POLICE

Although the percentage of women in the police force is rising, we must take into account the possibility that the percentage of women in the police is increasing on account of a reduction in the number of all officers in the police force, which happens in police organisations when a larger number of officers who were recruited at a time when women were not accepted, retire (Rubio et al., 2021, p. 2).

In 2023, the Slovenian police issued a research report on some aspects of organisational life in the police. The survey was specifically focused on identifying gender differences. The survey was carried out using an online survey method with a general invitation to all police employees of which 996 persons submitted a questionnaire. Respondents were asked whether women and men are treated equally in the police. They answered quite differently. 76.4% of women and 46.8% of men disagreed with this statement. Research also showed that the average performance ratings between 2019 and 2021 showed no significant differences between the sexes. The average

performance rating of men in 2020 was 4.79 (out of 5) and for women 4.67. It was slightly lower for both genders the year before and the year after, with the average of women's job evaluations in each of these years lower than for men. The gender differences are statistically significant in all years ($p = 0.000$). The results of the question on,

whether they agree with the statement that "an organisational culture which makes it easier for men to be successful and recognised as such, has an impact on women's potential disadvantage in their career path" show, that 85.2% of women agree with the statement, while 68.7% men disagree with it (Koporec Oberčkal et al., 2023, p. 31, 39, 42, 68).

When it comes to career aspirations, the results of this survey show that the majority (87.3% of men and 96.9% of women, i.e. almost all of them) of both genders desire promotion to a higher or different position within the Slovenian police. 89.6% of women and 76,6% of men say they want to be promoted to more demanding jobs, and 96.1% of women and 80,9% of men also express a desire for further training. The relationship between gender and the desire to take further training and move to a different or more demanding job is statistically significant ($p>0,01$). Women expressed a bigger desire for promotion. (Koporec Oberčkal et al., 2023, pp. 75 – 76). Podnar also found that the women in Slovenian police on average have a higher education than male officers (Podnar, 2024, p. 73).

Further research showed a diametrically different perception of women's position concerning their equal opportunities. Women disagree that they are treated equally than men in the police, while men overwhelmingly think that they are. Women also overwhelmingly disagree with the statement that they have the same influence as men in managerial positions, while men agree with the statement. The same applies to women's career opportunities and advancement and women's fulfillment of their work potential. Women overwhelmingly feel that none of these are realised, while men feel that they are (Koporec Oberčkal et al., 2023, pp. 112 – 113).

Podnar specifically researched the position of women in leadership positions in the Slovenian police. She used the numerical data, received by the Ministry of the Interior, and conducted the research which showed exact numbers of female leaders in Slovenian police in all three organizational levels. Research showed that Slovenian police employ a little over 18% of female police officers, but have only 3,6% female leaders. Women leaders are best represented at the state level, where they represent 4,6% of leaders. On the other hand, the smallest number of women leaders is at the local level (where there is only one kind of leadership position – chief of the police station), where they represent 2,9% of leaders. She researched the data for assistant leadership positions as well. Results showed, that women occupy 10% of all assistant leadership positions. While looking at the organizational levels, it shows that they occupy 10,4% of local assistant positions and 8,1% of assistant positions at the state level. There are no assistant leadership positions filled with women at the regional level. However, we must point out, that there are very few such positions all in all at the regional level (Podnar, 2024, pp. 67 – 70).

5. POLICE (SUB)CULTURE

Many articles have been written on the subject of police subculture and the personality of police officers, but there is still no clear answer to the question of whether there really is a police subculture and what the main personality traits of police officers should be. Some of the main characteristics that the profession associates with the police personality are courage, loyalty, authoritativeness, cynicism, suspiciousness, assertiveness, suspicion, conservatism, argumentativeness, decisiveness,

dominance and alienation (TenEyck, 2024, p. 271). Jetmore defined the development of organizational culture as "the integrated pattern of human behavior that includes thought, speech, action, and artifacts" and also depends on man's ability for learning and passing down the knowledge to next generations (Jetmore, 1997, pp. 1 – 2, as cited in Motsamai Modise & Raga, 2022, p. 1908).

The police subculture is manifested mainly in the attitudes, norms, values and work rules that influence individual behaviour. It has developed as a problem-solving mechanism and manifests itself in specific behaviours that are intended to help police officers cope with tensions in the service. However, even within a police organisation there is no single subculture, but several different ones that have developed based on the place, time and social context in which the individual carries out his or her work (Meško & Areh, 2004, p. 364).

The term "deviance" is often used in connection with the police subculture. It is said to be an aberrant subculture, the paradox being that certain qualities which a police officer must have to do his job well, can quickly degenerate or become excesses. Police leaders are no exception. They are in the unenviable position of needing the respect of their subordinates because their performance and reputation depend on the work of police officers. Police officers in the field who do not respect the leader, and consequently do not follow their instructions, are rebellious, do not trust their leader, and may even act arbitrarily or illegally, which casts a bad light on the leader. Whether or not a police subculture will develop, depends hugely on the leader. In this respect, it is particularly important to continuously educate police officers and remind them of the organisation's goals and values (Meško, 1994, p. 146).

A police (sub)culture also has a negative view of women in policing. Discrimination against women in that regard still exists to this day, though the situation is improving. Podnar found that women still face a glass ceiling regarding promotion, women in managerial positions face inappropriate and sexist comments, and they have to prove themselves more than their male counterparts to be respected. Police subculture is distinctly masculine and male-oriented, and so pervasive that sometimes women are not even aware of it. However, it is the police culture that needs to change to finally embrace women. There are still vulgar jokes, sexism and the glorification of typically masculine qualities present, which automatically excludes women and devalues them (Podnar, 2024, p. 72).

6. FUTURE RESEARCH DIRECTIONS

There are more and more articles about women in the police and law enforcement as a whole, which we consider positive. Given the slow growth in the number of women in the police, it is right that this topic is highlighted. This is all the more true in Slovenia, where Podnars' research was the first of its kind in the Slovenian police. However, although the number of female police officers is steadily growing, this does not seem to be the case in the area of managerial or leadership positions, where the figures have been hovering around 3% for some time. Given this, the authors of this paper will potentially repeat the survey to establish the trend of Slovenian policewomen in managerial positions. Only by repeating the same survey will it be possible to determine whether or not the situation is improving.

7. CONCLUSION

Women police officers have proven themselves over the years. They are an equal partner to their male counterparts and any argument about their weakness and inadequacy is refuted and unconfirmed. Data shows that, on average, women in Slovenian police have a higher level of education, a greater desire for promotion and a greater desire for further education. Although we have not

specifically researched the reasons for the low number of women in leadership positions within the police, arguments such as "they don't want to" and "they do not qualify" have already been challenged. Policewomen also receive fewer complaints against their procedures, enjoy greater public confidence and use less coercive means. Nevertheless, without an active and dedicated approach to the problem by the police as an institution, the situation will not change on its own, since most police officers are still men - as the Slovenian police survey itself shows (Koporec Oberčkal et al., 2023, p. 39, 122) - do not see a problem in attitudes towards equality for women in the police, but rather believe that equality has been achieved.

We can conclude that women are just as capable leaders as men, not just in general but also in law enforcement. Although they may lead in a different style, compared to men, they achieve results and get work done. Their different approach to leading (which some consider "soft") does not reduce the effectiveness or efficiency of their leadership. Accordingly, we conclude that it is not only sensible but necessary for the police to actively strive for gender balance in general and in leadership positions in particular.

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From Fixed Wages to Flexible Rewards: How Businesses in Post-communist Countries Navigate Tipping

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Abstract: *This article investigates tipping as a motivational factor in service industries, examining the reasons behind tipping, such as gratitude and social norms. The research explores how tips, especially early tips and compliments, can improve service quality, and how tipping behavior is influenced by gratitude and perceived service quality. The study focuses on Slovenia, Montenegro, Croatia, and Bosnia and Herzegovina, using a detailed questionnaire to assess tipping's motivational impact on employees. Statistical analysis, including ANOVA Eta Square and Tukey HSD Post Hoc tests, reveals a significant difference in the reward system concerning tipping regulations. However, no significant differences were found in guest satisfaction, quality of work, compensation, or group relationships. The findings suggest that the regulation of tipping influences the reward system's effectiveness, making it a potential tool for managing work flexibility, though it has limited impact on other aspects of work flexibility. Tipping thus can act as a managerial tool in specific contexts.*

1. INTRODUCTION

Meta-analysis is a powerful tool for synthesizing and analysing previous research findings (Sathian et al., 2009). It involves a systematic review of studies, the application of statistical methods to estimate effect size and variance, and the exploration of relationships between study characteristics and findings (Vasudev, 2019). This method is particularly useful when individual studies are too small to yield valid conclusions, and it can be applied to a range of study designs, including randomized control trials and non-experimental studies (Sathian et al., 2009). However, the quality of the underlying studies is a key limitation, and careful review and assessment of meta-analyses is essential (Sathian et al., 2009). Despite these limitations, meta-analysis can provide higher statistical power and a stronger estimate than any individual study (Vasudev, 2019).

We undertook a meta-analysis of previous articles on tipping involving Slovenia and Montenegro (Nikić et al., 2021) and new research for Croatia, Bosnia and Herzegovina. The purpose of the paper is to identify the peculiarities, common points, and fundamental differences in individual countries.

2. THEORETICAL BACKGROUND

Tipping in the service industry is a complex and multifaceted phenomenon. Azar challenges the common belief that tipping improves service quality, suggesting that it may not be sensitive enough to service quality (Azar, 2009). Employees may focus too much on tips and not enough

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on quality of service. However, Azar presents a model where tipping can be seen as a strategic investment in service quality, creating a reputation that influences future service (Azar & Tobol, 2007). Ross and Welsh (2020) highlight the societal significance of tipping, particularly in the US, where it is a legally recognized form of labour remuneration that can perpetuate worker precarity and social subordination. Tips can represent more than half of an employee's earnings. Shamir adds a social-psychological perspective, emphasizing the need to reconcile the economic, social, and psychological elements of tipping (Shamir, 1984).

Tipping has a significant impact on employee motivation, with both positive and negative effects. It can serve as a motivational tool for those who receive tips but can also demotivate those who do not. The distribution of tips, whether regulated or not, also plays a role in employee motivation (Clotildah et al., 2014; Raspor & Rozman, 2017). Tipping is mainly driven by gratitude, social norms, and the knowledge that employees' income depends on tips (Azar, 2010b). The perception of tipping as a reward or additional income varies among employees (Pala, 2020; Watulingas, 2019). Buyer monitoring, such as voluntary tipping, can enhance service quality and motivate employees (Kwortnik et al., 2014). Individual differences in tipping motivations, such as the desire to help servers or fulfil social obligations, also influence tipping behaviour (Lynn, 2015).

2.1. Fair Wages and Income Equality in the Service Industry

The debate surrounding fair wages for service staff is gaining momentum, with discussions on income equality and the impact of tipping on the overall financial well-being of workers. Hospitality businesses must consider these broader societal and economic implications. Research consistently shows that the hospitality industry is plagued by wage disparities, particularly along gender lines (Fleming, 2015; Morgan, 1982). These disparities are not solely due to the industry's low-wage nature, but also to the specific characteristics of its workers and jobs (Casado-Díaz & Simón, 2016). Gender discrimination, particularly in terms of labour mobility, is a significant contributor to these disparities (Campos-Soria et al., 2015). These findings underscore the need for measures to address wage inequality and promote fair wages in the hospitality sector.

The regulation of tipping by employers is a complex issue with legal, economic, and social implications. Employers in the restaurant and hospitality industry, in particular, must be aware of the Fair Labor Standards Act's regulations on tip wages (Bouvier Robinson, 2011). However, there is evidence that many employers do not comply with these regulations, leading to potential legal and financial consequences (Schmidgall & Tarras, 1995). Tipping also plays a role in the service relationship, with different practices being interpreted by both staff and customers (Auriacombe & Cova, 2014). The gig economy has further complicated tipping norms, with workers' increased autonomy leading to a decline in tipping (Duhaime & Woessner, 2019). Despite these challenges, tipping is seen as a valuable social institution that promotes cooperation, and the removal of legal restrictions on tip-pooling is suggested as a solution (Estreicher & Nash, 2018).

2.2. Highlight the Transition from Fixed Wages to a More Flexible Compensation System in Post-communist Countries

The transition from fixed wages to a more flexible compensation system in post-communist countries has been a complex and varied process. Jenkins (2001) notes that the move to market-based economies led to changes in wage determination, while Basu et al. (2004) found evidence of worker sharing in enterprise rents and losses during this period (Basu et al., 2004). However, this transition has also led to increased wage inequality, as documented by Newell (2001), with rising

income inequality in Eastern Europe (Newell, 2001). Despite these challenges, Roberts et al. (2023) highlights the reconstruction of education and training systems in these countries, suggesting a potential for continued progress in the labour market (Roberts et al., 2023).

2.3. What Motivates Employees in Service Companies to Do a Good Job?

A range of factors have been identified as key motivators for employees in service companies. Job certainty, career growth, and a quality working environment are crucial for service employees in Bangladesh (Rahaman et al., 2020). Young employees in the service sector are primarily motivated by relationships with peers, salary, personal life, and responsibility (Rahaman et al., 2020). In the Malaysian service industry, training and promotion are significant predictors of job performance (Aarabi et al., 2013). Intrinsic motivators such as collaboration, content, and choice are important for inspiring motivation in the workplace. Motivating employees is critical for excellent service delivery (Sturman & Ford, 2012). In the Indian service sector, perceived competence, autonomy, and relatedness are intrinsic motivators that influence employee performance (Mundhra, 2010). Motivation is also linked to improved job performance in the hotel industry (Rahaman et al., 2020). Lastly, expanding motivation concepts to include the client/customer can lead to productivity gains in service organizations (Mills et al., 1984).

Tipping in service companies can be a powerful motivator for employees, but it also has its drawbacks. Lynn et al. (2011) and Kwortnik et al. (2009) both highlight the potential benefits of tipping, such as attracting and retaining better workers and improving service quality. However, Clotildah et al. (2014) and Lynn and Withiam (2013) point out the potential for discrimination and other negative effects. Azar (2010a) and Lynn and Graves (1996) further explore the motivations behind tipping, with gratitude and social norms playing significant roles. Lavoie et al. (2020) and Kvasnička (2018) provide practical insights, with the former finding that early tips and compliments can improve service, and the latter showing that tipping is influenced by gratitude and service quality.

H1: Employee motivation is partially dependent on how tips are regulated.

2.4. How Does Tipping Affect the Work Flexibility of Employees in Service Companies?

Tipping can have a significant impact on workers' income and behaviour. Shy (2015) found that an increase in tipping rates can reduce hourly wages, while Lynn and Withiam (2013) highlighted the potential for discrimination and increased risk of income tax audits. Klein et al. (2021) further suggested that tipping can facilitate sexual objectification and legitimize sexual harassment. The gig economy has also led to a decline in tipping norms, with workers having increased autonomy (Duhaime & Woessner, 2019). Despite these negative effects, tipping can also serve as a motivation for high-quality service (Azar, 2010a). The decision to keep or abandon tipping in the restaurant industry ultimately depends on the relative benefits for both workers and employers (Lynn, 2017).

H2: Tipping affects the flexibility of employees' work in various modes across countries.

3. RESEARCH DESIGN AND METHODOLOGY

We undertook a meta-analysis of previous articles on tipping involving Slovenia (2019) and Montenegro (2019) and new research for Croatia (2020), Bosnia and Herzegovina (2020). The purpose of the paper is to identify the peculiarities, common points and fundamental differences in individual countries.

Survey Design: The researchers employed a structured survey questionnaire, crafted by the authors of the study, to investigate tipping practices. The questionnaire encompassed inquiries regarding employers' policies on tipping, their perceptions of tipping's motivational impact, and its effects on work flexibility.

Sampling and Data Collection: The study surveyed employers in Slovenia, Montenegro, Croatia, and Bosnia and Herzegovina. Data collection involves distributing survey questionnaires to employers and soliciting their responses. Random sampling techniques ensured diverse representation across sectors and regions. Surveys were administered via online platforms, email, or in-person interactions, accommodating participant preferences. Professional networks and business associations facilitated engagement with potential respondents. Demographic data is outlined in Table 1.

Data Analysis: Following data collection, researchers meticulously analysed survey responses. Quantitative methods quantified the prevalence of tipping practices and employers' perspectives. Qualitative analysis techniques identified recurrent themes and patterns in employers' attitudes and perceptions.

To make our analysis accurate, we carried out statistical data analysis with the help of Statistic Package for Social Science software (IBM SPSS Statistics version 25).

For statistical analysis, apart from the mean value, ANOVA Eta Square and Tukey HSD Post Hoc Test were used as well (Smith, 1972; Cohen, 1988; Henson, 2015; Molugaram & Rao, 2017).

One-way analysis of variance ANOVA was used to define if there is a statistically significant correlation between dependent variables (tipping collection/q1, tipping regulation/q2, tipping distribution/q3, motivational factors/q5, work flexibility/q6) and independent variable (type of service companies/q10, countries, tipping regulation/q2).

It must be noted when significance: $p \leq 0.05$ there is a significant difference between the mean values of the dependent variables in each group. Otherwise, when the $p > 0.05$ the difference between the two groups is not significant, but coincidental. On the other hand, for measuring differences between attitudes authors have used Eta square. Using the formula: sum squares/total we will get the value of eta square (interpretation of eta square: 0.01 - small effect; 0.06 - medium effect; 0.14 - major effect).

Additionally, the authors measured a significant correlation between a subset of data in independent variables regarding dependent variables, through the Multiple correlations Tukey HSD post hoc test method.

Ethical Considerations: The study adhered to stringent ethical standards. Researchers obtained informed consent from participants, respecting their autonomy and confidentiality. Transparent measures addressed potential biases or conflicts of interest, safeguarding the research's integrity and credibility.

Based on the image, which shows a table about employee motivators, here are the main findings:

- "Satisfied guests" was ranked third (with an average mean score between 4.03 and 4.12).
- Employees across all countries surveyed rated "work that is well done" as the most important motivator (with an average mean score between 4.05 and 4.23 on a 5-point scale).
- "Good pay (money)" was ranked second (with an average mean score between 4.09 and 4.62).
- "Getting a promotion" was ranked fourth (with an average mean score between 4.04 and 4.54).
- "Mutual relationships in the group in which they work every day" was ranked last (with an average mean score between 3.94 and 4.15).

It is important to note that these are averages and there may be significant variations within each country. For example, the standard deviation (SD) scores show that there is a spread in the responses for each category. This means that while "work that is well done" was the top-ranked motivator overall, some respondents within each country may have rated other factors such as pay or getting a promotion more highly.

Table 1. Data

	Slovenia		Montenegro		Croatia		Bosnia and Hercegovina		Total	
	F	VP	F	VP	F	VP	F	VP	F	VP
Q8 Organizational structure										
Public limited company (PLC)	30	28,04%	2	3,39%	4	11,76%	6	27,27%	42	18,92%
Private Limited Liability Company (LTD)	36	33,64%	55	93,22%	26	76,47%	13	59,09%	130	58,56%
Sole proprietorship (PC)	41	38,32%	2	3,39%	0	0,00%	2	9,09%	45	20,27%
Other (specify):		0,00%		0,00%	4	11,76%	1	4,55%	5	2,25%
Total	**107**	**100%**	**59**	**100%**	**34**	**100%**	**22**	**100%**	**222**	**100%**
Q9 Number of employees										
Micro companies (up to 10 employees)	25	23,36%	43	71,67%	25	71,43%	17	77,27%	110	49,11%
Small companies (up to 50 employees)	4	3,74%	7	11,67%	7	20,00%	4	18,18%	22	9,82%
Middle companies (up to 250 employees)	13	12,15%	2	3,33%	3	8,57%	1	4,55%	19	8,48%
Large companies (more than 250 employees)	65	60,75%	8	13,33%	0	0,00%	0	0,00%	73	32,59%
Total	**107**	**100%**	**60**	**100%**	**35**	**100%**	**22**	**100%**	**224**	**100%**
Q10 Business										
Hospitality	67	62,62%	39	66,10%	25	71,43%	16	72,73%	147	65,92%
Gambling	15	14,02%	1	1,69%	1	2,86%	1	4,55%	18	8,07%
Hair & beauty salon	6	5,61%	7	11,86%	3	8,57%	2	9,09%	18	8,07%
Service station	7	6,54%	2	3,39%	0	0,00%	2	9,09%	11	4,93%
Other (specify):	4	3,74%	7	11,86%	6	17,14%	1	4,55%	18	8,07%
Shop	8	7,48%	3	5,08%	0	0,00%	0	0,00%	11	4,93%
Total	**107**	**100%**	**59**	**100%**	**35**	**100%**	**22**	**100%**	**223**	**100%**
Q11 Ownership of the company										
Private	68	64,76%	52	86,67%	29	82,86%	21	95,45%	170	76,58%
State-owned	25	23,81%	6	10,00%	2	5,71%	0	0,00%	33	14,86%
Mixed	12	11,43%	2	3,33%	4	11,43%	1	4,55%	19	8,56%
Total	**105**	**100%**	**60**	**100%**	**35**	**100%**	**22**	**100%**	**222**	**100%**

Source: Own processing

Tips motivate workers to work harder and produce higher quality work: There is a weak positive agreement across all countries (Mean between 1.02 and 1.11 on a 5-point scale). Slovenia and Croatia showed the strongest agreement (Mean 1.02 and 0.826 respectively).

Tips make workers friendlier towards guests: There is a moderate positive agreement across all countries (Mean between 3.82 and 4.21). Slovenia showed the strongest agreement (Mean 3.82).

Getting a tip does not influence how workers perform their jobs: There is a weak disagreement across all countries (Mean between 2.57 and 3.23). Montenegro showed the strongest disagreement (Mean 3.23).

Workers feel satisfied when they receive tips because they feel their work is valued: There is a moderate positive agreement across all countries (Mean between 4.05 and 4.31). Slovenia again showed the strongest agreement (Mean 4.29).

Tips do not affect how workers feel in general: There is a weak disagreement across all countries (Mean between 2.63 and 3.00). Montenegro showed the strongest disagreement (Mean 3.00).

In addition to their salary and bonuses, tips make workers more willing to work overtime: There is a weak positive agreement across all countries (Mean between 2.44 and 3.63). Croatia showed the strongest agreement (Mean 3.63).

Tips are a financial motivator in the workplace: There is a weak positive agreement across all countries (Mean between 2.67 and 4.09). Montenegro showed the strongest agreement (Mean 4.09).

Table 2. Motivational factors

	Slovenia (N=103)		Montenegro (N=64)		Croatia (N=39)		Bosnia and Hercegovina (N=21)		Total (N=227)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Satisfied guests.	4,12	1,008	4,12	1,038	4,03	,778	4,03	,778	4,04	,972
Work that is well done.	**4,17**	,919	4,05	,983	4,23	,667	4,23	,667	4,12	,892
Reward system.	3,81	1,098	4,22	,838	4,44	,718	4,44	,718	4,07	,978
Good pay (money).	4,09	1,034	4,51	,753	4,62	,544	4,62	,544	4,29	,910
Getting a tip.	4,09	,981	4,25	,936	4,54	,555	4,54	,555	4,22	,904
Mutual relationships in the group in which they work every day.	3,99	,980	3,86	1,116	4,15	,745	4,15	,745	3,94	,980

Source: Own processing

Table 3. Tipping and work flexibility

	Slovenia (N=103)		Montenegro (N=64)		Croatia (N=39)		Bosnia and Hercegovina (N=21)		Total (N=227)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
If they get a tip, they work harder and therefore produce higher quality work.	3,89	1,023	4,03	1,112	4,28	,826	3,81	,928	3,99	1,015
If they get a tip, they are friendlier towards guests.	3,82	1,041	4,00	1,098	4,21	,864	3,86	1,014	3,94	1,031
Getting a tip in no way influences their work with guests.	2,95	1,262	3,23	1,306	2,77	1,266	2,57	1,028	2,96	1,264
When they get a tip, they feel satisfied because their work has brought results.	4,29	,986	4,05	,916	4,31	,766	4,14	,573	4,21	,902
Getting a tip does not affect how they feel.	2,71	1,204	3,00	1,280	2,85	1,159	2,95	,973	2,84	1,198
In addition to pay and bonuses, they also receive tips, so they are prepared to work overtime.	2,44	1,253	3,63	1,189	3,42	1,106	3,19	,981	3,01	1,297
Tips fall within financial stimulation in the workplace.	2,87	1,158	4,09	,996	4,05	,705	3,86	,655	3,50	1,165
Because their income mainly consists of tips, they take fewer sick leaves.	1,87	1,128	3,38	1,141	3,26	1,044	2,80	,951	2,63	1,303
If they can receive a tip directly in their pockets and do not have to share it with co-workers, they are prepared to work overtime.	2,10	1,295	3,46	1,147	3,49	,997	3,14	,964	2,82	1,347

Source: Own processing

Workers who rely on tips take fewer sick leaves: There is a weak positive agreement across all countries (Mean between 1.87 and 3.38). Croatia showed the strongest agreement (Mean 3.38).

Workers are more willing to work overtime if they can keep their tips directly without sharing them with co-workers: There is a weak positive agreement across all countries (Mean between 2.10 and 3.49). Croatia again showed the strongest agreement (Mean 3.49).

It is important to note that these are averages and there may be significant variations within each country. For example, the standard deviation (SD) scores show that there is a spread in the responses for each category. This means that while some workers agreed that tips motivate them to work harder, others did not agree as strongly.

Further analysis, shall test the hypothesis, by observing dependent and independent variables.

Table 4. Employee motivation vs tipping regulation

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Q51 Satisfied guests					
Between Groups	2,247	2	1,123	1,19	0,306
Within Groups	213,316	226	0,944		
Total	215,563	228			
Q52 Work that is well done					
Between Groups	0,45	2	0,225	0,281	0,755
Within Groups	179,338	224	0,801		
Total	179,789	226			
Q53 Reward system					
Between Groups	6,828	2	3,414	3,654	0,027
Within Groups	211,189	226	0,934		
Total	218,017	228			
Q54 Good pay (money)					
Between Groups	3,242	2	1,621	1,972	0,142
Within Groups	185,736	226	0,822		
Total	188,978	228			
Q55 Getting a tip					
Between Groups	0,667	2	0,334	0,406	0,667
Within Groups	184,925	225	0,822		
Total	185,592	227			
Q56 Mutual relationships in the group in which they work every day					
Between Groups	0,871	2	0,436	0,451	0,638
Within Groups	218,273	226	0,966		
Total	219,144	228			

Source: Own processing

Significant difference is confirmed only regarding to reward system. ANOVA shows that significant differences between means of dependent variables exist within examined groups of reward systems concerning tipping regulation as the independent variable.

We note there is no statistically significant difference between other observed groups regarding satisfied guests, well-done work, good pay(money), getting a tip and mutual relationship in the group as dependent variables according to a type of service companies as independent variable.

The value of Eta square is below the minimum set values (less than 0,01) which means that influence is very small.

The Post Hoc Test shows statistically significant differences in a subset of data regarding the rewarding system, with no statistically significant differences among other pairs of groups.

H1: Employee motivation is partially dependent on how tips are regulated confirmed.

Table 5a. Tipping affection on the flexibility of employees' work among countries

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
If they get a tip, they work harder and therefore produce higher quality work.					
Between Groups	5,073	3	1,691	1,655	0,178
Within Groups	228,91	224	1,022		
Total	233,982	227			
If they get a tip, they are friendlier towards guests.					
Between Groups	4,681	3	1,56	1,478	0,221
Within Groups	236,459	224	1,056		
Total	241,14	227			
Getting a tip in no way influences their work with guests.					
Between Groups	9,412	3	3,137	1,988	0,117
Within Groups	350,305	222	1,578		
Total	359,717	225			
When they get a tip, they feel satisfied because their work has brought results.					
Between Groups	2,85	3	0,95	1,17	0,322
Within Groups	181,001	223	0,812		
Total	183,85	226			
Getting a tip does not affect how they feel.					
Between Groups	3,567	3	1,189	0,826	0,481
Within Groups	319,375	222	1,439		
Total	322,942	225			
In addition to pay and bonuses, they also receive tips, so they are prepared to work overtime.					
Between Groups	64,827	3	21,609	15,29	0
Within Groups	315,155	223	1,413		
Total	379,982	226			
Tips fall within financial stimulation in the workplace					
Between Groups	78,724	3	26,241	25,663	0
Within Groups	228,025	223	1,023		
Total	306,749	226			
Because their income mainly consists of tips, they take fewer sick leaves.					
Between Groups	111,035	3	37,012	30,368	0
Within Groups	269,347	221	1,219		
Total	380,382	224			
If they can receive a tip directly in their pockets and do not have to share it with co-workers, they are prepared to work overtime.					
Between Groups	100,129	3	33,376	24,001	0
Within Groups	311,498	224	1,391		
Total	411,627	227			

Source: Own processing

ANOVA shows that significant differences between means of dependent variables such as overtime work, workplace financial stimulation, fewer sick leaves and non-sharable tipping exist within examined groups regarding the country as an independent variable which means that there are significant differences concerning overtime work, workplace financial stimulation, fewer sick leaves and non-sharable tipping among observed countries.

We note there is no statistically significant difference between other observed groups regarding harder and higher quality work, friendliness towards guests, no influences on work with guests, satisfaction with work results, and no effect on how they feel as dependent variables according to country as independent variable.

The value of the Eta square is presented in the next table.

Table 5b. Eta square

Measures of Association		
	Eta	Eta Squared
Q61 * Country	0,147	0,022
Q62 * Country	0,139	0,019
Q63 * Country	0,162	0,026
Q64 * Country	0,124	0,015
Q65 * Country	0,105	0,011
Q66 * Country	0,413	0,171
Q67 * Country	0,507	0,257
Q68 * Country	0,540	0,292
Q69 * Country	0,493	0,243

Source: Own processing

Regarding this measure, it could be noted that the country as an independent variable has a high influence concerning overtime work, workplace financial stimulation, fewer sick leaves and non-sharable tipping.

The Post Hoc Test shows statistically significant differences in a subset of data regarding the type of countries.

Table 5c. Post Hoc Test

Multiple Comparisons						
Dependent Variable		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
If they get a tip, they work harder and therefore produce higher quality work.						
Slovenia	Montenegro	-0,137	0,161	0,829	-0,55	0,28
	Croatia	-0,388	0,19	0,175	-0,88	0,1
	Bosnia and Herzegovina	0,085	0,242	0,985	-0,54	0,71
Montenegro	Slovenia	0,137	0,161	0,829	-0,28	0,55
	Croatia	-0,251	0,205	0,614	-0,78	0,28
	Bosnia and Herzegovina	0,222	0,254	0,819	-0,44	0,88
Croatia	Slovenia	0,388	0,19	0,175	-0,1	0,88
	Montenegro	0,251	0,205	0,614	-0,28	0,78
	Bosnia and Herzegovina	0,473	0,274	0,312	-0,24	1,18
Bosnia and Herzegovina	Slovenia	-0,085	0,242	0,985	-0,71	0,54
	Montenegro	-0,222	0,254	0,819	-0,88	0,44
	Croatia	-0,473	0,274	0,312	-1,18	0,24
If they get a tip, they are friendlier towards guests.						
Slovenia	Montenegro	-0,183	0,163	0,678	-0,61	0,24
	Croatia	-0,388	0,193	0,187	-0,89	0,11
	Bosnia and Herzegovina	-0,04	0,246	0,998	-0,68	0,6
Montenegro	Slovenia	0,183	0,163	0,678	-0,24	0,61
	Croatia	-0,205	0,209	0,759	-0,75	0,34
	Bosnia and Herzegovina	0,143	0,258	0,946	-0,53	0,81
Croatia	Slovenia	0,388	0,193	0,187	-0,11	0,89
	Montenegro	0,205	0,209	0,759	-0,34	0,75
	Bosnia and Herzegovina	0,348	0,278	0,595	-0,37	1,07
Bosnia and Herzegovina	Slovenia	0,04	0,246	0,998	-0,6	0,68
	Montenegro	-0,143	0,258	0,946	-0,81	0,53
	Croatia	-0,348	0,278	0,595	-1,07	0,37

Getting a tip in no way influences their work with guests.						
Slovenia	Montenegro	-0,283	0,2	0,491	-0,8	0,24
	Croatia	0,182	0,236	0,869	-0,43	0,79
	Bosnia and Herzegovina	0,38	0,301	0,589	-0,4	1,16
Montenegro	Slovenia	0,283	0,2	0,491	-0,24	0,8
	Croatia	0,465	0,255	0,265	-0,2	1,13
	Bosnia and Herzegovina	0,663	0,316	0,157	-0,15	1,48
Croatia	Slovenia	-0,182	0,236	0,869	-0,79	0,43
	Montenegro	-0,465	0,255	0,265	-1,13	0,2
	Bosnia and Herzegovina	0,198	0,34	0,937	-0,68	1,08
Bosnia and Herzegovina	Slovenia	-0,38	0,301	0,589	-1,16	0,4
	Montenegro	-0,663	0,316	0,157	-1,48	0,15
	Croatia	-0,198	0,34	0,937	-1,08	0,68

When they get a tip, they feel satisfied because their work has brought results.						
Slovenia	Montenegro	0,244	*0,143*	0,324	-0,13	0,62
	Croatia	-0,016	0,169	1	-0,45	0,42
	Bosnia and Herzegovina	0,148	0,216	0,902	-0,41	0,71
Montenegro	Slovenia	-0,244	0,143	0,324	-0,62	0,13
	Croatia	-0,261	0,183	0,485	-0,73	0,21
	Bosnia and Herzegovina	-0,096	0,227	0,974	-0,68	0,49
Croatia	Slovenia	0,016	0,169	1	-0,42	0,45
	Montenegro	0,261	0,183	0,485	-0,21	0,73
	Bosnia and Herzegovina	0,165	0,244	0,906	-0,47	0,8
Bosnia and Herzegovina	Slovenia	-0,148	0,216	0,902	-0,71	0,41
	Montenegro	0,096	0,227	0,974	-0,49	0,68
	Croatia	-0,165	0,244	0,906	-0,8	0,47

Getting a tip does not affect how they feel.						
Slovenia	Montenegro	-0,288	0,192	0,44	-0,79	0,21
	Croatia	-0,135	0,225	0,933	-0,72	0,45
	Bosnia and Herzegovina	-0,241	0,287	0,836	-0,98	0,5
Montenegro	Slovenia	0,288	0,192	0,44	-0,21	0,79
	Croatia	0,154	0,245	0,923	-0,48	0,79
	Bosnia and Herzegovina	0,048	0,303	0,999	-0,74	0,83
Croatia	Slovenia	0,135	0,225	0,933	-0,45	0,72
	Montenegro	-0,154	0,245	0,923	-0,79	0,48
	Bosnia and Herzegovina	-0,106	0,325	0,988	-0,95	0,73
Bosnia and Herzegovina	Slovenia	0,241	0,287	0,836	-0,5	0,98
	Montenegro	-0,048	0,303	0,999	-0,83	0,74
	Croatia	0,106	0,325	0,988	-0,73	0,95

In addition to pay and bonuses, they also receive tips, so they are prepared to work overtime.						
Slovenia	Montenegro	-1,183*	0,189	0	-1,67	-0,69
	Croatia	-,979*	0,225	0	-1,56	-0,4
	Bosnia and Herzegovina	-,748*	0,284	0,045	-1,48	-0,01
Montenegro	Slovenia	1,183*	0,189	0	0,69	1,67
	Croatia	0,204	0,243	0,836	-0,43	0,83
	Bosnia and Herzegovina	0,435	0,299	0,468	-0,34	1,21
Croatia	Slovenia	,979*	0,225	0	0,4	1,56
	Montenegro	-0,204	0,243	0,836	-0,83	0,43
	Bosnia and Herzegovina	0,231	0,323	0,892	-0,61	1,07
Bosnia and Herzegovina	Slovenia	,748*	0,284	0,045	0,01	1,48
	Montenegro	-0,435	0,299	0,468	-1,21	0,34
	Croatia	-0,231	0,323	0,892	-1,07	0,61

Tips fall within financial stimulation in the workplace.						
Slovenia	Montenegro	-1,227*	0,16	0	-1,64	-0,81
	Croatia	-1,189*	0,194	0	-1,69	-0,69
	Bosnia and Herzegovina	-,992*	0,242	0	-1,62	-0,37
Montenegro	Slovenia	1,227*	0,16	0	0,81	1,64
	Croatia	0,038	0,208	0,998	-0,5	0,58
	Bosnia and Herzegovina	0,235	0,254	0,791	-0,42	0,89
Croatia	Slovenia	1,189*	0,194	0	0,69	1,69
	Montenegro	-0,038	0,208	0,998	-0,58	0,5
	Bosnia and Herzegovina	0,197	0,276	0,892	-0,52	0,91
Bosnia and Herzegovina	Slovenia	,992*	0,242	0	0,37	1,62
	Montenegro	-0,235	0,254	0,791	-0,89	0,42
	Croatia	-0,197	0,276	0,892	-0,91	0,52

Because their income mainly consists of tips, they take fewer sick leaves.						
Slovenia	Montenegro	-1,513*	0,176	0	-1,97	-1,06
	Croatia	-1,385*	0,208	0	-1,92	-0,85
	Bosnia and Herzegovina	-,929*	0,27	0,004	-1,63	-0,23
Montenegro	Slovenia	1,513*	0,176	0	1,06	1,97
	Croatia	0,128	0,224	0,94	-0,45	0,71
	Bosnia and Herzegovina	0,585	0,282	0,166	-0,15	1,32
Croatia	Slovenia	1,385*	0,208	0	0,85	1,92
	Montenegro	-0,128	0,224	0,94	-0,71	0,45
	Bosnia and Herzegovina	0,456	0,304	0,437	-0,33	1,24
Bosnia and Herzegovina	Slovenia	,929*	0,27	0,004	0,23	1,63
	Montenegro	-0,585	0,282	0,166	-1,32	0,15
	Croatia	-0,456	0,304	0,437	-1,24	0,33

If they can receive a tip directly in their pockets and do not have to share it with co-workers, they are prepared to work overtime.						
Slovenia	Montenegro	-1,364*	0,187	0	-1,85	-0,88
	Croatia	-1,390*	0,222	0	-1,96	-0,82
	Bosnia and Herzegovina	-1,046*	0,282	0,002	-1,78	-0,31
Montenegro	Slovenia	1,364*	0,187	0	0,88	1,85
	Croatia	-0,026	0,239	1	-0,64	0,59
	Bosnia and Herzegovina	0,319	0,296	0,704	-0,45	1,08
Croatia	Slovenia	1,390*	0,222	0	0,82	1,96
	Montenegro	0,026	0,239	1	-0,59	0,64
	Bosnia and Herzegovina	0,344	0,319	0,703	-0,48	1,17
Bosnia and Herzegovina	Slovenia	1,046*	0,282	0,002	0,31	1,78
	Montenegro	-0,319	0,296	0,704	-1,08	0,45
	Croatia	-0,344	0,319	0,703	-1,17	0,48

*. The mean difference is significant at the 0.05 level.

Source: Own processing

Additionally, the statistical significance of the differences between each pair of groups can be observed with the subsequent test (Post Hoc Tests), which is shown in Table 5c.

Using countries as independent variables could be observed statistically significant differences for overtime work among pairs of countries such as Slovenia and Montenegro; Slovenia and Croatia; and Slovenia and Bosnia and Herzegovina; with no significant differences regarding other pairs of groups. Concerning workplace financial stimulation/q67 significant differences are observed among pairs of countries: Slovenia and Montenegro; Slovenia and Croatia; and Slovenia and Bosnia and Herzegovina; there are no significant differences among the rest of all pairs of countries.

Regarding fewer sick leaves there a significant differences among pairs of countries such as Slovenia and Montenegro; Slovenia and Croatia; and Slovenia and Bosnia and Herzegovina; there are no significant differences among the rest of all pairs of countries.

Concerning non-sharable tipping there a significant differences among pairs of countries such as Slovenia and Montenegro; Slovenia and Croatia; and Slovenia and Bosnia and Herzegovina; there are no significant differences among the rest of all pairs of countries.

H2: Tipping affects the flexibility of employees' work in various modes through countries partially confirmed.

4. DISCUSSION

Significant differences regarding the reward system about tipping regulation and no significant differences regarding other motivational factors indicate that the reward system could motivate employers depending on tipping regulation. Tipping has a significant impact on the work attitudes of service employees, with positive effects on job satisfaction and performance (Wung & Nanfosso, 2023). It can also serve as a means of attracting and retaining better workers (Lynn et al., 2011). However, the practice of tipping can lead to negative consequences, such as discrimination and potential lawsuits (Lynn & Withiam, 2013). The distribution of tips can vary by country, with some having a regulated system (Vukčević et al., 2021). Tipping can also be a form of buyer monitoring, positively influencing service quality (Kwortnik et al., 2014). However, the evaluation of tips by employees can lead to negative emotions and behaviour (Saunders, 2015).

Taking into consideration overtime work, workplace financial stimulation, fewer sick leaves and non-sharable tipping as elements of the flexibility of employees' work regarding tipping it was observed statistical differences in all observed countries with high influence. In other elements the flexibility of employees' work there were no statistical differences among countries such as higher quality work, friendliness towards guests, no influences on work with guests, satisfaction with work results, and no effect on how they feel. It could be noted that in observed countries tipping influences some aspects of work flexibility which means that tipping could be used as a management tool to reduce or enlarge work flexibility in the mentioned aspects on the second side tipping policy is not an interesting tool for dealing with other elements of work flexibility.

5. CONCLUSION

Research on the impact of tipping on work flexibility reveals a complex relationship. On one hand, workplace flexibility, including the ability to work from home and adjust schedules, has been associated with improved well-being and work-life balance (Ray & Pana-Cryan, 2021) (Hill et al., 2001) (Shagvaliyeva & Yazdanifard, 2014). However, this flexibility can also lead to work intensification, where employees trade flexibility for increased effort (Kelliher & Anderson, 2010). The type of flexibility also matters, with regular working hours and control over working time being important factors in reducing sickness absence and maintaining work-life balance (Olsen & Dahl, 2010). Despite these potential drawbacks, the benefits of workplace flexibility, particularly in the post-COVID era, are significant, including increased productivity and employee well-being (Stella et al., 2020; Possenriede, 2014).

The study provides useful information on tipping as both an extrinsic motivational instrument and a component of flexible reward systems in service sectors of post-communist nations—Slovenia,

Montenegro, Croatia, and Bosnia and Herzegovina. The results are that tipping regulation significantly affects employee motivation with respect to reward systems; however, its impact on other motivation elements, such as job satisfaction, interpersonal relations, and work quality, appears to be low.

In addition, the culture of tipping has a considerable influence on most aspects of work flexibility, including readiness to work overtime, financial motivation, absenteeism reduction, and attitudes towards non-sharable tips—demonstrating much variation in the nations surveyed. On the other hand, the impact of tipping is seemingly small or erratic on employees' friendliness, job satisfaction, and emotional responses to guest interactions.

The findings indicate that, although tipping may be a useful managerial strategy for improving some elements of labour flexibility, it is not a sufficient elixir for facilitating all elements of employee participation or performance. Service and hospitality industry employers must take into account existing local cultures and regulatory environments when crafting tipping policies, and incorporate tipping as an element within more comprehensive, systematic human resource programs. Further research should cover a larger geographic region and incorporate a greater sample size to substantiate these results and examine long-term effects.

Applicability of the Research:

The results of this research will be useful for employers in service companies, helping them understand how they can collect and distribute tips in a way that will motivate employees and improve their work flexibility. The results will also be useful for employees in service companies, helping them understand how they can influence the way tips are collected and distributed.

Limitations of the Research:

This research has some limitations as the research is limited to a small number of service companies. Despite these limitations, we expect this research to provide valuable insight into how employers in service firms collect and distribute tips, what factors influence these decisions, and how tipping policies impact employee satisfaction and motivation. However, the small sample size may affect the generalizability of the findings. Furthermore, data was primarily collected through interviews and self-reported surveys, which could introduce bias or inaccuracies due to subjective responses. Future research could benefit from a broader dataset, including multiple service sectors and geographical areas, as well as incorporating quantitative performance indicators to support qualitative findings.

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Social Responsibility as the Foundation of a Company's Image

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Abstract:

Purpose: *In today's globalized business environment, social responsibility is key to successful business. Companies are increasingly aware that their actions affect financial results, the community, and the environment. In this context, socially responsible business (CSR) is an ethical obligation and a strategic approach that can significantly shape a company's image.*

Results: *One of the key findings of the research relates to consumer trust. More than 75% of surveyed companies reported that consumers perceived their business more positively after actively participating in social initiatives. This increase in trust is directly related to increased customer loyalty, resulting in increased repeat purchases. In the context of increasingly strong competition, this perception can be a decisive advantage in the market. Such an atmosphere not only improves the working environment but also increases the productivity and creativity of employees.*

Conclusion: *In conclusion, the results of this research indicate that social responsibility is the key foundation of corporate image in the Republic of Croatia. CSR not only improves perception among consumers and employees but also contributes to financial success and business sustainability.*

1. INTRODUCTION

In today's business environment, where consumers pay more and more attention to the ethical aspects of business, social responsibility becomes a key factor in shaping a company's image. Social responsibility, which includes environmental, social and economic aspects, not only improves the company's reputation, but also contributes to its long-term sustainability (Leaniz & Bosque, 2013) and performance. In this context, consumers, investors and employees increasingly prefer cooperation with companies that demonstrate social and environmental responsibility. Increasing competition in the market further emphasizes the importance of a positive image, which can be achieved through active participation in social initiatives and sustainable development. Social responsibility can also influence consumer decisions, as customers often choose products and services from brands that stand for ethical values. This creates a cycle of positive influence, where responsible business leads to greater customer loyalty and strengthening of the market position. Social responsibility is not only a moral obligation but also a strategic tool for building a company's reputation and image (Tai & Chuang, 2014). Organizations that recognize and actively work on their social obligations gain a competitive advantage and strengthen their position in the market. Therefore, we will explore different aspects of social responsibility and their impact on the corporate image, analyzing how this

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concept has become an integral part of business strategies. The main goal of the work is to clarify how social responsibility can serve as a basis for building a positive corporate image and its long-term competitive advantage.

2. THE CONCEPT OF CSR: DEFINITIONS AND CHARACTERISTICS

Insistence on Corporate Social Responsibility (CSR) is increasingly present in organizational communication, primarily due to growing demands for transparency in financial reporting, as well as reflection on the impact on the organization and society (Orbaningsih et al., 2021 ; according to Rosak-Szyrocka et al., 2022, p. 210). The concept of corporate social responsibility (CSR) is not new, and numerous organizations have been trying to answer the question of how CSR affects environmental and social issues for almost 50 years (Auld et al., 2008 ; Carrera, 2022 ; according to Kurtulan & Begeç, 2023, p. 1). CSR must be clearly defined at the organizational level, and the inflation of the interpretation of this term (Virvilaite & Daubaraite, 2011) opens the possibility of multiple interpretations (Marakova et al., 2021). Early definitions related to CSR focused on corporate activities outside economic and legal frameworks. CSR contributes to the improvement of life in the community, but also to the individual's sense of well-being (Vaitkevicius & Stukaite, 2009 ; according to Virvilaite & Daubaraite, 2011, p. 544), as well as more effective management of human resources. He compares Carroll's definition of CSR from 1991, which counts four levels of responsibility (ethical, legal, economic and philanthropic), whereby he considers economic to be the most important, with Lantos' systematization from 2002, which lists the following levels: ethical, altruistic, strategic and the level of responsibility (Caroll, 1991; Lantos, 2002 ; according to Virvilaite & Daubaraite, 2011, p. 535). Although the concept of CSR originated in the USA, Rosak-Szyrocka et al. (2022) warn of the somewhat paradoxical fact that it is mostly applied in European countries. Today, CSR is an indispensable part of the business strategy of most organizations that „try to integrate it into all levels of corporate life" (Trbušić et al., 2019, p. 49). The concept of CSR according to the World Business Council for Sustainable Development (WBSD) encompasses responsible and ethical activity of the organization in the community, which contributes to ensuring the well-being of internal and external stakeholders and society as a whole (Islam, 2023). Also, it can have a stimulating effect in the context of consumer engagement.

The analysis of previous CSR research in Croatia shows a lack of a clear concept of CSR in companies. In Croatia in 2013, according to UNDP research prepared by Stuart Black from 2008 , there were about 200 companies that applied this concept (HUP, 2013; according to Trbušić et al., 2019, p. 53). The role of the Croatian Business Council for Sustainable Development (HRPSOR) in this context is indispensable, since this body monitors organizational reporting on sustainability, but also provides continuous education related to effective corporate management. Potočnik et al. (2019) state that many companies under CSR mean the short-term philanthropic activities of the organization instead of the entire business, which includes internal stakeholders, but also the external public. Furthermore, they believe that most companies in Croatia still view the concept of CSR as a cost, calculating the actual effects of its application (Medenica-Mitrović & Popović, 2019). An additional problem is the absence of a CSR strategy, as well as insufficient incentive measures (Trbušić et al., 2019, p. 121).

CSR is becoming an important part of the strategic planning of many companies due to social, global and environmental crises. According to PR Newswire, the green technology and sustainability market in the US alone is worth $28.6 trillion today and is expected to grow to $134.9 trillion by 2030. They state that CSR management today mainly relies on activities that are ethical, sustainable and responsible - towards the individual, but also the community as a whole (Benessia & Funtowicz, 2015 ; according to Lee & Jeong, 2022, p. 2). The above also requires responsible

leadership, and ethical individuals, as well as appropriate policies, are important for making ethical decisions (Bovee & Thill, 2021). Responsible action also affects knowledge about the organization, as well as the perception of its values and image. The connection between CSR and brand image affects the level of trust as well as the creation of brand/organization loyalty (Becker-Olsen & Hill, 2006 ; O'Connor & Meister, 2008 ; according to Lee & Jeong, 2022, p. 2). Trust in a brand refers to consumer expectations that a brand should fulfill, as well as sharing values with consumers (Chaudhuri & Holbrook, 2001 ; according to Lee & Jeong, 2022, p. 2).

Better CSR attracts investors (Hussain et al., 2019; Marakova et al., 2021) and brings multiple benefits to the organization such as 1) a good corporate image as a result of transparent action, 2) better engagement/connection with clients in a stronger and more sincere context interaction, 3) creating a sense of (co)operation and belonging to the brand/organization and 4) strengthening loyalty and devotion (Sons, 2022; Voung & Bui, 2023). Furthermore, Asemah et al. (2013) point out the following benefits of CSR implementation: „1) strengthening the brand and reputation, 2) reducing operating costs, 3) attracting new customers, 4) balance between power and responsibility, 5) discouraging the authorities in business regulation, 6) promotion of long-term profit, 7) recognition of moral business duties, 8) improvement of relations with the investor community for the purpose of better access to capital, 9) improvement of relations with employees, productivity and innovation, and 10) strengthening of relations with the community through stakeholder engagement" (Asemah et al., 2013, p. 50-51).

3. CSR AS A TOOL FOR STRENGTHENING ORGANIZATIONAL IMAGE AND REPUTATION

„A company's reputation is part of an intangible asset" states Klopotan (2021, p. 2) and recalls its growth and role in ensuring competitiveness. Reputation is made up of the perceptions of various stakeholders, which relate to the attitudes and expectations of each of these groups, which may or may not be satisfied. Building a reputation is a long-term and painstaking process based on excellent communication based on the application of CSR. Furthermore, CSR serves as an indispensable tool for building and strengthening reputation and corporate image (Demeke & Ravi, 2024). It is about how others see us (clients, employees, the public in general), and this can be achieved by their active involvement in the process of creation of CSR.

The public plays an increasingly important role in creating a corporate image, and this same public is also increasingly demanding and particularly sensitive to the application of CSR, especially in the context of environmental protection. Recently, many organizations are turning to green topics to build a sustainable corporate image (Alam & Islam, 2021), mostly in the context of growing concern about the devastating impact of climate change on the individual and society as a whole. However, insisting on sustainability may also include reliance on greenwashing techniques (Vuković et al., 2023) as part of unwanted marketing and communication practices. In five-year studies, McKinsey and Nielsen IQ investigated the effects of ESG claims on consumer behavior in terms of whether they change their behavior, whether they affect trust in the brand, etc. The results did not prove a connection between ESG statements and purchase decisions. Furthermore, reliance on greenwashing techniques exposes organizations to reputational risk and a decline in consumer trust in brands. The results showed that consumers pay attention to ESG claims on products, but also that brands that rely on ESG achieve certain growth (Bar Am et al., 2023).

Babić observes the structure of the corporate image through 6 elements, „manager's image, business policy, organizational structure and organizational culture, market identity, product/

service image and visual identity“ (Babić, 2012, p. 278). Furthermore, the corporate image consists „of product image, brand image and brand consumer image“ (Worcester, 2009; according to Virvilaite & Daubaraite, 2011, p. 536). A positive corporate image is important for employees, but also for customers, since it affects sales, as well as consumer confidence, and requires continuous review and adjustment. It is easier to retain clients who associate CSR with positive outcomes of corporate communication (Simbrisio et al., 2021). On the other hand, exposure to negative information undermines the image of the organization, as well as trust in it. The level of client satisfaction depends on their experiences, but also on the perceived value of the organization's image (Ueltschy et al ., 2007; according to Dawood, 2019, p. 38). The perception of the corporate image can be inaccurate, so managers have a great responsibility in managing it. It is a long-term and demanding process that can have direct and indirect effects - in the first group, we include the creation of a desirable public attitude, and the loyalty of internal stakeholders (employees, owners, management), and in the second the growth of sales, productivity and profits in general (Babić, 2012, p. 279). Research conducted by Babić in 2004 showed that Croatian citizens consider the attitude towards employees in the first place, and social responsibility in the second place (Babić, 2012, p. 280). The results of numerous studies have shown that corporate social responsibility (CSR) has a positive effect on brand image, but also that there is no direct connection with consumer satisfaction and trust. On the other hand, the brand image serves as a mediating variable between CSR, satisfaction and trust. Thanks to the development of technology, consumers are more aware and critically analyze information before deciding who to trust.

4. RESEARCH RESULTS

Consumers are increasingly inclined to associate social responsibility with a positive brand image. Namely, the results so far have shown that brands that actively participate in social initiatives achieve greater consumer loyalty, which suggests that ethical practices are becoming increasingly important in the process of making purchase decisions. The results indicated that stakeholders, including investors and local communities, are placing increasing expectations on companies in terms of social and ethical standards. Failure to meet these expectations can result in reputational risks and a loss of trust. These conditions indicate that social responsibility is not only an ethical obligation but a key factor in creating and maintaining a positive corporate image. In this context, the research for the purposes of this paper is focused on identifying concrete strategies and practices that companies can apply in order to make the most of the benefits of CSR in strengthening their image. This research aims to analyze the role of social responsibility (CSR) as a fundamental factor in shaping and maintaining a company's image. The research focuses on understanding how socially responsible practices affect the perceptions of stakeholders, including consumers, employees and investors, and how failure to meet their expectations can result in reputational risks.

According to what was stated, the objectives of the research are:

- identification of key elements of social responsibility that contribute to the positive image of the company;
- analyze stakeholders' expectations of companies in terms of ethical and social standards, and the consequences of not meeting these expectations;
- investigate the perception of consumers and employees about socially responsible practices and their impact on purchasing decisions and satisfaction with the work environment;
- develop recommendations for companies on concrete strategies and practices they can implement to improve their image through active participation in social responsibility.

The hypotheses that will be tried to be proven by the research are:

Hypothesis 1: There is a positive correlation between the level of corporate social responsibility and consumer perception of brand image.

Hypothesis 2: Failure to meet stakeholders' expectations regarding social responsibility leads to reduced trust and reputational risks.

The research was conducted in several retail chains (areas of the city of Zagreb, Varaždin and Čakovec) in two weeks on a sample of 520 respondents in the period from June 15, until June 30, 2024. Respondents were selected randomly at the exit of the stores, which ensured the diversity of the sample in terms of age, gender and socioeconomic background. All respondents were informed about the purpose of the research and asked to participate anonymously, thus ensuring their privacy and freedom of expression. A survey consisting of 50 questions based on a Likert scale was used as an instrument for data collection. The questions focused on perceptions of social responsibility, impact on brand image and purchase decisions. Respondents were encouraged to give honest answers that reflected their actual attitudes and behavior. After collection, data were processed using statistical methods. The analysis included descriptive statistics as well as correlation analysis to examine the association between the level of social responsibility and brand image perception. The results will enable the identification of key factors influencing consumer decisions.

The survey, which included 520 respondents, showed a diverse socio-demographic structure that helps in understanding the perception of corporate social responsibility among different groups. By analyzing the age, gender, number of family members and monthly income of the respondents, important conclusions can be drawn about the demographic characteristics of the participants. In the analysis of the respondents' gender, the majority of participants are women, who make up 65% of the total sample (338 respondents). This significant representation of women may indicate their active role as consumers, which is important for understanding how corporate social responsibility affects their perception and purchase decisions, but it may also be a kind of limitation. The most represented age group among respondents was between 35 and 40 years old, which makes up 30% of the sample (156 respondents). This age group often represents stable and informed consumers, who are aware of social issues and expect companies to actively engage in social responsibility. The next most represented age groups include those from 25 to 34 years (25%) and from 41 to 50 years (20%), which indicates that the majority of respondents are in middle age when they are more financially stable and more involved in making decisions about consumption.

Regarding the number of family members, most respondents (30%) have two members, while 25% of respondents live in a family with three members. This structure suggests that many participants have family dynamics that may influence their attitudes about social responsibility, as they are often motivated by concern for the future of their children and community. Interestingly, 20% of respondents live independently, which may indicate a growing trend of independence, especially among young women. When it comes to monthly income, the most represented category are respondents with incomes between 500 and 1,000 euros (40%), while 25% of respondents earn between 1,001 and 1,500 euros. This financial stability may indicate a greater tendency of consumers to value corporate social responsibility, as they tend to think about the ethical and social aspects of their purchases. In comparison, 15% of respondents earn less than 500 euros, which indicates that some participants may be in more sensitive financial situations, which may affect their priorities and expectations from the company.

Table 1 shows the Cronbach Alpha coefficient, which was measured on 50 items, i.e. particles that were evaluated by the respondents using a Likert scale. Based on the obtained data, the coefficient is 0.783, which indicates an acceptable level of reliability. But if two items were removed, namely: *If the company does not apply any form of socially responsible business, to what extent can that company be successful?* and *Does the image depend on corporate social responsibility?* Then the Cronbach Alpha coefficient would be 0.864, which indicates very good reliability.

Table 1. Cronbach Alpha coefficient

Reliability Statistics	
Cronbach's Alpha	N of Items
0,783	50

Source: Own research

Table 2. Measures of mean and dispersion, and internal reliability coefficient (Cronbach Alpha) of the scale of expectations between corporate social responsibility and consumer perception of brand image

	N	**Arithmetic mean**	**SD**	**Minimum – maximum**	**Cronbach Alpha**
Social responsibility has a positive impact on the impression.	520	4,31	0,9	1 – 5	0,864
Socially responsible initiatives have a positive effect on the appreciation of brand significance.	520	4,20	0,9	1 – 5	
Social responsibility programs enhance reputation.	520	4,13	1	1 – 5	
Brands that are more active in social initiatives attract my attention more.	520	4,11	1	1 – 5	
Socially responsible companies have better quality products.	520	4,10	1	1 – 5	
Corporate social responsibility helps build an emotional connection between me and the brand.	520	4,07	1	1 – 5	
Strengthening the brand image through social responsibility has a positive effect on my trust in the company.	520	4,06	1	1 – 5	

Note: ratings are given on a Likert scale from 1 to 5
(1 – extremely low expectations, 5 – extremely high expectations)
SD – standard deviation

Source: Own research

In the framework of the research focused on brand perception through the prism of corporate social responsibility, items were selected that directly measure the key dimensions of the model: 1) Brand perception, 2) Product quality, 3) Corporate social responsibility and emotional connection, 4) Importance of CSR for reputation and 5) Importance of CSR for price. The following items, divided into two subdimensions ("Values and ethics" and "Contribution to the community"), were excluded from the analysis for two reasons:

1. Conceptual overlaps with existing dimensions. Items measuring personal values ("Values and ethics") often showed high correlations among themselves, but were not clearly distinguished from dimension 3 (emotional connection and image). They reflect the general social and ethical orientation of the respondents, and not the specific perception of the brand or its CSR activities. Therefore, their inclusion would violate the purity of the factor structures and make the interpretation of the main variables more difficult.

2. Factor analysis and reliability of the measure. The particles "Contribution to the community" - although conceptually important - in the preliminary explanatory factor analysis showed weak factor loadings (< 0.40) on the primary factors and moderate internal consistency (Cronbach's α < 0.70). They measure the broader social impact and operational aspects of CSR (e.g. investment in education, environmental protection), which differ from the attitudes about reputation and trust that we observe. The inclusion of these particles would increase the heterogeneity of the scale and reduce the comparability of the results with the literature on CSR-perception.

Further statistical analysis of the data, where the differences in average scores for these items were within the range of –0.444 to –0.799 with t-values between –3.0 and –5.4 (df = 251, $p < 0.001$), further confirmed that the exclusion of indicators from other domains (e.g. operational aspects of CSR or broader social loyalty) in the conditions of this model unnecessarily diluted the focus and reduced the interpretability of the measure. It was concluded that the application of clearly defined and theoretically grounded items in the domains of trust, emotions, reputation and image is crucial for achieving valid and reliable results in brand perception research through the prism of corporate social responsibility.

Measures of the mean and dispersion of ratings of expectations from individual elements of corporate social responsibility are shown in Table 2. The highest rating, arithmetic mean 4.31 (standard deviation SD 0.9) for *Social Responsibility has a positive impact on the impression*, for *Socially Responsible Initiatives has a positive impact on the appreciation of brand significance*. 4.2 (SD 0.9), *Social responsibility programs enhance reputation* is next with a score of 4.13 (SD 1), *Brands that are more active in social initiatives attract my attention more* with a score of 4.11 (SD 1), *Brands that have a higher activity in social initiatives attract my attention more* with a rating of 4.1 (SD 1). The lowest expectations are related to *Corporate social responsibility helps to build an emotional connection between me and brand* where the Arithmetic mean is 4.07 (SD 1.1), statement related to *Socially responsible business can be seen in the function of building not only an image but also building an identity and reputation with* Arithmetic environment score 3.65 (SD 1.1) and *The success of the company depends on the application of socially responsible business* with an arithmetic mean score of 3.62 (SD 1.2). The internal reliability coefficient of Cronbach alpha for the scale of expectations of individual elements in the tourist offer is 0.864, which means that it is a good tool for evaluating expectations of individual elements of social responsibility and its impact on the elements of image, identity and reputation, in the examined sample.

In Table 3, with the t-test, we tested the existence of a difference in the assessment of expectations regarding the elements of social responsibility in relation to value creation, trust building and risk reduction. We set the significance level at $\alpha = 0.05$. If the probability p is less than the given significance level (e.g. 0.05) across all "particles" shown in Table 3, it indicates that the effect, difference or association exists in all observed cases, i.e. that the result is not the result of chance and that there is a statistically significant difference. Respondents who evaluated the evaluation of the elements of social responsibility with regard to the perception of the brand have potential, compared to those who evaluated that they have no potential to become a socially responsible company significantly gave the highest rating to the expectation of a particular attraction to the item *"My trust in the brand decreases when I learn about their failures in social responsibility."* (difference -0.587, 95% confidence interval of difference from -0.8 to -0.3, Student's t-test, $p < 0.001$); "Social responsibility programs enhance reputation" (difference -0.533, 95% confidence interval of the difference from -0.8 to -0.3, Student's t-test, $p < 0.001$), while the least "*Perception of reputational risk increases when a company does not fulfill its social promises."* (difference -0.494, 95% confidence interval of the difference from -0.8 to -0.2, Student's t-test, $p < 0.001$).

Table 3. Assessment of the elements of social responsibility on the perception of brand value, increasing trust in the brand and reducing risk

	Assessment of **expectations** regarding the elements of increasing brand value, increasing trust and reducing risk						P*
	Arithmetic mean (standard deviation)		Difference	95% range reliability		t (df)	
	There is none potential	It has potential		From	To		
Social responsibility has a positive impact on the impression.	3,16 (1,1)	3,82 (1,1)	-0,658	-1,0	-0,4	-4,2 (251)	**<0,001**
Socially responsible initiatives have a positive effect on the appreciation of the importance of the brand.	3,64 (1,0)	4,27 (0,9)	-0,632	-0,9	-0,4	-4,8 (251)	**<0,001**
Social responsibility programs enhance reputation.	3,79 (1,0)	4,34 (0,9)	-0,553	-0,8	-0,3	-4,3 (251)	**<0,001**
Socially responsible companies have better quality products.	3,69 (1,0)	4,21 (0,9)	-0,523	-0,8	-0,3	-3,9 (251)	**<0,001**
Corporate social responsibility helps build an emotional connection between me and the brand.	3,49 (1,1)	4,13 (1,0)	-0,642	-0,9	-0,4	-4,6 (251)	**<0,001**
Strengthening the brand image through social responsibility has a positive effect on my trust in the company.	3,54 (1,1)	4,18 (1,0)	-0,640	-0,9	-0,4	-4,5 (251)	**<0,001**
When a company fails to meet expectations regarding social responsibility, I lose trust in them.	3,42 (1,1)	4,12 (0,9)	-0,706	-1,0	-0,4	-5 (251)	**<0,001**
A company's failure to fulfill its social responsibilities can influence my purchasing decision.	3,51 (1,1)	4,25 (0,9)	-0,740	-1,0	-0,5	-5,2 (251)	**<0,001**
When I learn that a company has failed to meet stakeholder expectations, I consider their reputation at risk.	3,31 (1,1)	4,10 (1,0)	-0,783	-1,1	-0,5	-5,4 (251)	**<0,001**
Companies that do not fulfill their social responsibility create greater risks for their image.	3,67 (1,0)	4,29 (0,9)	-0,619	-0,9	-0,4	-4,6 (251)	**<0,001**
My trust in the brand drops when I learn about their failures in social responsibility.	3,88 (1,1)	4,47 (0,8)	-0,587	-0,8	-0,3	-4,7 (251)	**<0,001**
Failure to meet consumer expectations regarding social responsibility leads to negative comments about the brand.	3,31 (1,2)	4,07 (1,0)	-0,756	-1,1	-0,5	-5,0 (251)	**<0,001**
Companies that do not respect stakeholder expectations regarding social responsibility lose market share.	3,57 (1,0)	4,12 (1,0)	-0,556	-0,8	-0,3	-4,0 (251)	**<0,001**
The perception of reputational risk increases when a company fails to fulfill its social promises.	3,25 (1,1)	3,75 (1,1)	-0,494	-0,8	-0,2	-3,0 (251)	**<0,001**
My attitude towards the brand changes when I learn about their defaults in social responsibility.	3,24 (1,2)	4,04 (1,0)	-0,799	-1,1	-0,5	-5,2 (251)	**<0,001**
A decrease in trust in a brand due to not meeting social expectations may lead to my decision to stop buying their products.	3,78 (1,1)	4,22 (0,9)	-0,444	-0,7	-0,2	-3,3 (251)	**<0,001**

* t-test

Source: Own research

Table 4. Correlation matrix between corporate social responsibility and corporate reputation and image

Variable 1	Variable 2	Pearson coefficient (r)	p-value	Significance
CSR – Transparency	Image and reputation	0,65	0,000	**
CSR – Ethics	Image and reputation	0,58	0,001	**
CSR – Community Engagement	Image and reputation	0,62	0,000	**
CSR – Consumer Trust	Image and reputation	0,70	0,000	**

Source: Own research

All CSR dimensions show a statistically significant and positive correlation with the perception of corporate image and reputation. Consumer trust has the strongest influence, while ethics and community engagement also play an important, but somewhat more moderate, role.

This confirms that corporate social responsibility has a direct and measurable impact on strengthening brand reputation.

Social responsibility not only encompasses economic and environmental aspects but also extends to social dimensions, which play a significant role in how consumers perceive brands. The research shows that the social responsibility of the company has a positive effect on the consumer's impression of the brand, which is manifested through several key aspects. First, many consumers believe that corporate social responsibility improves their brand image. When consumers know that a company actively implements socially responsible initiatives, it significantly increases their perception of the brand's quality and ethics. In this sense, social responsibility becomes synonymous with reliability and commitment to the community, which can lead to a strengthening of the emotional connection between the consumer and the brand. Also, companies that have strong social responsibility programs often enjoy a better reputation in the eyes of consumers.

This reputation, built on the foundations of ethical business and social engagement, enables brands to stand out in a competitive market. Consumers, looking for qualities such as sustainability and social impact, increasingly choose brands that share their values, which further confirms the importance of social responsibility. Social responsibility also affects purchasing decisions. Consumers often believe that companies that actively participate in social initiatives offer better quality products or services. This perception of quality is often the result of the belief that socially responsible companies are more inclined to maintain higher standards in production and business. When consumers are satisfied with a company's social engagement, it contributes to a positive brand image, which increases loyalty and trust. Furthermore, brands that are active in social initiatives attract the attention of consumers more than those that do not. This attention can manifest itself in the form of positive marketing, referrals and word of mouth, further strengthening the brand image. Strengthening the image through social responsibility has a positive effect on consumer trust, creating a virtuous cycle that encourages further consumer engagement.

Finally, it should be noted that companies that ignore social responsibility often experience negative reactions from consumers. Such brands may lose reputation and trust, which may lead to reduced sales and market share. In today's world, where information is readily available, negative news about corporate social responsibility spreads quickly and can have long-term consequences for a brand's image. The perception of social responsibility and brand image can vary among consumers, depending on their personal experiences, values and beliefs, making it difficult to generalize about consumers. Accordingly, the subjectivity of perception is the main limitation of this research.

Social responsibility and corporate image can change over time, and the results of the research should be viewed in the context of the time when the research was conducted. Participants may be biased towards socially desirable responses, which may distort actual attitudes and perceptions.

The research aimed to examine the relationship between different dimensions of corporate social responsibility (CSR) and the perception of corporate image and reputation. Based on the correlation analysis between CSR variables and the perception of corporate image, we can draw clear conclusions in relation to the hypotheses set.

Hypothesis H1: There is a positive relationship between the level of corporate social responsibility and the perception of corporate image and reputation.

The results of the correlation analysis show:

CSR – Transparency and Image: $r = 0.65$, $p < 0.001$
CSR – Ethics and Image: $r = 0.58$, $p = 0.001$
CSR – Community Engagement and Image: $r = 0.62$, $p < 0.001$
CSR – Consumer Trust and Image: $r = 0.70$, $p < 0.001$

All coefficients show a moderate to strong positive correlation, and all results are statistically significant at the $p < 0.01$ level, meaning that there is a very low probability that these results are due to chance.

The strongest correlation was recorded between consumer trust and image ($r = 0.70$), confirming that it is the emotional and ethical component of CSR that contributes most to creating a positive image of the company. On the other hand, other dimensions, such as transparency and community engagement, also have a significant contribution to building reputation.

The results confirm that consumers respond positively to corporate social responsibility. When companies are transparent, ethical, involved in the community and foster trust, their reputation and image are strengthened.

This is in line with previous research in the literature, which suggests that CSR activities act not only as a moral obligation, but also as a strategic tool for strengthening market position and brand differentiation.

The correlation analysis conducted provides a strong basis for confirming this hypothesis. First of all, the dimension "CSR – Consumer Trust" showed the highest correlation with the perception of image and reputation ($r = 0.70$, $p < 0.001$), which unequivocally confirms that trust is strongly related to the socially responsible behavior of a company. In other words, when consumers perceive that a company acts in accordance with social and ethical expectations, their trust increases, and with it a positive perception of the image.

At the same time, within the items used in the research, we find statements that directly point to the negative consequences of not meeting social expectations, such as:

"When a company fails to meet expectations in terms of social responsibility, I lose trust in it."

"My trust in a brand decreases when I learn about their failures in social responsibility."

"When I learn that a company has not met the expectations of stakeholders, I believe that their reputation is at risk."

"Companies that fail to meet their social responsibility create greater risks for their image."

These statements are not only indicators of perception, but also measuring tools that directly operationalize hypothesis H2. Positive and significant correlations between these claims and the image construct show that failure to fulfill CSR obligations is not neutral - it activates a decrease in trust and an increase in reputational risks, which confirms the hypothesis.

5. CONCLUSION

In conclusion, it was confirmed that all the CSR initiatives examined had a statistically significant impact on improving the perception of brand value and consumer trust, as evidenced by the average differences of -0.444 to -0.799 in the "before" and "after" scores, with t-values ranging from -3.0 to -5.4 ($df = 251$, $p < 0.001$). This empirically supported the fact that consistent implementation of socially responsible practices causes a shift in positive brand experience, while failure to meet these obligations increases perceived reputational risk and negative effects on purchase intention.

It was further emphasized that strengthening the image through CSR activities acted synergistically to strengthen competitive advantage and enabled the creation of an emotional connection with consumers, which resulted in broader social and environmental benefits. Based on the results obtained, it can be concluded that the integration of CSR into strategic management is not just an ethical choice, but a key factor in the sustainable development of a company, community and environment, and is considered equally important for success in modern business as the achievement of financial goals.

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French and German Negotiation Styles

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Abstract: *France and Germany have played important roles in the last centuries, and they are two important players in the European Union; even if they are based on the same establishment - Roman Empire influence - they have grown up in quite different manners. This is due to their diverse cultures. One culture is cartesian, while the other is dialectical. This gives them distinction in the way of seeing the world, acting, negotiating, and building the state's institution and the relationship between the state and society. The paper intends to analyse these differences and how they impact the negotiation styles of people emanating from these cultures.*

1. INTRODUCTION

Two nations located on an old continent, sharing a common border are very different. The paper aims to present them in comparison and to shape differences, what generated them, and how they influence two cultures that underscore specific general behaviour and peculiar negotiating styles. Even the whole continent shares two common traits – as Roman law and Greek philosophy transcending Christianity – all countries, and in our specific case, Germany and France, developed along quite different paths, resulting in distinct world views reflected in different negotiating styles. There is a remarkable variety of customs, manners, and forms of social organization (Cohen, 2002, p. 10) which is reflected in peculiar negotiation styles; which is also true regarding Germans and French, too. Three key aspects of culture are of utmost importance (Cohen, 2002, p. 10): it is a quality not of individuals, but of the society where these individuals spring from; it is acquired through acculturation and socialization by individuals from their respective societies; each culture is a unique complex of attributes regarding areas of social life, including here *negotiation*, which is first of all a *social process*, beyond being the central function of diplomacy as a mean of promoting specific (national) interests.

2. GEOGRAPHY AND HISTORY

Both these nations belong to the Old Continent; they are close neighbours, sharing a common border of 450 km, a part of it being along the Rhine river with a length of some 200 km. Natural elements, rivers especially, are integrating factors from a social point of view; they promote human settlement and civilization's evolution, with people sharing common interests and developing in common interaction. But the effects of rivers upon the regions through which they flow tend to alternate between unifying regions culturally and politically, and making a political boundary of the same river.

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As Mommsen (1991) mentioned, the Italics and Greeks were brothers, while Celts, Germans and Slavs, were their cousins; in this context, in ancient times, Germanic tribes settled on both sides of the lower Rhine valley, while Celts went to its upper course. As Roman influence spread in Gaul, especially following Julius Caesar's conquering of Gaul, the Rhine river, even though it was bridged and crossed multiple times by this legendary historical figure, became for the first time along its course from Lake Constance to its mouth at Lugdunum Batavorum (present-day Leiden, in the Netherlands) the *border* of the Roman Gaul. Since then, people on both sides of the river – even though they have been very close from the geographical point of view – have developed along quite different paths; Celts, strongly influenced by Roman law, *centralized* administration and language, while Germans developing along a quite different path with multitude layers of overlapping authority. Furthermore, as a centralized France has been located in the Western part of Europe, protected by easy defensive borders but one, on its North-Eastern part, Germans located in the heart of Europe, have been divided along a *multitude* of tribes and authorities with sovereignty over much smaller geographical areas, with only one easy defensive border in the South-Western.

The location of both France and Germany frames their diplomacy, historical evolution, culture, and negotiators' behaviour. As France appeared as a nation-state four centuries before Germany (Ergang, 1971, p. 31), Germans arrived to often call themselves the delayed nation, *die verspatete Nation*. Before that, during the large span of time of the Middle Ages and after the Renaissance, the German nation was the core of the Holy Roman Empire established in 962 and covering an area from Hamburg to Rome, and from Aachen to Prague. The space of present-day Germany was formed by a puzzle of aristocratic ownerships and lands belonging to the church, with changing numbers, but always counting into hundreds. Looking at France, it spreads from one ocean to the Mediterranean Sea, but there manifests a latent cultural divide in this country: there is a more austere temperament in its northern part, while in the South-East the Latin character is more pronounced, this divide is marked by an imaginary line from Saint-Malo to Geneva (Chartier, 1997, p. 2819).

Germans over most of their history functioned within a multiplicity of associations, between larger and smaller states or ecclesiastical possessions and farmers, tradesmen, merchants, and silversmiths; every profession, and form of activity has its association (Smyser, 2003, p. 17). Within the shelter of those associations, an aristocrat, a merchant, a family or a small group might find the equivalent of personal autonomy (Smyser, 2003, p. 17).

In opposition to this evolution stands France's; with its centuries-old tradition of a centralized state radiating from Paris, the French nation imagines the State as the founder of the entire life of the nation, giving to French state almost a corporeal notion (Cogan, 2003, p. 13).

As a consequence of these two different historical evolutions, French negotiators highly wanted to defend the position of the state, reaching an agreement being for him of secondary importance; while Germans focused on the peculiarity of any proposal to fit in a logical framework and they are inclined to work hardly to reach consensus. German geography and their specific culture of associations compelled Germans to find ways to identify common solutions and to avoid isolation.

For a French being isolated is not a problem – on the contrary – for a German, it is the most must-avoidable situation. French are characterized by a culture of opposition to the dominant norms – and so being isolated is a quality – while Germans are in search of consensus through compromises – so being isolated is for them avoidable almost at all costs. Their different history, which was influenced in the greatest part by their geography, has shaped the evolution distillated in these differences.

3. POLITICAL CULTURE AND PHILOSOPHY

France, by its history, "has developed a reflex of revolt" (Nora, 1992, p. 2998), which is connected to ancient Gaul culture characterized by curiosity, and audacity, but which can be followed by a quick changing of mood; reflex of revolt is linked to a formalistic and hierarchical style passing through a "divine right" monarchy, a statist bureaucratic centralization down to all social relations to couples and families; France is "the land of command"! (Nora, 1992, p. 2998) At the same time, French political culture is characterized by a permanent oscillation between servility toward authority and sporadic repulsion towards it (Knapp & Wright, 2001, pp. 202-203).

In contrast, Germans share a culture based on a tradition of *divided authority* (Smyser, 2003, p. 67) marking especially German evolution during Holly Roman Empire; as a consequence, Germans believe that a collective construction is a strong barrier against a possible concentration of power and decisions in a single place, individual, or party (Smyser, 2003, p. 63).

Even transport networks in these two neighbouring countries reflect two different political cultures: in France, Paris is the capital which concentrates all motorways and railroads, beyond being at the same time the principal banking, administrative and political centre, Paris behaving like a spider which controls the evolution of movement of this network, while in Germany one cannot tell which is the most important transportation hub. Munich and Frankfurt are more important than Berlin, Frankfurt is best connected to global finance, Munich (Bayern) and Stuttgart (Baden-Wurtemberg) to research and development with applications in industry, while Hamburg and Bremen facilitate the global connection of Germany to the world economy; Berlin is connected to centralization of Germany during the second part of the nineteenth century and to present day political (partial) centralization.

French are inspired by reluctance to compromise and missing of a backup plan in case French fail to persuade their counterparts with their opening arguments (Cogan, 2003, p. 12) addressed in a Cartesian logical manner and clear presentation (Cogan, 2003, p. 49) with audacity, conversational ability, wit, elegance of expression (Bell, 2001, p. 159). So it is possible that if the other party doesn't follow their point, they can retreat into isolationism, which does not bother them too much, while this is the most avoidable result for a German.

In contrast to this manner, German listens carefully and after that, he presents the arguments framed by a *Gezamtkonzept* (a general framework) in a very clear manner to avoid any misunderstanding and to come to an agreement without unnecessary delay (Smyser, 2003, p. 17). For Germans, the search for consensus and social peace (Wilson, 1999, p. 18) is a core guiding principle in every negotiation; they do not negotiate for their own sake!

If French are audacious, having a taste for confrontation and aggressiveness in verbal exchanges (Cogan, 2003, p. 19), German counterparts could be – and always are – less vocal, but they are tough, purposeful, determined, assertive, haughty and unbending (Smyser, 2003, p. 19).

We can say that the French are Cartesians, which means that French negotiators emphasize rationalism to the point of abstraction, which generates a deductive mode of reasoning; they identify basic principles, and afterwards, they deduce content, the approach being a top-down one, from the general to particular. Great emphasis is put on logical and clear presentation, giving them the feeling that they are right, even in such cases that others around them may not agree; they don't care about being right, and *alone* at the same time (Cogan, 2003, pp. 48-52).

Contrasting this, lacking political focus, German philosophy has focused on the internal process of the mind, on the logical rationalism pointed out by Leibnitz and on moral issues far from the world of politics. But it influenced the way Germans see the world, as Fichte indicated that the idea was more important than the thing, subjective thought leading better to truth than objective observation, which is peculiar to Anglo-Saxons. Furthermore, Hegel strengthening the importance of ideas saw the movement of Spirit and the progression of history as an advance dominated by dialectic, and that what is real is the rational.

French stresses linear logic while German is dialectic, both placing deductive reasoning on a higher stage than inductive reasoning. For Germans, nothing can be real without a concept to make it real; that for *Gesamtkonzept* is at the core of German negotiating style; everything must fit in this general framework. As Heine put it, France and Russia controlled the land and England the seas, Germans owned "the realm of dreams" (Stern, 1987, p. 3).

Related to education, France has a system of respected training institutions for people who will have positions in France's state institutions and international negotiation teams; they are called *grandes écoles* and we can encounter here ENA (*École Nationale d'Administration*) or Sciences Po; in Germany, members in international negotiations are respected and experienced negotiators, with a large background in Germany's minister of foreign affairs, who could be doubled by representatives from different Germany's lands and business community, with special interests in a specific negotiation. Even the typology of negotiators reflects the historical evolution and philosophical framework of these two nations. For example, in France, the president does not have to consult (and deal with the legislature) if he wants to, which is not the case in Germany. In France, which is a normative country, "there is the *rule* and how it is applied" and this stems from its long history of administration and the rationalist mode of thinking (Cogan, 2003, pp. 111-112). In most cases, French start the discussion; the French interlocutor will often begin by making a speech, seizing the floor; for French, it is important to demonstrate that one's thinking is well founded, and not (necessarily) to arrive at an agreed solution. In contrast, Germans prepare in the minute details everything, listen carefully, and try hard to find a common solution fitting the *Gesamtkonzept*; they do not talk or negotiate for its own sake.

Furthermore, the French need a comfortable negotiation atmosphere, while the Germans can start immediately. This is because French culture is a culture of a higher context, related to Germans' culture - more focused on what is discussed, not how it is done. In a culture of higher context – as is the case of French culture – most of the information is "in the person" or physical context where communication develops; in lower-context culture – as is in Germans' case – most of the meaning and information is to be identified in the message itself. Higher-context communication expressively uses language, while in a lower-context cultural framework, language is instrumental (Avruch, 1998, p. 64). So, relationships are crucially important in high-context culture, while in lower-context the content is at the forefront (Hall, 1976).

Of course, Germans want to build long-term relationships, but they start from the content and keep contact in the aftermath of a negotiation; for the French, on the other hand, building a relationship is far more important, and after that comes the development of further subjects in different fields of interest.

As France is a society of authority, its negotiators seek to get others to accept their point of view, while Germans are inclined to search for grounds that would support consensus. While for the French appearance is important (as in clothing, for example), Germans want to know the content; even proving an argument is, in most cases, done elegantly by a French, while Germans try to argue in a logical manner fitting in their general framework.

4. ENTERTAINMENT

In a negotiation with the French, they bring all aspects of their culture: yet for them, *food* is a vital part of their culture, France has a special relation to food (Ory, 1997, p. 3750). As Germans don't like to bring emotions in a negotiation and try to keep a positive spirit (Smyser, 2003, p. 83), for the French, the emotional tenor of negotiations is important (Cogan, 2003, p. 472); and it manifests in the culinary area, too. "The taste for gastronomy is innate in the race" (Rouff, 1984, pp. 18-19) and it contrasts with German food, which is consistent, but massive, heavy, and thick, like German thought. Yet they are proud of their (white) wine, beer, and music; they cannot use such occasions to impress others with the length of their culinary heritage, but they do the best with what they have (Smyser, 2003, pp. 117-118).

5. CONCLUSION

Taking account of the importance these two countries have at European and global levels – Germany, especially through their products, and France due to its political and cultural influence – the paper wants to present the historical and cultural differences between these two societies and to make us aware of the importance of understanding the background of these differences.

As the negotiation is, first of all, a social process, it is important to identify such main traits, and their base, and to understand them, to help other nationals in dealing with people/negotiators springing from these two countries.

A successful negotiation involves not only reaching an agreement but also upholding the agreed-upon details and fostering a long-term relationship. Understanding the cultural backgrounds of negotiation partners from France and Germany can be key, not just for achieving success in the negotiation itself, but for laying the foundation for future collaboration and development.

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The Curse of Knowledge in Consumer Decision-Making: Bridging the Gap Between Experts and Consumers in Food Marketing

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Abstract: *This study aims to explore the complexity of consumer decision-making through a complex cognitive psychological phenomenon, focusing on food consumption. The paper summarizes the general interpretation of the curse of knowledge and theories related to consumer decision-making. The novelty of the review lies in its focus on food consumption and the broadening of the perspective to include food marketing approaches. Both classic theories and more recent publications are discussed. In this study, the author analyzes the pervasive nature of the curse of knowledge, which extends its influence beyond adults to children. It can be stated that neglecting this phenomenon can have far-reaching consequences, including marketing. The curse of knowledge poses a significant challenge for brands regarding effective communication with their target audience, particularly regarding food consumption. The primary research is a qualitative study. The results of in-depth interviews with food influencers further illustrate the complexity of the problem. The phenomenon may lead to consequences such as the partial or total misinterpretation of messages, or even the complete breakdown of communication. Marketing professionals must understand and navigate the curse to communicate more effectively with their target audience and foster better engagement. At the end of the article, the author outlines future directions and offers suggestions for addressing the curse of knowledge. These approaches could effectively respond to the challenges presented by the ever-changing marketing environment and the impact of the curse of knowledge on consumer decision-making. These future directions include fostering empathy among professionals and using analogies, storytelling, and food influencers in marketing communication.*

1. INTRODUCTION

In the dynamically evolving world of marketing relationships between consumers and brands face constant challenges. Communication between brands and consumers is becoming increasingly complex as consumers gain access to ever-greater amounts of information that can influence their decisions. An intriguing issue in food marketing is that, while in some cases the social media presence of food brands creates value, in others it can have a detrimental effect (Peeroo et al., 2017). Certain forms of branding can also lead to negative consumer evaluations due to the continuous erosion of credibility (Han et al., 2021).

This study aims to explore the challenges of decision-making situations in food marketing, focusing on the challenges related to the consumption of virtual food content. The article delves into the concept of the curse of knowledge, examining its roots in cognitive psychology and its broader implications for the marketing profession. The primary research focuses on food influencers.

The role of influencers in modern marketing is becoming increasingly significant. The success of influencer marketing lies in influencers' ability to establish authentic and direct connections with

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their target audience. Thereby purchasing decisions more effectively than traditional advertisements. Followers trust them, they think their messages are more personal and credible. This is especially important in light of the curse of knowledge phenomenon, where brands' communications often fail to persuade consumers. This article hypothesizes that food influencers bridge the communication gap between brands and consumers. The research focuses on the following two questions:

RQ1: Can food influencers bridge the gap between consumers and brands?

RQ2: How does the curse of knowledge manifest in the context of food influencers?

The goal of creating a comprehensive analysis is to illuminate how marketing professionals can effectively navigate the challenges presented by the curse of knowledge. This understanding is crucial for overcoming hurdles and ultimately building stronger connections with their target audience. The study aims to assist industry players in recognizing ways to overcome the curse of knowledge and establish valuable, long-term relationships with their consumers.

2. LITERATURE REVIEW

An essential part of our social life is the ability to make ourselves understood by others and to understand those who communicate with us accurately. Additionally, a critical skill in social interactions is our capacity to consider perspectives other than our own, which forms the foundation of social interaction. However, researchers have consistently demonstrated that individuals often develop imperfect perspectives and exhibit egocentric biases (Camerer et al., 1989; Birch, 2005; Ghrear et al., 2021; Samuel, 2023; Tullis & Feder, 2023). In striving for effective communication, a specific cognitive bias frequently impacts our ability to accurately convey information we already know to others. This phenomenon, known as the curse of knowledge, has numerous implications across various fields from education to business.

Cognitive biases related to communication skills and the curse of knowledge affect not only individual relationships but also broader societal and business challenges. Previous literature highlights that during the learning process individuals often lose the accuracy of their judgments regarding others' knowledge (Camerer et al., 1989; Birch, 2005; Ghrear et al., 2021; Li et al., 2023; Samuel, 2023; Tullis & Feder, 2023). Assumptions driven by increased knowledge can lead to misunderstandings and conflicts between groups. Tullis and Feder (2023) found that learning and possessing more information decreases the accuracy of judgments about others' knowledge. This occurs not because individuals rely excessively on their experiences but because they lack diagnostic cues about others' knowledge (Tullis & Feder, 2023). Some findings suggest that egocentric biases are more likely to emerge when individuals are more deliberate, such as when making decisions under uncertainty (Samuel, 2023).

The curse of knowledge manifests in various ways in food marketing. For instance, wine consumers who perceive themselves as well-informed about wines are more likely to exhibit choice-seeking behavior (Ellis & Mattison Thompson, 2018). However, the theory of the curse of knowledge posits that better-informed agents may experience losses because they cannot disregard the additional information they possess. Furthermore, well-informed agents typically focus more on the outcomes of their decisions than on the decision-making process itself, often resulting in suboptimal outcomes (Camerer et al., 1989). More information does not always lead to better decisions as individuals may overestimate their ability to predict outcomes accurately. This overconfidence can amplify negative emotions such as regret and self-pity, especially when decisions lead to unfavorable outcomes.

The curse of knowledge is a cross-generational phenomenon as evidenced by research from Ghrear et al. (2021), which reveals that it can be observed even in children. Recent findings in food marketing research highlight that adolescents around the age of 12 are the primary target group for digital marketing communication promoting unhealthy foods (Ares et al., 2022; van der Bend et al., 2022; Kacharczuk et al., 2022). Food advertisements often depict various levels of reality leading less-informed consumers to perceive certain products as healthier than they truly are (van der Bend et al., 2022). The curse of knowledge may partly explain the assertion that a significant mental shift occurs during the cognitive development of children (Birch, 2005). Older generations, already possessing the knowledge expected from the younger ones, find it difficult to imagine a time when they lacked such understanding. This distortion can lead to misinterpretations which are a natural byproduct of the curse of knowledge and affect every generation.

Influencers play a crucial role in food marketing within the digital sphere. Several researchers identify influencers as key drivers of persuasive communication (Giuffredi-Kähr et al., 2022). Influencers simplify and translate brand messages into language and contexts that their followers can easily comprehend and embrace. As external observers of products influencers communicate in ways that resonate with consumers, thereby overcoming the communication barriers imposed by the curse of knowledge. They help brands more effectively convey the value of their products, enabling consumers to connect with the offerings on a personal level.

Navigating the new era of influencer marketing is no easy task, but selecting credible individuals for brand communication is critical. Haenlein et al. (2020) emphasize the importance of identifying suitable influencers for collaboration. This is vital in the industry as influencers are among the most significant factors influencing consumers' food related decision-making processes (Ares et al., 2022; Görgényi Hegyes et al., 2017; Vukolic et al., 2022). The method of delivering information to consumers and their reception of it matters greatly. Beyond misinterpretations, marketers must also address potential cognitive dissonance in their messaging.

The most apparent consequence of the curse of knowledge is miscommunication, and in extreme cases a complete breakdown of communication. In food marketing social media communication plays a particularly significant role. The virtual space has a profound impact on consumers' decisions related to food and gastronomy (Ares et al., 2022; Görgényi Hegyes et al., 2017; Vukolic et al., 2022). Therefore, it is crucial to consider the challenges posed by the curse of knowledge when analyzing influencer marketing communication in this field. I propose that influencers play a pivotal role in bridging the gap as they simplify and clarify product messages for their followers. By bridging the gap between expert and consumer perspectives influencers circumvent the communication challenges posed by the curse of knowledge, thereby enhancing the promotion of products.

The curse of knowledge is a pervasive cognitive bias affecting marketing communication across various domains. Recognizing its existence and implementing strategies to mitigate its impact is essential for understanding consumer decisions facilitating effective learning and improving the efficiency of collaborations.

3. MATERIALS AND METHODS

To address whether influencers can bridge the gap between consumers and brands (RQ1), it is essential to understand how consciously and professionally influencers operate and whether they experience the curse of knowledge (RQ2). Qualitative research involved conducting 11 online

in-depth interviews, guided by a questionnaire consisting of 12 open-ended questions. These interviews aimed to explore the participants' thought processes, gain deeper insights into their operational methods, uncover and comprehend their motivations, and analyze their approaches and habits for resolving marketing challenges. This research design provides a nuanced understanding of influencers' operations, the challenges they face in food marketing, and their potential to overcome the curse of knowledge.

Table 1. Comprehensive table of the food influencers

interview subject	Instagram Followers (in thousands)	YouTube followers (in thousands)	TikTok Followers (in thousands)	Profession
I.	85.3	95.1	4.5	full-time blogger
II.	77.6	8.89	10.5	full-time blogger
III.	4.4	0	0	self-employed, television personality in the sector
IV.	22	0.01	0	not a full-time blogger, employed in another sector
V.	56.5	4.95	2.8	not a full-time blogger, employed in another sector
VI.	16	0.08	5.8	self-employed in the sector
VII.	7.2	0.8	2.2	not a full-time blogger, employed in another sector
VIII.	43.5	0.02	23.9	not a full-time blogger, employed in another sector
IX.	15.3	0	0.003	not a full-time blogger, employed in another sector
X.	35.1	0	7.8	self-employed in the sector
XI.	51.3	0	11.1	self-employed in the sector

Source: Own research

Participants Profile:

The interview subjects were Hungarian food influencers, including several prominent figures in the online gastronomy scene. The group consisted of:

- Influencers whose main platform is YouTube video creation
- Individuals recognizable from several television appearances
- Content creators with significant followings on Instagram and TikTok
- Food influencers who focus predominantly on blogging.

Through the open-ended questions, the goal is to uncover their perspectives on the current online food market, their level of professionalism and intentionality in communication, and their awareness of their audience. Specifically, it is examined whether they could characterize and segment their followers.

Participant Categories and Platform Engagement:

The 11 interview participants were divided into three categories based on their primary professional focus (Table 1).

1. Full-time bloggers (2 participants): Exclusively active on their platforms which serve as their main livelihood.
2. Full-time entrepreneurs (4 participants): In addition to managing their platforms they undertake other sector-related activities such as marketing, product photography, and creative writing for other stakeholders in the market.
3. Part-time influencers (5 participants): Their primary income stems from jobs in other sectors.

Platform Use:

- Instagram: All participants were active on Instagram, with varying levels of engagement.
- YouTube: Three participants regularly produced content, while four others maintained channels without consistent uploads.
- TikTok: All but two participants had a presence.

Based on the research, it can be concluded that a high number of followers is not a condition for activity in the sector to be an individual's primary source of livelihood. High number of followers is not necessary for someone to work in this field full-time, but they need to expand the focus of their activity and work on other sites in some form besides their own (e.g. photography, marketing). However, based on the sample high number of followers is essential for an individual to be a full-time blogger and live exclusively from their platforms.

4. RESULTS

In terms of communication, nine of the respondents do not communicate consciously but rather rely on their intuitions. Six inform, one person primarily uses storytelling, and two people mentioned entertainment: they use words with vague meanings. Absolute objectivity appeared in two additional individuals. In many cases they do not even inform, they only objectively state the name of the cake and the recipe, and they do not color their communications with any adjectives. Interestingly, based on this sample no correlation can be shown between the number of followers and communication. It cannot be established that entertainment and audience involvement would result in a higher number of followers. Surprisingly even with absolute objectivity an exceptionally high number of followers can be achieved when examining the communication strategy, ceteris paribus.

> "For me education is a very important mission. I am not a showman. I understand why things happen in the media, but I can't identify with it. For me, my communication is absolutely educational. When we started the Main Menu (TV show), this was also a problem." – Interviewee III.

> "Sometimes I just write down the name of the cake and the recipe, and nothing else, and I don't think anyone takes it seriously." – Interviewee V.

According to the research the biggest challenge for the subjects is knowing their followers. Out of all 11 subjects only 2 people said they didn't know their followers and couldn't characterize them in any way. The rest of the influencers think they know them completely but when they were asked to characterize them, the opposite was experienced. However, 6 people can make statements and facts about them based on the data, but they can't characterize them in detail.

> "I think 91% of my followers are women, and the 20-50 age group is the largest. So I try to "shoot" at women and shape my content more feminine." – Interview subject VIII.

> "I am not in a confidential relationship with the majority of my followers. There is a certain circle who take pictures of their food and send them to me and give feedback, I am very happy about them. But there are a lot of people who do not react to anything, so obviously I do not know their taste and what they would like to see. I do not expect 50 thousand people to indicate one by one, but... I see that they are young. Mothers are not so typical." – Interview subject V.

The majority of the subjects have an idea of who their followers are and can give facts about them, but the vast majority cannot characterize them or classify them.

Based on the results, analyzing competitors is a mentally stressful process for a significant part of the subjects (6). They consider competitor analysis unworthy of their time and view it as a waste of effort. Although the majority try to analyze website data in some form, most of the respondents lack the knowledge, resources, or motivation to analyze or incorporate insights. The majority (9) believe that the innovative nature of the market is driven by supply. Additionally, most interviewees (7) observe that there are peaks in demand during the autumn and winter seasons, with a decline occurring in the summer and at the beginning of the year, consistently every year. When defining the market, all but one of the interviewees highlighted the significant influence and unpredictability of algorithms used by social media platforms. Most of the subjects (10) attribute a prominent role to visuality in this market, and they try to comply with this to the best of their ability. Overall, it can be concluded that the two full-time bloggers have a more professional approach to many business factors, and it seems that they are making significant efforts to not only maintain their existing competitive advantage but also to increase it in the future.

5. CONCLUSION

The psychological roots of the curse of knowledge stem from the inability to imagine what it was like to live without that particular piece of information. This phenomenon can impact both adulthood and childhood. This study explained that neglecting the curse of knowledge can have serious consequences in the field of marketing. The paper focused specifically on the phenomenon of consumer decision-making within the context of virtual food marketing. By understanding the cognitive roots and analyzing real-life cases, marketers can navigate the challenges posed by the curse of knowledge to build more authentic and effective relationships with their target audience.

Based on the qualitative research, it can be concluded that most food influencers do not communicate consciously, they are very intuitive. According to the curse of knowledge simplicity and clarity should guide communication, for which intuition is the key. This is why they can serve as excellent actors to bridge the communication gap between brands and consumers (RQ1). It should be emphasized and noted that the curse of knowledge also appears in food influencers (RQ2). The reflection of the curse is manifested in the fact that analyzing competitors is a mentally stressful process for a significant part of the subjects and they experience it quite negatively. It is also interesting to note that while the majority of the subjects believe they know their followers, most are actually unable to accurately characterize or categorize them. The study highlighted that different forms of the curse can appear from communication problems to incorrect assumptions about knowledge, and these can hinder consumers' decision-making and the effectiveness of marketing strategies in many ways. Overcoming the curse of knowledge is not just a skill but a necessity in the pursuit of effective communication. Analyzing and comprehensively exploring the curse can provide valuable insights for researchers and marketers alike. Understanding this area is key to effective communication, product management, and marketing strategy development across a wide range of sectors.

6. FUTURE RESEARCH DIRECTIONS

In conclusion, this study explores potential future directions and offers suggestions for practitioners providing a forward-looking perspective on this pervasive cognitive bias. As the marketing landscape continues to evolve, so must our strategies for combating the curse of knowledge. To overcome the curse of knowledge marketers must adopt targeted strategies. Developing empathy in professionals can be a good starting point. If they can put themselves in the mindset of a novice, they can approach a familiar topic with the humility and curiosity of someone hearing it for the first time. This mindset allows the expert to see the topic from the perspective of the learner, which

can improve communication. Breaking down complex ideas into more digestible components should be among the basic strategies for effective knowledge transfer.

Simplicity and clarity should be the guiding principle in communication, avoiding and abandoning unnecessary jargon can result in easier understanding. Therefore, influencers who rely primarily on intuition can perform outstandingly in the sector. Furthermore, storytelling as a marketing communication tool can appear as an effective antidote to the curse of knowledge. The psychological characteristics behind the effectiveness of storytelling in marketing (consumers' recall stories faster than facts (Törőcsik, 2018)) can guide the development of narratives that resonate with the target audience. Creating a hook and metaphors can also be an effective tool for experts to bridge the communication gap. By drawing parallels between well-known concepts and more complex ideas messages become more relatable, comparable, and accessible to the audience. This will help assess the level of understanding of consumers, and then make modifications in the approach to the topic and communication accordingly.

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Managerial and Economic Aspects in the Educational System

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Abstract: *"The leader's task is to be more and more efficient" (P. Druker) "Management renounces its traditional master - profit; it commits itself to the service of value (moral, humanitarian, social, cultural, etc.)." (P. Drucker)*

Education is the main component in the formation of an individual, from a personal point of view, but also professionally, through the development of knowledge, skills and abilities, which are essential for the economic growth of a country.

This paper aims to highlight the economic and managerial aspects present in the educational system of Romania. Management practices, resource management and how the management concept is implemented in the educational system will be analyzed.

Management represents the set of general and specific activities through the efficient use of all resources (human, informational, financial and material resources) to obtain the maximum level of results. In educational management, emphasis is placed on human resources and informational resources. The teacher must be a good manager to manage all situations and to achieve the objectives.

Educational management represents a process that includes the 5 managerial functions (Foresight, Organization, Coordination, Command (Decision, Training-Learning), Managerial control (Evaluation-Control)), to achieve the objectives. Without the element of educational management, the educational system could not function within normal parameters.

This research uses the documentary method to analyze the economic and management aspects of the educational system. The method allows a systematic examination of existing sources, helping to outline a relevant theoretical framework and highlight trends and challenges specific to this sector.

1. INTRODUCTION

Education is the main component in the formation of an individual, from a personal point of view, but also professionally, through the development of knowledge, skills and abilities, which are essential for the economic growth of a country (Rădulescu & Tîrcă, 2002).

The management represents the set of general and specific activities through the efficient use of all resources (human, informational, financial, and material) to get the maximum level of results. In educational management, the accent is on human resources and informational resources, (Stanciu et al., 2003). The teacher must be a good manager who realises all the situation and achieves the educational goals.

Educational management represents a process that includes the 5 managerial functions (Foresight, Organization, Coordination, Command (Decision, Training-Learning), and Managerial control (Evaluation-Control)), to achieve the objectives. Without the element of educational management, the educational system could not function within normal parameters.

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This paper aims to highlight the economic and managerial aspects present in the educational system and, thus, are analysed the management policies, resource management and how the concept of management is implemented in the educational system.

This research uses the documentary method, to analyze the economic and management aspects in the educational system. The method allows a systematic examination of existing sources, helping to outline a relevant theoretical framework and highlight trends and challenges specific to this sector. In the educational system, all these qualitative research methods contribute to a better understanding of the subject and the success of the research. To ensure the validity of the data, we employed the method of theoretical triangulation, interpreting the data through multiple theoretical frameworks.

2. RESEARCH METHODOLOGY

This article is based on documentary research, to analyze the literature and official documents relevant to the approached topic. Various sources were consulted, including national legislation (such as the Law on Pre-University Education no. 198/2023), reports of public institutions (Ministry of Education, National Institute of Statistics), as well as academic works. The sources were selected according to their relevance and timeliness, aiming to ensure a balance between institutional perspectives and critical or analytical ones.

The article aims to provide an argumentative foundation based on credible sources, contributing to the understanding of the phenomenon investigated. The interpretations presented reflect an analytical approach, being open to reinterpretation depending on the evolution of the data or the social and educational context.

3. THE ECONOMY AND THE MANAGERIAL PRACTICES IN THE EDUCATIONAL SYSTEM

The economy plays a significant role in the field of education; therefore, an insufficient budget affects not only the quality of infrastructure but also the teaching process. On the other hand, an adequate budget provides access to modern resources for students and helps attract qualified teaching staff—factors that are essential for effectively preparing students for the labour market (Ioana et al., 2013). The economic impact in the educational field can be seen in the gross domestic product allocated in the educational system, and in the unemployment rate. Figure 1 represents the insufficient budgetary allocation in the educational system and its consequences.

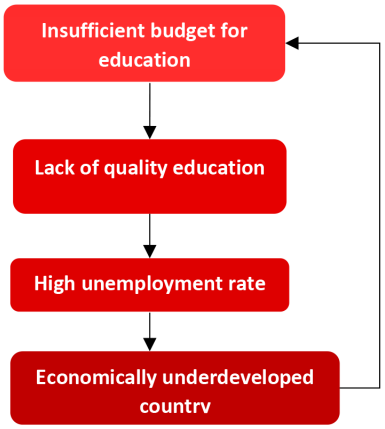

Figure 1. Insufficient budget allocation in the education system and its consequences
Source: Own research

The economic impact in the educational field has long-term effects on the country. The lack of an adequate budget for the education system (lack of infrastructure, lack of specialized teaching staff, etc.) leads to the lack of quality of education, even the lack of the educational act itself, all of which contribute to the high unemployment rate and, thus, eventually reaching a poorly developed country from an economic point of view. If the country is economically poorly developed, again, it has a direct impact on the education system (Ioana et al., 2019). The economic impact on the educational system is controlled through educational management because it represents the process of coordination of resources (human, financial, material, and informational).

Management in the educational system is similar to management in other fields, thus the 5 managerial functions are applied: Foresight, Organization, Coordination, Command (Decision, Training-learning), and Managerial Control (Evaluation-Control). The functions of management (Foresight, Organization, Coordination, Command (Decision, Training-learning), Managerial Control (Evaluation-Control)) reflect the dual character of the managerial process, both as a science and as an art. The foresight and organization functions require theoretical knowledge of management, and those of training, coordination, and control evaluation require practical experience. The management functions are general, being specific to any management action, regardless of the profile and size of the organization. The most essential functions in the management process are the foresight and control functions because they provide information about the stages and states of the work processes in organizations (Ioana et al., 2011).

Management in the educational system can be both centralized and decentralized and it is useful to define them. In centralized management, it is understood that the decisions and the operations of the entire organization are made by the management at the highest level. Decentralized management refers to the delegation of authority and responsibility to the lower hierarchical levels of an organization, thus there is autonomy for decision-making, leading to increased efficiency. Decentralized management in the educational system means greater autonomy and, therefore decision-making at the level of educational institution, which leads to efficiency, innovation, and better communication in the educational field. Decentralized management in the educational system means greater autonomy and, therefore decision-making at the level of educational institution, which leads to efficiency, innovation, and better communication in the educational field, (Anghel, 2020).

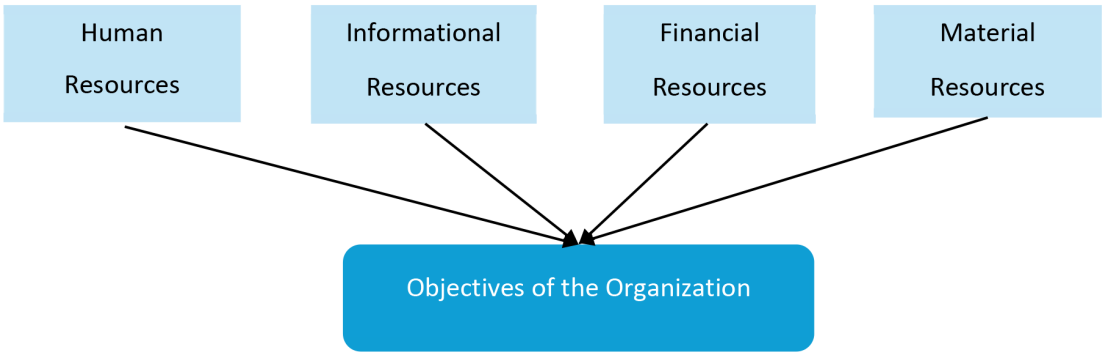

Figure 2. Definition of management
Source: Own research

The implementation of the concept of management in the educational system includes both the efficient management of resources and the application of the 5 managerial functions to achieve educational objectives. Management is the process of coordinating human, informational, financial, and material resources, to achieve the organization's objectives. Figure 2 shows this definition of management, (Ioana et al., 2011)

In the educational system, the management of resources (human, informational, financial and material) contributes to the quality of the educational act. The lack of any mentioned resource affects the quality of the educational act. The human resource is the most important, but the combination of all resources: human, informational, financial and material contributes to the achievement of the objectives, (Ioana et al., 2021). Financial resources also play an important role, as they have a direct impact on infrastructure, school facilities, teachers' salaries, etc., (National Institute of Statistics, n.d.).

4. RESULTS AND DISCUSSIONS. ANALYSIS OF THE EDUCATIONAL SYSTEM IN ROMANIA

The budget allocated to education has effects on infrastructure, teacher training, and educational performance, but also has a long-term effect on the economy. Figure 3 shows the total budget for financing education in Romania as a percentage of the gross domestic product (GDP) over the last 10 years (Statista, 2023).

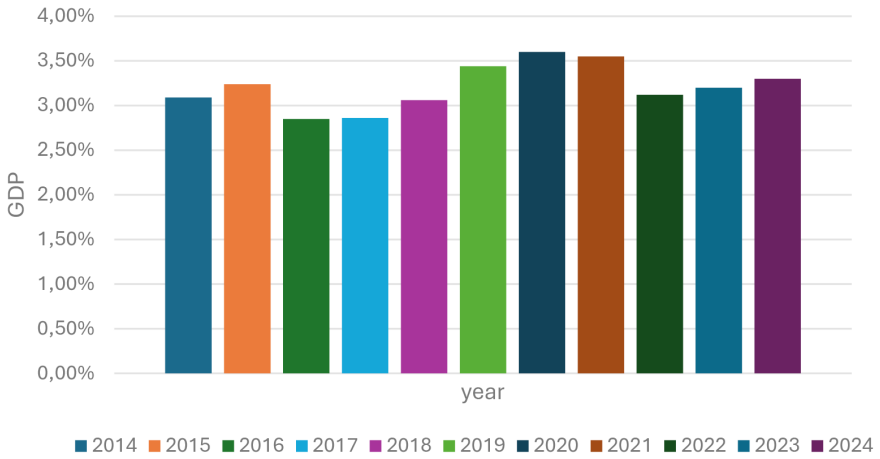

Figure 3. Total budget for financing education in Romania as a share of gross domestic product from 2014-2024

Source: Own processing

It can be seen that the maximum budget allocated in Romania from the gross domestic product was in 2020, with 3.60% of the GDP being allocated, therefore an insufficient budget for quality education.

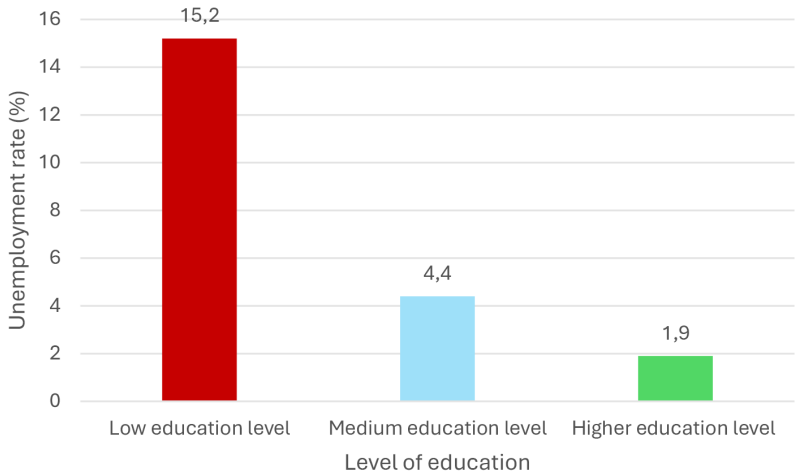

Figure 4. Unemployment rate depending on the level of education in the year 2024

Source: Own processing

The unemployment rate will also be further analyzed. Figure 4 shows the youth unemployment rate for the year 2024, depending on the level of education, according to the National Statistical Institute (National Institute of Statistics, 2025).

According to the quoted source, unemployment affected graduates with a low and medium level of education to a greater extent, for whom the unemployment rate was 15.2% and 4.4%, respectively. The unemployment rate was only 1.9% for people with higher education. From this figure, it can be seen that the unemployment rate is lower among people with a higher level of education (university studies).

Currently, according to the Ministry of Education, there is centralized management in educational institutions in Romania. From the documents issued and publicly displayed, it can be seen that the Romanian Ministry of Education has a major influence on important decisions on the school curriculum, resource allocation, structure, and functioning of schools (Ministry of Education, n.d., 2023). In the educational system in Romania, from the official documents issued by the Ministry of National Education, it was identified a series of major challenges in terms of educational management at the level of the institution and economic aspects. The main problems identified are: Centralized management, bureaucracy, lack of funding, lack of qualified personnel, and lack of motivation of teachers. Figure 5 shows these aspects.

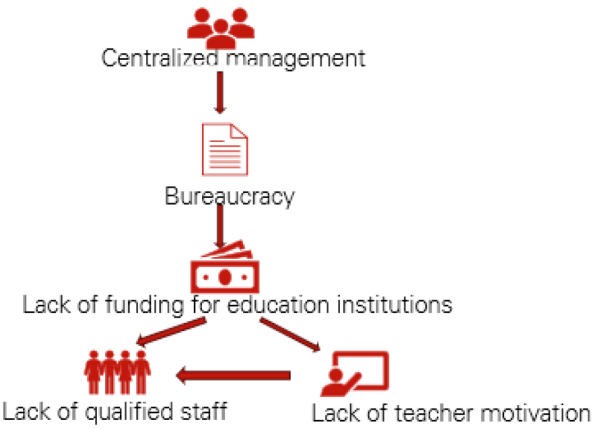

Figure 5. The main problems of the educational system in Romania

Source: Own research

As can be seen in the figure above, the main problem of the educational system in Romania is the centralized management, which leads both to the lack of autonomy of the school units, but also to the bureaucracy, from here reaching the lack of funding, which leads to the lack of motivated and qualified educational staff. All the problems identified lead to the quality of education. Thus, there is a close link between the lack of human and financial resources and the results of educational institutions.

5. FUTURE RESEARCH DIRECTIONS

Future research directions on managerial and economic aspects should be directed towards:

- The effectiveness of centralized versus decentralized management in the educational system, because this analysis would allow the identification of the advantages and disadvantages of the management system, thus studying the impact of decisions on the performance of the school unit.

- By comparing the education management system in the world, but also by comparing the budget allocated from the Gross Domestic Product for the education system, this study will help to identify the key factors of a successful education system.
- Transparency, efficiency and responsibility for the allocation of financial resources in the education system, with the help of programs for monitoring and evaluating education expenditures, but also the impact that budgetary transparency has on the education system.

All this future research will contribute to the development of education systems, solving current challenges and creating an educational future adapted to the demands of the labor market.

6. CONCLUSION

Measures must be taken, at least in the educational system in Romania, in terms of the educational system and the labor market, so that the educational system is compatible with the labor market. For example, in some communities, public-private partnerships can be achieved, so that current students and future employees are prepared for the labor market. But for this, it is necessary to change the educational curriculum. Currently, this happens only at high schools with a technological profile and in the universities of Romania.

From the results, it can be seen that the unemployment rate is low in the case of people with higher education. It is necessary to adopt a series of measures to prevent school abandonment, such as financial support for students from disadvantaged backgrounds, attracting students through access to schools, state-of-the-art technology, etc.

In the Romanian education system, exists major bureaucratic barriers in the decision-making process, the literature indicates that there is a discrepancy between the reality of education policy implementation and the need for decentralized management. Decentralized management can provide the possibility for institutions to contribute to performance improvement and at the same time to make institutions more efficient. Decentralized management contributes to adaptability, accountability, and innovation in the education system. It can be implemented through pilot programs involving at least 10% of educational institutions.

The budget allocated for education contributes to the development of a country, so for sustainable development, a bigger budget should be allocated to education and institutions should have internship programs, encouraging learning by doing.

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Navigating Education Amidst Crisis: The Transformation of Higher Learning During the COVID-19 Pandemic

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University;
Students

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Abstract: *The pandemic caused by the SARS-COV-2 virus led to social distancing measures in this context, universities temporarily closed in Romania and most states of the world.*

The educational process has moved to the online environment, taking place through online platforms.

According to General Comment no. 13 of the Committee for Economic, Social and Civil Rights 140, education is characterized by four elements in an interdependent relationship, namely availability, accessibility, acceptability and adaptability. Thus, the state must provide institutions and educational programs, which provide libraries and digital facilities, accessible to students. The accessibility of educational institutions refers to three aspects: non-discrimination, accessibility from a geographical point of view and accessibility from an economic point of view, which implies that education does not involve too high costs. Acceptability concerns aspects related to the form and content of education, from teaching methods to the curriculum, and adaptability represents how the educational process can adapt to the needs of changing societies.

1. INTRODUCTION

Some of the oldest institutions in the world are represented by universities. The first universities established were al-Qarawiyyin University in Morocco, founded in 859 AD, al-Azhar University in Egypt, in 970 AD, and University of Bologna, 1088 AD. Even though there were religious crises, particularly serious political, financial and health problems, they continued to function. The founding of universities began long before mankind had access to paper. In the last 30 years, thanks to the explosion of the Internet in the world (in 1993), universities have adapted to the new challenges by supplementing both the quantity and the quality of resources available in the online environment. Innovative pedagogical techniques such as "flipping the classroom" have been adopted in many university courses in response to the availability of information on a large scale. This led to the transformation of the teacher from a mentor in front of the students to a guide to direct the interest of his students. Distance higher education began to be implemented, but only in the case of a very limited number of courses because in-person education, considered of higher quality by most institutions, remained the preferred form of university decision-makers. Massive Online Open Courses (MOOCS), in which a very large number of students participated in courses offered free of charge by world-class universities (course fees applied only to assessments), appeared in 2007, however, they did not become as popular as originally expected due to the limitation of social interactivity within the courses and the high dropout rate.

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Traditional universities looking to promote online education will face stiff competition from "education providers" such as Coursera, edX, and even Google. In the future employers will be interested in "non-formal education", obtained outside the traditional university systems as long as they can hire staff who have the necessary practical and theoretical skills (Kamarianos et al., 2020).

In some countries (United States, Australia, and Great Britain), university costs have increased exponentially in recent decades. During the pandemic, there were debates regarding the un -justification of these costs in the new exclusively online educational framework. Should fees be reduced in the case of full or partial transposition of courses in the online environment?

During the pandemic, the digitization of educational systems was accelerated, and the idea of digitizing educational systems has been debated for a long time. The educational system was seriously affected by the total closure of universities (United Nations Development Programme, n.d.).

After the initial shock of the total closure, teachers and members of the administrative and technical bodies in the education systems around the world reacted in a truly extraordinary way, trying to transfer the entire didactic activity to the online environment. The teachers, even if before the pandemic were not trained in the operation of digital platforms (Zoom, Google Meets and Microsoft Teams), they became familiar in the shortest possible time. Most of them have adapted surprisingly well to the new systems, appreciating the concrete advantages they bring and trying to quickly overcome the inherent problems:

1. The ability to offer and participate in educational courses, without physical presence, in the classroom raised significant logistical and temporal problems for students who lived far from university campuses.
2. The ease of interaction through the chat function of digital platforms during the actual courses created a close bond between students and teachers.
3. During the online period, there was an improvement in both the quality and the quantity of available digital resources.
4. The reduction of social interactivity among students was a disruptive factor, especially for those at the beginning of their university careers.
5. There were difficulties in understanding the grounded disciplines based on experimental or practical activities. (biology, pharmacology, medicine, archaeology, performing arts, fine arts, architecture, engineering).
6. Difficulties in accessing libraries that did not have fully digitized resources. Especially for students and researchers in the field of humanities and social sciences.
7. There were difficulties for teachers unfamiliar with digital platforms and resources. There was also a socio-economic division, which made teaching-learning activities significantly more difficult for teachers or students who did not have modern technological devices or uninterrupted high-speed Internet access.
8. Concentration difficulties for students, in online courses compared to the same courses held in person, especially for young graduates.
9. Psychological problems related to social isolation or the reduction of social interactions despite the help provided by psychological support within university institutions in 2020 and 2021.

2. IMPACT OF THE COVID-19 PANDEMIC ON EDUCATION: CHALLENGES, BEHAVIORAL CHANGES, AND THE SHIFT TO ONLINE LEARNING

The risk due to the SARS- Cov 2 epidemic presents the following defining particularities:

- The virus has not affected the human population in the past. During the epidemic over 90% of the population was susceptible to this infection.
- The virus has a higher transmission rate than other pathogens, coupled with airborne transmission. This particularity led to rapid infection of the exposed population, in the absence of measures of control and generated extensive outbreaks overloading and sometimes exceeding the sanitary systems.
- Due to the wide interval of the incubation period part of the epidemiological investigations they do not identify all possible ramifications of transmission chains.
- The development of a specific effective antiviral compound or a vaccine, thus that control measures are based only on non-pharmaceutical measures, measures of which effective is dependent on the understanding and cooperation of the communities.
- Compared to the other types of risk that can affect communities, this type of risk has generated a worldwide pandemic.

Clinical studies have shown that the Covid-19 pandemic has had an impact alarming and worrying negatively on the health of students around the world, but also on the higher education system. Most of the students are faced with difficulty concentrating during school activities, being prone to be distracted during class by a family member or by household chores, but also by video games and social media. The situation is due to the lack of direct social interaction between students and teachers, respectively students-students, but also the long period that students have to spend in front of the computer, an aspect that determines the loss of concentration, the installation of boredom, monotony with a negative impact on the level of performance academic (Cotoranu et al., 2021; United Nations Educational, Scientific and Cultural Organization, 2020).

The entire educational system is facing one of the biggest health crises caused by the pandemic.

Covid-19. Thus, starting in March 2020, all educational institutions worldwide were forced to stop teaching activities in the format classic and adapt to a new teaching system, the online teaching system. The transition from the mode of classical teaching to the online teaching mode highlighted a series of negative aspects which the Romanian as well as the world educational system faced at the time and which affected the way directly the efficiency and effectiveness of teaching and learning. In addition to the lack of digital infrastructure necessary to support the transition of the online teaching and learning process. The measures adopted had a negative psychological impact on students and teachers.

University in the online environment meant, first of all, participation in the domestic space. This form of participation determined an increase in academic performance for motivated students. At the same time, an incomplete student profile for the non-involvement of some of them. Moving back to the place of residence meant for many students a significant reduction in professional opportunities. Carrying out didactic activities exclusively online, regardless of the platforms used, involved a series of adaptations of both the university contents addressed, as well as didactic techniques and assessment methods. Until now, numerous studies carried out on the topic of the online university have highlighted aspects regarding the preservation of student-centered education and in the online format in the context where digitization, as a technological and cognitive resource, is not yet evenly distributed in society (Comisia Națională a României pentru UNESCO, 2020).

The COVID-19 pandemic, for the first time in the history of higher education, transformed education from the classic face-to-face model to distance learning. The new standard didactic method was for almost two university years. The quality of the courses and the level of teaching were not always at the previous level of education, at least not for all students, but the results obtained at the end of this period were remarkable. Proposals for high numbers of distance learning courses present a clear opportunity for the post-COVID-19 "new normal", but come with specific new challenges:

- The COVID-19 pandemic has left indelible marks on the education system around the world. A fact that led to major changes in the student's behavior. These behavioral changes were new challenges for teachers.
- Active learning techniques, group activities, hands-on activities and problem-based learning can significantly improve student engagement. According to the "Journal of Educational Psychology," it was found that active learning methods increase student motivation and academic performance.
- Strong relationships between teachers and students can mitigate defiant behavior. Teachers must understand the individual needs and backgrounds of each student, showing empathy and respect. Building trust and relationships can lead to an environment where students feel valued and respected.

3. CONCLUSION

The SARS-CoV-2 pandemic had a dramatic impact on the entire world; however, just as in the case of political or health crises, it also brought some benefits to societies around the world. Education, especially higher education, will benefit from the digital impulse of that period. High-quality online education can be particularly useful for formal, informal and long-term education for the majority of active staff in higher education institutions. However, the challenges and risks associated with strong digital transformations, such as social isolation and the reduction of human interactivity, especially among young people and psychologically vulnerable people, must be properly addressed.

The epidemic of COVID-19 since the beginning of 2020 had a negative impact on education for students of all ages. The sudden shift from face-to-face learning to distance learning has caused a major impact on student and teacher engagement. This led to a dramatic reduction in instructional time hindering student understanding.

The COVID-19 pandemic has disrupted the social and emotional development of students in all universities. The increased isolation among them created high levels of anxiety and depression. It was found that students had emotional, social and behavioural problems during the pandemic. Universities have had to find innovative ways to combat student learning losses.

There was a lot of talk about the involvement of teachers to use this opportunity caused by the pandemic to make major changes in education. In other words, education should radically change from curriculum to pedagogy, from teacher to student, from learning to evaluation.

Today, after the experience of the COVID-19 pandemic, it was noticed that access to technology, both hardware and resources, was not equal for all students in the world. This problem will continue to create gaps and therefore efforts must be made for education together with technology to eliminate the digital gap. Access to resources must be accelerated for all students.

Four years after the start of the COVID-19 pandemic, it can be seen that the efforts to recover the academic performance of the students who followed remain a continuous challenge to education.

Students in certain communities where the closures lasted longer were the most affected by lost training time and most in need of recovery efforts. Navigating the Post-Covid Recovery Landscape requires a nuanced approach. Although no analysis can summarize the diversity of recovery models, post-COVID recovery examinations require models that can represent key features of students and communities.

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An Approach for Backup in LMS Moodle

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Keywords:
Moodle;
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Cloud computing;
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Abstract: *The increasing reliance on information and communication technologies (ICT) in education has underscored the importance of ensuring data availability, security, and integrity. Learning Management Systems (LMS), such as Moodle, are critical tools in modern education, enabling the management of educational resources, assessments, and learner progress. This paper proposes a structured and practical approach to backing up and restoring Moodle-based educational platforms. The approach is designed to ensure reliability, minimize downtime, and comply with best practices in information security. The method is supported by empirical testing in a real educational environment and can be easily adapted to other institutions.*

1. INTRODUCTION

Security and the ability to quickly and accurately archive and recover data in problematic situations become key factors for the success of organizations. In education, this problem is also serious – educational institutions are becoming increasingly competitive, working, and developing in a highly competitive environment. At present, the predominant types of e-learning systems are two: LMS (Learning Management Systems) and LCMS (Learning Content Management Systems), which can also be divided into academic and corporate. LMS are based on repositories of digital content called learning objects, which resemble libraries where volumes are electronic files in various formats supported by the e-learning standard that the platform supports. Additionally, these platforms have functions for course creation, exam applications, exam simulators, user registration, etc. Although the term LCMS is currently used synonymously with LMS, it can be considered a version with greater functionality than LMS, as they not only have the functions of LMS but also include the entire cycle of content creation, publishing, delivery, and measurement of usage. What distinguishes this type of platform from other types of information systems is its educational content. While others store data, information, or knowledge, these systems store information and knowledge in the form of learning objects, and capsules of necessary and sufficient content to achieve an educational goal.

In their research, Parusheva et al. (2018) found that in Bulgaria, 23 out of 24 of the examined universities use platforms for electronic and distance learning. The research shows that the most preferred LMS is Moodle. In publications from the last 2-3 years concerning education and the educational process as a whole, the authors note the increasingly widespread use of platforms like Moodle. The catalyst for this process is considered to be the COVID-19 pandemic. However, the platforms themselves are not a solution to the problem of improving the quality of the educational process, addressing the inadequate engagement of learners, and their low motivation for continuously improving their knowledge and skills. According to Blagoeva-Karamfilova and Parusheva (2022), it is recommended that lecturers are encouraged to intensively prepare and upload rich digital educational content on e-platforms so that students can be more fully involved in learning.

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Almost 15 years ago, Piotrowski (2010) found that the functionality of e-learning platforms typically includes access to learning content and tests, communication and collaboration tools for students, and course management and assessment facilities for instructors. E-learning platforms may also include administrative functionality or interfaces to administrative systems (often called "campus management systems") for managing student admissions and enrollment (sometimes termed "student life cycle management"), for resource planning, accounting, etc. Generally, e-learning platforms can be considered as managed repositories of educational elements. However, effective work with these repositories requires a very serious, modern, and continuously updated hardware and software infrastructure. The increasing number of enrolled and active learners, as well as published resources, raises the requirements for the infrastructure necessary for the seamless operation of the platform. Cloud technologies emerge and are actively developed to help organizations cope with this problem. The NIST Definition of Cloud Computing is: cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models (Mell & Grance, 2011). Based on this definition, it can be concluded that the use of cloud computing can support educational institutions in providing the necessary infrastructure for the seamless operation of LMSs.

2. LITERATURE REVIEW

Regardless of the choice of LMS and the method of providing resources for its operation, serious attention must also be paid to the content published on the platform. It is important to note that developing and continuously adding new content to courses in LMSs is a labor-intensive process that requires not only knowledge of the subject matter but also an understanding of the technologies through which this material can be digitized and presented to learners in the most suitable format – textual description, images, video. However, only a small portion of teachers are familiar with and can easily utilize modern technologies for developing electronic educational resources. The requirements for teachers are numerous, and a good presentation is made by Spirin et al. (2024). Nevertheless, they make significant efforts, utilizing the support of specialists in the field. Therefore, it is important for the developed materials published on e-learning platforms (LMSs) to be protected from:

- Unauthorized access;
- Accidental or intentional disclosure of content;
- Accidental or intentional alteration;
- Accidental or intentional destruction.

Contemporary organizations have information security policies, which generally aim to:

- Ensure techniques and establish a regulatory framework to prevent abuse or loss of information;
- Define the responsibilities of leaders and employees involved in information resource security;
- Establish requirements for information confidentiality;
- Control access and provide the ability to track changes made to information resources;
- Provide opportunities for rapid and timely recovery of system operations following system problems.

The latter goal – rapid and timely recovery of e-learning platform operations following problematic situations – is the subject of the present study. This is due to the fact that the normal operation of computer systems is important for every modern organization. Educational institutions and

e-learning platforms, as an integral part of the contemporary educational context, are no exception. Petrov et al. (2022) thoroughly studied the issue of Data Management quality. They believe that continual provision is an important part of modern systems, and incorporating it into a fully automated monitoring system would improve the effectiveness of both the monitoring process and the educational organization's operations. The parameters whose values need to be monitored to determine the quality of control are:

- The number of system components affected by operational incidents;
- Unplanned hours when the system was unavailable due to poor processing management;
- The number of incidents and operational delays caused by incidents;
- The number of incidents caused by deviations in the submitted parameters;
- The percentage of processes that were scheduled but were not completed;
- The number of incidents caused by insufficient procedures;
- The frequency with which procedures are updated;
- The proportion of tasks that are automated.

Having an automated approach to monitor these parameters enables organizations to quickly react to changes, identify problematic areas in the IT infrastructure's operation, and take timely actions to prevent unwanted events or, if not possible, promptly restore the system to a functional state. Deploying the platform on cloud infrastructure helps facilitate monitoring of parameters and resource management. Cloud technologies have become an established approach in all types of projects over the past few years. They provide development opportunities for educational institutions by offering greater flexibility in the distribution and utilization of their computer resources.

The integration of cloud technologies also complements the principles and guidelines provided by ISO standards, which ensure robust and secure IT management practices. The Standard for Information Security Management is ISO 27001. Their application and compliance are a good approach. The main provisions of the standard are described by Kitsios et al. (2023) and have been used in the proposal of the current approach.

3. EMPIRICAL DATA ON BACKUP AND RECOVERY PROCESSES

To evaluate the efficiency of the current backup and recovery processes for Moodle at the University of Economics – Varna, data was collected on the infrastructure and performance during real-world tests. These data prompt the search for an effective approach that considers different types of backups—full system backups, incremental backups, and database-only backups.

The Moodle platform operates on a distributed server infrastructure, as summarized in Table 1. The performance metrics for backup and recovery processes, including data sizes, speeds, and execution times, are detailed in Tables 2 and Table3, respectively.

Table 1. Server infrastructure

	Web Servers (3 instances)	**File Server**	**Database Server**
CPU	2 cores	2 cores	2 cores
RAM	2 GB	4 GB	4 GB
Storage	256 GB each	256 GB for OS 700 GB dedicated to MoodleData	500 GB

Source: Own calculations

Table 2. Backup Performance

Component	Data Size	Speed	Time to Backup
Database (mysqldump)	1.39 GB	~ 100 MB/s	~ 14 seconds
MoodleData (tar + gzip)	390 GB	~ 120 MB/s	~ 54 minutes
Moodle code (tar)	1 GB	~ 150 MB/s	~ 7 seconds
Total Backup	392.39 GB	-	~ 54 minutes 21 seconds

Source: Own calculations

Table 3. Recovery Performance

Component	Data Size	Speed	Time to Backup
Database (mysql import)	1.39 GB	~ 80 MB/s	~ 18 seconds
MoodleData (untar)	390 GB	~ 150 MB/s	~ 43 minutes
Moodle code (untar)	1 GB	~ 150 MB/s	~ 7 seconds
Total Backup	392.39 GB	-	~ 43 minutes 25 seconds

Source: Own calculations

The analysis reveals that the MoodleData directory (390 GB) is the primary bottleneck for both backup and recovery processes, accounting for the majority of the total time (~54 minutes for backup and ~43 minutes for recovery). Optimizing the process by implementing incremental backups with ***rsync*** and using multithreaded compression tools like *pigz* could significantly reduce the overall duration.

The database (1.39 GB) is relatively small, allowing for fast backup and recovery times (~14–18 seconds). Additionally, reviewing MoodleData for unnecessary files and leveraging cloud storage for less frequently accessed content could further improve performance. These findings provide the groundwork for the optimized backup approach presented in the following section.

4. APPROACH FOR MOODLE BACKUP

Instructions and a detailed plan regarding information security provisions are provided by ISO standards, specifically ISO 27001. Its implementation and adherence are good practices, but it does not provide specific guidance regarding information archiving and recovery. The core principles of the standard are described by Kitsios et al. (2023) argue that companies can become more resilient in the face of information security threats and cyberattacks by effectively integrating security strategies They, however, do not address the issue of creating and implementing the backup plan within the organization, yet the presence of such a plan can mitigate the risk of disastrous events. In ISO 27001, Annex A describes information security controls, with Annex A 8 focusing съдържа Technological controls, a Annex A 8.13 of ISO 27001 is Information backup – Backup copies of information, software and systems shall be maintained and regularly tested following the agreed topic-specific policy on backup. This means that the existence of a backup policy (plan) is not a mandatory document according to ISO 27001, but the standard recommends creating one. Several arguments can be made in support of the necessity of developing and implementing a backup plan that aligns with business requirements, security needs, and information criticality.

One of the most important aspects—and often the greatest challenge—in creating such a plan is identifying critical data and systems that require regular backups. This step involves analyzing the organization's operations to determine which components are essential for continuity and must be prioritized in backup procedures. The complexity arises from the need to balance comprehensive data coverage with the practical limitations of storage capacity, backup frequency, and recovery speed.

In the context of an educational institution, critical data includes user information, course content, learner activity records, and uploaded files. These elements are essential for maintaining the continuity of the learning process and ensuring compliance with regulatory requirements for data retention.

Given Moodle's role as a central hub for delivering and managing educational content, its backup plan must account for the dynamic nature of the platform. Frequent updates to course materials, high user interaction rates, and varying course durations add layers of complexity to identifying what data needs to be backed up and how often.

Databases are one of the primary and critically important components of any information system, and they receive serious attention regarding their archiving and recovery capabilities. Active research in this area by authors such as Kuyumdzhiev and Nacheva asserts that the backup plan determines the intensity, sequence and type of backup that apply to the database. It depends on various factors: what is the amount of information available, at what periods and how it enters the database, what part of it could be recovered from other sources, etc. The recovery plan depends on the implemented backup strategy (Kuyumdzhiev & Nacheva, 2019).

From the perspective of archiving and restoring LMS Moodle, and according to the platform's documentation, three main elements are distinguished in the current study:

- The data stored in the database (MySQL database);
- The uploaded files (Sites and course files uploaded via Moodle located in moodledata);
- The Moodle code (Everything in server/htdocs/moodle).

All of this is defined in the configuration file *config.php*. It is crucial to regularly archive these components. The information database and files uploaded by users are critically important because they would be difficult to recover without a backup. The code of the platform itself can be downloaded and restored from the official Moodle website, but adapting it to the respective educational institution requires significant time. In this context, for the purposes of the current study, two main parts are distinguished in the system backup approach.

Based on the data presented in the previous section and considering the specifics of the educational process, an approach for archiving Moodle has been proposed. This approach addresses the need to retain data on learner activities for a period defined by regulatory documents, as well as the requirements for rapid restoration of individual courses and the entire platform in case of issues.

The first part of the approach involves archiving all courses through the platform's built-in tools, accessible via the administrative panel. It also includes functionality for a full system backup, which can be configured to execute periodically. It is important to specify that after the backup is made, the archive is downloaded and stored in a separate physical location according to the established policies for information security in the specific organization. This process is carried out at the end of each semester following the academic calendar for the current academic year in the educational institution. The second part of the approach involves a comprehensive backup of the file system. The goal is to create a mirror copy of the existing infrastructure on a local server located in the organization.

To execute this part, it is necessary to export the database from the server to the cloud infrastructure. For this purpose, the *mysqldump* tool, which is part of the Linux operating system running Moodle, can be used. The file generated by *mysqldump* is archived to reduce its size.

The next step is to download the archived database from the server using *SCP (Secure Copy Protocol)*. The final step after downloading the SQL file is to delete it from the cloud because it is an additional memory resource in the cloud infrastructure that will be charged.

Having an archive of the database from the working platform, the next step is to synchronize the cloud server with the local one using the rsync tool. It identifies which parts of the files already exist in the target system and transfers only the changed data, making it much more efficient than traditional copying tools. It synchronizes entire directories, subdirectories, and the files within them by comparing modification times and file sizes. RSYNC encrypts the data before transmission, ensuring secure communication (Linux man page, n.d.). This process takes some time as it synchronizes the two servers.

After completing the archiving of all described elements, they are also stored on an external hard drive. The data is downloaded from the local server and additionally preserved on an external disk for storage.

Once the archiving process is finished, the reliability of the backup is tested by restoring it to another server. This procedure checks the archive for errors and its ability for effective restoration. It allows for the rapid restoration of normal operation of the e-learning platform in case of a crash or issue with the working machine. Additionally, this type of backup is used to build a testing environment and verify the system's functionality before introducing new plugins or making other significant changes to the platform, thus protecting against crashes in the live environment.

It is not reasonable to assume that a backup strategy works without testing. To avoid the failure of the archiving and recovery strategy, it must be tested to ensure that it archives and restores data correctly. The graphical representation of the approach is shown in Figure 1.

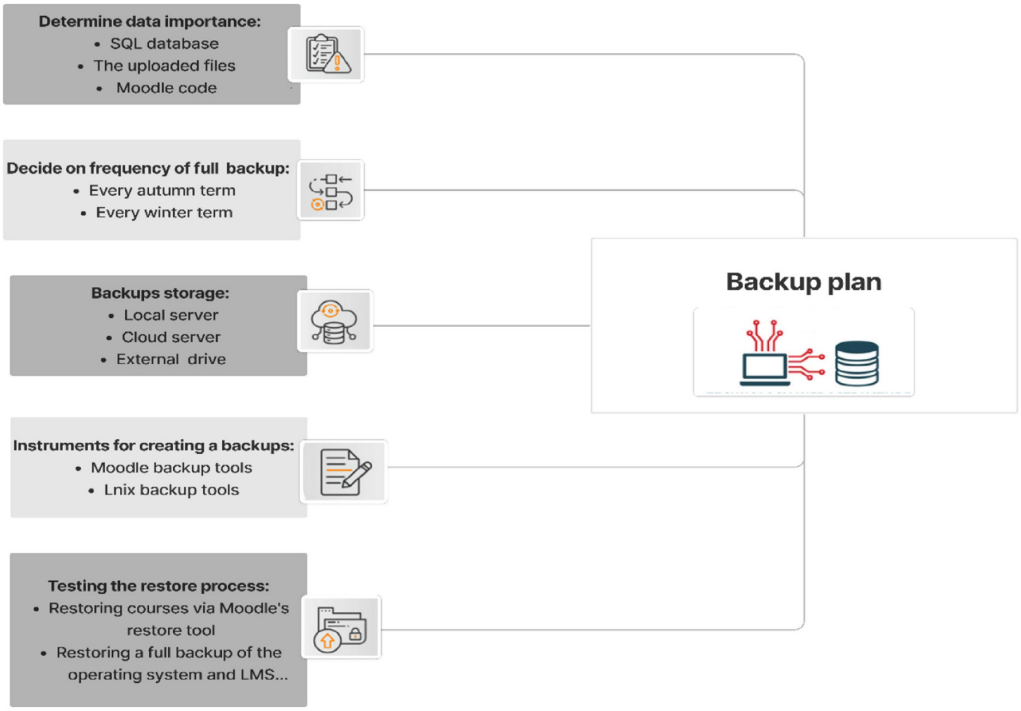

Figure 1. Backup plan for Moodle platform.
Source: Author's development

The presented scheme is a general approach; however, the specifics of the backup action plan for Moodle in a particular educational institution depend on multiple factors. These factors can be categorized as follows:

- Data and User-Related Factors;
- Regulatory and Institutional Requirements;
- Infrastructure and Technical Considerations;
- Course-Specific Characteristics.

Some key indicators to consider include:

- The number of active users (students and teachers);
- The volume and type of data generated, including uploaded files, assignments, and forum posts;
- The frequency of user interactions and their impact on data size;
- The necessity to retain learner activity data for periods defined by legal or regulatory frameworks;
- The specific organizational policies for data security, privacy, and archiving;
- The academic calendar structure, such as semesters, academic years, or modular terms;
- The duration of course validity (e.g., short-term modules versus full-semester courses);
- The need for extended access to course materials after the course has officially ended.
- The server's processing capacity and storage capabilities;
- The availability and configuration of external storage solutions for long-term data retention;
- The network bandwidth and its impact on backup and restoration speeds.

For a more practical perspective, the following examples illustrate specific cases of course backup and restoration. When archiving a course with 68 participants, including assignments, lecture and exercise topics, and quizzes, the generated file has a „*.mbz*" extension and a size of 134.7 MB. The backup operation takes 2 minutes and 45 seconds. Restoring the same archive into a new course requires 3 minutes and 7 seconds.

A test was also conducted with a significantly larger course, totaling 6.6 GB. The resulting archive file was reduced to 2 GB and the backup process took 8 minutes and 31 seconds. Restoring the archive required 10 minutes and 34 seconds.

Following regulatory requirements and institutional policies, data archiving within the Moodle system is a critical process that involves storing examination materials and student work for pre-determined periods. However, it is important to note that this archiving does not imply that the data must be continuously accessible; rather, it ensures that the data can be restored when needed. For example, according to the regulations of the Center for Electronic and Distance Learning (CEDO) at the University of Economics – Varna, data from conducted electronic training, including exams and student work, must be stored in an electronic archive for 5 years. This also applies to archiving the entire Moodle platform for the same duration, ensuring the data is preserved but not necessarily constantly available for direct access.

Furthermore, according to the Bulgarian Higher Education Act (Article 44, Paragraph 1), instructors are obligated to retain written materials from knowledge assessments for no less than one year after their completion. Archiving these materials in Moodle, with the ability to restore them as necessary, is a method for complying with this requirement.

Another example – after the last day of liquidation exams, the platform undergoes additional preparation for the upcoming academic year. This includes the planned deletion of all courses from the

winter semester of the previous academic year. Such measures highlight the necessity of a robust backup system to ensure that archived data from deleted courses remains accessible if needed.

The academic calendar structure directly influences these processes, as institutions must carefully schedule platform maintenance and data deletion to align with semester transitions. The timing ensures that the system is optimized for the new academic cycle while safeguarding past course data for legal, administrative, or academic review purposes.

Similarly, the duration of course validity is reflected in the planned retention of data. Short-term courses may see their data archived sooner due to quicker turnover, whereas semester-long or year-long courses may necessitate longer retention policies to support ongoing academic activities or future reviews.

These examples demonstrate the impact of course size and complexity on the time and resources needed for backup and restoration, emphasizing the importance of considering such factors when designing an effective backup strategy.

Considering these factors comprehensive approach ensures that the backup plan is not only effective and secure but also tailored to the unique requirements of the educational institution and its learners.

5. CONCLUSION

The presented approach to archiving courses in Moodle is developed based on existing standards for information security, taking into account the characteristics of e-learning platforms, the specific operational methods of educational institutions, and particularly those of higher education institutions in Bulgaria. The approach aims to support the work of Moodle administrators and to provide a structured approach to their tasks. The proposed approach can be easily adapted by various educational institutions and applies not only to the higher education sector. The subject of the next study will be an analysis of the degree of security of the backups and their ability to be quickly restored if necessary. How well the backups meet current data security standards.

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China's Tiangong Space Station: Geopolitical Influences and Opportunity for Collaboration

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Abstract: *China's Tiangong space station program represents a critical milestone in its ascent as a global space power. This paper investigates China's goals for the Tiangong Space Station, comparing them with other space station programs of the ISS and the Soviet Union. It examines how geopolitical tensions shape China's space mission and evaluates whether China can maintain its trajectory independently. By addressing questions of geopolitical rivalry, technological self-sufficiency, and international cooperation laws, the paper argues that while China has achieved significant independence by successfully launching and operating the Tiangong Space Station in 2022, now China is at a crucial stage to cooperating with other nations to be able to sustain economic investment and creating frameworks that facilitate sustainable progress for the benefit of humanity as a whole in the space industry.*

1. INTRODUCTION

The manned space station is one of the critical factors in the development of aerospace in the world because it reflects a country's level of space technology and is an important indicator of its economic, technological, and military capabilities, as well as its overall national strength (Wang et al., 2024). Although the United States and the Soviet Union were pioneers in manned space station programs during the Cold War, China has emerged in the 21st century as the third major country to pursue this goal with 11 launches and on-orbit missions from 2021 to 2022 and completed the assembly and started the official operation of its space station (Wang et al., 2023).

China's Tiangong space station, which reflects decades of technology, economic investment, and strategic planning, will serve as a national space lab and a platform for international scientific and technological cooperation and exchange. Unlike the US-led International Space Station (ISS) or the Soviet Union's Mir, Tiangong launched and operates within the complexities of today's geopolitical landscape and technological context defined by the US law banning China or Chinese entities from international cooperation with the ISS (Yin et al., 2023; Gu & Ba, 2024). This paper examines how China's approach differs from historical precedents and evaluates the extent to which China can sustain its space ambitions independently in the future.

2. OVERVIEW OF SPACE STATIONS

A space station can be defined as a manned or unmanned spacecraft or space object located in outer space used for permanent inhabitation and discharge of various scientific and technical tasks (Smith, 2019). Manned space stations allow humans to live and work in space for long periods. They have life support systems, research facilities, and docking ports for spacecraft (Yang, 2021). Some notable manned space stations include the Salyut series (1971–1986), the first space station,

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and the Mir (1986–2001), the first modular station for international crews launched by the Soviet Union. The ISS, established in 1998 by a global partnership between NASA, Roscosmos, ESA, JAXA, and CSA, is another example of a manned space station. Alternatively, the Tiangong Space Station of China was launched in 2022 as a modular station for international scientific work (Wang et al., 2024). At the forefront of human knowledge, these stations are crucial for advancing human space exploration to the Moon, Mars, and beyond (Hoffman, 1997).

Unmanned spacecraft operate autonomously. They mainly support research, test technology, and observe the space environment (Bard, 1986). Before the Soviets, USA, or China established their manned space stations, several unmanned programs were used to support manned missions. One such program was the Almaz by the Soviet Union, which was a military reconnaissance project. Alternatively, Skylab's unmanned phase in the USA tested systems before manned missions, and Tiangong-1 of China operated autonomously after its manned phase (Gu & Ba, 2024).

International cooperation in outer space is crucial for space activities, as highlighted by Jiang and Zhao (2021). Since the launch of the first artificial satellite in 1957, this concept has been embedded in various legal documents. The U.N. Charter prioritizes "achieving international cooperation" to maintain peace and tackle global issues. Chapter 9 promotes international economic and social collaboration. The 1970 Declaration on Principles emphasizes states' duty to cooperate, particularly in science and technology for developing countries. The 1967 Outer Space Treaty also reinforces this by encouraging nations to cooperate internally in space exploration. A historical example is the cooperation between the United States and the Soviet Union from the late 1960s to the early 1970s, despite their respective political and economic challenges. Hence, a comprehensive political review of these space systems is often necessary when evaluating such cooperation, as purely legal approaches may fall short.

2.1. The Soviet Union Space System

During the Cold War, space rivalry became crucial for demonstrating technological and ideological superiority between the Soviet Union and the United States. The USSR achieved significant milestones that greatly influenced the trajectory of the space rivalry, including the launch of Sputnik 1 in 1957 as the first artificial satellite and Yuri Gagarin, a Russian astronaut who became the first person to travel to space in 1961 aboard Vostok 1 (Siddiqi, 2000).

The Soviet Union recognized the importance of having people live in space for a long time following the success of early satellite and crewed missions. This idea initiated the Salyut program, which aimed to transition from short missions to establishing orbital stations for research, espionage, and international collaboration. Salyut-1, the world's first space station, was successfully launched in 1971, followed by six additional stations until 1982. Among these, Salyut 1 to 5 represented the first generation of space stations, each equipped with only one docking port for the Soyuz spacecraft. In contrast, Salyut 6 and 7 formed the second generation with an additional docking port for cargo ships. Ultimately, the Salyut program paved the way for the development of the Mir space station, the first permanent space station in the world, launched by the Soviet Union in 1986 (Jiang & Zhao, 2021).

The same study from Jiang and Zhao (2021) also suggested that because all these space stations were constructed and operated solely by the Soviet Union, and because the service life of most coincided with the Cold War, international cooperation was limited. The Soviet Union claimed exclusive ownership over its space stations and designated itself as its only registering entity; thus, ownership, jurisdiction, and control were entirely in its hands. However, it did engage in limited international cooperation during the 1970s within the framework of the Warsaw Treaty Organization, although

participation was restricted to fellow socialist countries. This situation changed somewhat in the mid-1980s when the Soviet Union began collaborating with capitalist countries. However, cooperation remained limited to a few activities, such as scientific experiments in Spacelab and astronaut training. The Soviet model was, in fact, a tool the Soviet Union used to exert influence in diplomatic and policy arenas and to vie for military supremacy in outer space against the historical backdrop of the Cold War. The model's failure, driven by the technological capacity of a single country and hindered by a lack of capital resources, serves as a cautionary example that emphasizes the importance of international cooperation with equal participation and equitable resource sharing to establish space stations. Accordingly, the model adopted by China when it engages in international cooperation to establish such a station should be truly open and inclusive.

Despite such cooperation, Russia plans to leave the ISS after 2024 and launch its space station, a decision influenced by the war in Ukraine. This announcement by space agency head Yuri Borisov is a setback for international space collaboration, as Russia has not committed to supporting the ISS, which relies on it for critical operations. NASA Administrator Bill Nelson acknowledged the challenges this poses, although the ISS is not in immediate danger. Concerns grow over the future of international cooperation as the US explores commercial alternatives to replace the ISS. This movement reflects a strategic pivot towards ambitious national objectives, including developing the Russian Orbital Service Station (ROSS) to enhance self-sufficiency in space exploration. Furthermore, Russia's collaboration with China on the International Lunar Research Station (ILRS) demonstrates a commitment to forging new alliances and pursuing bold goals in crewed missions, lunar exploration, and advancements in space technology (Heilweil, 2022).

2.2. The ISS System

ISS is the largest and most complex manned space station in history, exemplifying successful multilateral cooperation among thirteen nations, including contributions from the Russian Space Agency, the European Space Agency, Canada, Japan, and the United States. It functions as a unique laboratory in low Earth orbit for high-value scientific research in microgravity, supporting a crew of six astronaut scientists. The ISS, measuring over 300 feet wide and 200 feet long, provides facilities for research in life sciences, biomedical sciences, and engineering that cannot be conducted on Earth (Erickson, 2018). Operational agreements among members outline liability, intellectual property, and criminal responsibility, creating a robust legal framework that serves as a role model for international collaboration that China's Tiangong space station might want to follow. However, excluding China and other developing countries from the ISS highlights the need for broader international cooperation, as emphasized by the Outer Space Treaty, which promotes inclusive participation for the global community (Ma et al., 2023).

As of writing this paper, the United States, ESA, Japan, and Canada have not definitively decided when the program will end. However, in 2021, the Joe Biden administration indicated that the program would receive US support through 2030. The ESA, Japan, and Canada have also committed to support the ISS through 2030. As stated above, Russia had announced it would support the station through 2028 and begin work on its orbital space station (Harland, 2024).

2.3. The China's Tiangong System

China's space program began in 1992 when the government announced its development plans. Following this announcement, China concentrated on developing the Shenzhou crew spacecraft and the Long March 2F rocket to enable human spaceflight with Yang Liwei onboard in 2003,

who became China's first astronaut in space (Solomone, 2013). Although China expressed interest in becoming a partner in the ISS (O'Brien, 2013), this possibility was effectively banned by a 2011 decree from US lawmakers that prohibited NASA from coordinating directly with China or any Chinese-owned entities. As a result, direct collaboration between NASA and Chinese space stations is strictly forbidden, rendering the prospect of sending US astronauts to the Tiangong or Chinese astronauts to the ISS virtually impossible (Torres-Spelliscy, 2024).

To establish and operate a manned space station without cooperation with the ISS, China first needed to test crucial systems, including life support and technologies required for the rendezvous and docking spacecraft traveling at 17,448 mph (28,080 kph) in orbit. To accomplish this, China launched the Tiangong 1 space lab in 2011, a 9-ton (8.2 metric tons) experimental laboratory comparable in size to a one-bedroom apartment, to evaluate docking technologies and operations essential for the functionality of a space station. In 2016, an upgraded yet similarly sized Tiangong 2 was launched, successfully hosting two astronauts for a 30-day mission and demonstrating the feasibility of long-duration spaceflight, thus setting China a record for human spaceflight mission duration (Harvey, 2019). Neither of these space labs is operational today; Tiangong 1 underwent an uncontrolled reentry into Earth's atmosphere in April 2018, burning up over the Pacific Ocean. Tiangong 2 was intentionally deorbited in a planned demise over the Pacific in July 2019 (Madhusudan, 2022).

As the Tiangong 2 mission progressed, China was finalizing its preparations for a permanent space station akin to the Soviet Mir space station. The Tiangong space station was designed to serve as a national space lab and platform for international scientific and technological cooperation. The space station consists of three modules: the Tianhe core module, the Wentian experiment module, and the Mengtian experiment module, arranged in a T-shaped configuration. The design principles of the space station prioritize conformity to China's national conditions, outstanding Chinese elements, technical progress, application benefits, and economical operation. The space station has a lifespan of over 10 years and can accommodate up to 6 crew members (Wang et al., 2023). With the completion and operation of the Tiangong space station in 2022, China became the third country able to build and operate space stations after the Soviet Union and the United States.

China's interest in space cooperation is driven by political motivations and the desire to address socio-economic challenges. Economically, it helps offset the costs of space programs; politically, it promotes stability; and technologically, it enhances performance and reduces failure risks. Since the 1970s, China has prioritized international cooperation in space, engaging in various activities, including manned spaceflight, deep space exploration, and satellite navigation. A 2016 white paper highlighted China's strategy of pursuing multilateral and bilateral cooperation, leading to 43 agreements with 29 countries and organizations from 2011 to 2016. Notable partnerships include collaborations with developed nations like Russia and developing countries like India and Brazil (Jiang & Zhao, 2021).

China supports and funds one of the world's most ambitious space programs. Viewing space investments as part of a more extensive infrastructure and logistical industrial development, China points out that its space investments will build resilient national systems that will help China to develop internally and internationally. Among China's foremost space goals are to build its own permanent space station (the Tiangong, which was completed in late 2022); build its Mars robotic missions, including Mars sample return, by 2030; develop its Lunar robotic mission program and establish a Lunar station on the Moon by 2036; develop a human landing system for Mars by 2049; construct space-based solar power satellites in GEO by 2050; construct asteroid probes (2029–2034); and develop planetary defense. China also aims to assemble, by 2030, a resilient space support structure with a fleet of satellite constellations that includes both civilian and military satellites (Namrata, 2023).

3. OBSERVATION

With rapid advancements in space station technology, the future of space stations presents endless opportunities and it is not easy to estimate how space stations could transform human life in remarkable ways in the future. Compared to past space stations, the future appears rooted in science fiction, yet it is becoming a reality as nations intensify their efforts and commitments. The possibilities are limitless.

After conducting a comprehensive literature review, we can recognize that international cooperation in space is a mutual benefit that leads to economic efficiency, political sustainability, and workforce stability. It is crucial to balance the interests of the participating members in the program. International cooperation in space also should proceed in bilateral, multilateral, global, and regional frameworks, encompassing all science, technology, funding, and regulation aspects. This collaboration aims to address common problems affecting the international community. While the principle of international cooperation is well-established, it is often too general. It does not adequately address all relevant issues involved in the process of international cooperation in outer space.

China has expressed international cooperation in space based on equality, mutual benefit, peaceful utilization, and common development. It has expanded collaboration with developing countries, contributing to capacity-building and fostering regional leadership. However, challenges remain in higher-level space activities, such as positioning itself as a leader in space by 2050. This requires a careful balance between national interests and shared international goals. This study proposes two possible solutions for China to sustain its space ambitions in the long term.

First, challenging but China could be open to negotiating with the US to lift existing restrictions that currently prevent its participation in the ISS. For this to happen, the US would need to modify its laws and policies regarding international space partnerships and technology transfer. Other factors such as geopolitical relations, national security, and international treaty obligations also need to be addressed. Any changes would require agreement from the US Congress, which would involve extensive negotiations and diplomatic discussions. It is also important to note that while the restrictions primarily affect NASA to cooperate with China and Chinese entities, other US space agencies, such as the Department of Defense and the Federal Aviation Administration (FAA), have different policies (Sheehan, 2007). For example, the FAA regulates US commercial crew launches to the ISS, with companies like SpaceX and Boeing holding contracts with NASA to transport astronauts. Due to the existing laws, Chinese spacecraft are excluded from these US astronaut launches. Changes in US policy need to be considered within this broader national and international context. As of the writing of this paper, there is no official information indicating that either the re-elected Trump administration or the current Biden administration plans to lift the ban on China's participation in the ISS. The Trump administration is historically recognized for imposing strict restrictions on China concerning trade and emerging technologies such as 5G (Nguyen, 2022). The U.S. concerns about involving China in the ISS mainly relate to foreign policy and security issues. International space cooperation involves multiple countries and is affected by international laws, treaties, and the interests of other stakeholders. Any changes to current policies must carefully consider these factors. While studies show that international cooperation in building space stations can be beneficial, there can also be challenges, such as conflicting interests among member states, which may complicate decision-making and reduce efficiency.

Second, China can continue to develop its space program by leveraging domestic resources and technology. This includes advancing its lunar and Mars exploration initiatives. While direct collaboration with the US may be limited due to current restrictions, China can still seek partnerships

with other countries. However, keep in mind that Russia is still having a conflict with Ukraine, which may affect the supply needed to build the space station. Additionally, China can engage with international private companies to cooperate in technology and service. This could involve partnerships with firms such as SpaceX and Blue Origin from the US or European companies like Airbus and ArianeGroup. Such partnerships can help China access advanced technologies and expertise without needing direct collaboration with the US government.

4. FUTURE RESEARCH DIRECTIONS

China's space station program represents a dynamic and multifaceted sector requiring continuous research to close the gap between its implications and potential impacts. This development plays a crucial role in shaping international cooperation, global governance, and the future landscape of space exploration among other nations. Significant progress has been made in recent decades, especially with the successful launch of the Tiangong Space Station in 2022. However, the program continues to face various challenges.

Future research should focus on several key areas, including developing international cooperation policies, advancements in space technology, and addressing concerns related to space debris and security. A deep understanding of the design and operation of space stations is essential for maintaining a sustainable human presence in space over the long term. And lastly the social and cultural impacts of space exploration.

5. CONCLUSION

China's space station is undoubtedly at a crucial step in its development, with ambitious objectives set for the coming decades. The goals include reaching parity with leading space nations by 2030 and positioning itself as a leader in space exploration by 2050.

There is a famous saying, "If you want to go fast, go alone; but if you want to go far, go together." that often to be true in many aspects of life, and now it resonates strongly in this context for China. While a solitary approach might yield rapid progress, true longevity and impact in space exploration would require international cooperation. Such cooperation efforts are crucial not only for advancing space technologies but also for promoting a new way to work with other countries, addressing mutual challenges, and creating frameworks that facilitate sustainable progress for the benefit of humanity as a whole.

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A General Overview of PPP and Concession Contracts, Their Statistical Treatment and Classification

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Abstract: *This paper explores the role of Public-Private Partnerships (PPPs) and concessionary contracts in economic development, highlighting the collaboration between public and private sectors in delivering infrastructure and public services. PPPs leverage private expertise, capital, and management to efficiently finance, build, and operate projects traditionally provided by the public sector, such as roads, hospitals, and utilities. Concessionary contracts, a form of PPP, grant private entities rights to operate public services or manage infrastructure, typically funded through user fees.*

The analysis underscores the advantages of PPPs, including cost savings, risk-sharing, and reduced public debt, supported by studies emphasizing efficiency gains and enhanced service delivery. Key motivations for using PPPs include managing fiscal constraints while addressing complex projects, reducing risks, and promoting equity in-service distribution.

Furthermore, the paper will explore the statistical treatment and classification of PPP contracts, emphasizing the importance of transparent and standardized accounting practices as outlined by Eurostat, EPEC, and the World Bank. By adhering to these standards, governments can manage their fiscal responsibilities effectively while ensuring accurate economic reporting.

1. INTRODUCTION

Economic literature highlights various models and examples of economic development across countries, emphasizing the crucial relationship between the public and private sectors in fostering growth. Among the diverse forms of these partnerships, Public-Private Partnerships (PPPs) and concessionary contracts have gained particular significance, especially in infrastructure development and public service delivery. These arrangements enable governments to leverage private sector expertise, capital, and management, addressing critical needs in areas traditionally dominated by public provision, such as transportation, healthcare, and utilities. This paper aims to explore the role of PPPs in fostering economic development while examining the legal and statistical frameworks governing their treatment in public sector accounts. By analyzing both the benefits and challenges of PPPs, as well as their implications for fiscal policy and international governance, the paper seeks to provide a comprehensive understanding of their contribution to sustainable development and sound fiscal management.

Despite the potential benefits of PPPs, their complex financial and operational structures necessitate careful legal and statistical treatment, particularly in relation to government deficit and debt reporting. In the European Union, the European System of Accounts (ESA 2010) and Eurostat (2016) Manual on Government Deficit and Debt (MGDD) provide essential frameworks for classifying PPP contracts. These guidelines ensure that the economic impact of long-term public-private collaborations is accurately reflected in national accounts, facilitating transparent fiscal management and compliance with EU regulations.

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2. GENERAL AND STATISTICAL TREATMENT OF PPP-S

In the absence of sufficient financial resources, public institutions turn to private entities through Public-Private Partnership (PPP) instruments, which offer a method of financing or managing a public service aimed at social welfare. Unlike traditional methods of promoting competition and increasing public services offered, as seen in the experiences of other countries, PPPs are increasingly considered the most efficient forms with a significant impact on a country's economic development. In a PPP, the public and private sectors work together to build public infrastructure projects such as roads, railways, hospitals, schools, hydroelectric dams, and more.

A Public-Private Partnership (PPP) is a collaborative arrangement between one or more public sector entities, such as governments or public agencies, and private sector companies. These partnerships are commonly employed to finance, construct, and manage projects that serve public needs and that traditionally are being provided by the public sector (Farquharson & Yescombe, 2018). Such projects can include infrastructure like roads, bridges, and hospitals; public services such as education and healthcare; and utilities like water supply and energy. In a PPP, the private sector contributes expertise, capital, and management skills, while the public sector provides regulatory support and oversight. The fundamental goal of these partnerships is to allocate risks and rewards between the public and private partners, ensuring that the projects are completed more efficiently and effectively than if undertaken by the public sector alone.

A Concessionary Contract is a specific form of PPP. Under this agreement, a government or public authority grants a private entity the right to operate a public service or develop and manage infrastructure for a predetermined period. During this period, the private entity is responsible for the investment, operation, and maintenance of the service or infrastructure. In return, the private entity typically earns revenue through user fees or tariffs. Although the concessionaire (the private entity) assumes the investment risk, it also stands to profit from the operation. At the end of the concession period, the infrastructure or service usually reverts to public sector control, often in a pre-agreed condition.

According to the OECD (2015), concessions are defined as: "A concession is a form of partnership between the public and private sectors in the provision of public works and services" ." They are further defined in the European Commission Directive "On Public Sector Procurement, 2004/17/EC," as contracts where the compensation for the works or services to be performed consists either solely in the right to exploit the work or service or in this right along with payment. The directive treats work concessions and service concessions differently. Works concessions are subject to specific provisions of the directive that cover how they are rewarded. Service concessions are excluded from the directive's coverage, although the principles of the Treaty will apply to the awarding of service concessions where there is potential cross-border interest.

Understanding these definitions is critical for grasping the legal and regulatory frameworks that govern public-private collaborations. The PPP Legal Resource Center (PPPLRC) is a key reference point in this context. Although there is no standard definition for PPPs universally, the PPPLRC serves as a comprehensive resource hub that provides legal, regulatory, and policy information relevant to PPPs. It offers a range of resources, including legal frameworks, guidelines, templates, case studies, and best practices. These resources are invaluable to governments, private sector entities, and legal professionals engaged in planning, negotiating, and executing PPP projects. The PPPLRC ensures that PPPs are structured effectively, legally sound, and in alignment with global best practices, thereby enhancing the success and sustainability of these partnerships.

The primary motivation for utilizing Public-Private Partnerships (PPPs) lies in their ability to deliver critical infrastructure and public services while offering several key advantages. These include lower costs, reduced risks, minimized budget deficits, improved efficiency and effectiveness, and enhanced equity. By combining the resources and expertise of both the public and private sectors, PPPs enable governments to address complex and expensive projects without the need for substantial public sector borrowing, which is often a significant concern in maintaining fiscal health.

Numerous studies have supported these claims. For example, Sarmento and Renneboog (2016) highlight that PPPs can lead to cost savings through competitive tendering and private sector efficiency. The private sector's expertise in project management, financing, and operational efficiencies often results in lower overall costs compared to traditional public sector procurement. Additionally, Iossa and Martimort (2015) argue that PPPs align incentives between the public and private sectors, leading to better project outcomes, as both parties have a vested interest in the project's success.

In addition to cost savings, PPPs are designed to distribute risks more effectively between public and private partners. This is crucial, as construction and operational risks can be significant in large infrastructure projects. According to Grimsey and Lewis (2005), risk-sharing in PPPs is one of the key factors that make them attractive to both public and private sectors. The private sector typically assumes the risks related to construction delays, cost overruns, and operational performance, while the public sector focuses on providing regulatory oversight and ensuring that the project serves the public interest.

Moreover, by involving private sector partners, PPPs can alleviate the financial burden on public budgets. Given that private entities often finance the initial investment in infrastructure, governments can avoid substantial increases in public debt. This is particularly important in the context of fiscal constraints, where governments are seeking ways to fund essential services without exacerbating budget deficits. A study by Engel et al. (2014) emphasizes that PPPs can be an effective tool for managing public sector liabilities while still delivering necessary infrastructure.

PPPs offer numerous advantages, including cost efficiency, reduced fiscal pressure, and improved risk-sharing mechanisms between public and private entities. Through the involvement of the private sector, governments can implement large-scale projects without heavily relying on public borrowing, thus maintaining fiscal stability. Furthermore, concessionary contracts—a specific form of PPP—allow private entities to manage public services or infrastructure for a set period, often funded through user fees, before returning the assets to public control.

Finally, PPPs can contribute to greater equity by ensuring that essential public services and infrastructure are accessible to all, including marginalized and underserved communities. By structuring agreements that emphasize public welfare, governments can ensure that the benefits of PPP projects are broadly distributed, promoting social equity and inclusion. This aspect of PPPs is crucial in achieving long-term sustainable development goals.

Another critical aspect that this paper would like to address is the statistical treatment of Public-Private Partnership (PPP) contracts from an international perspective, which is a fundamental concern for national statistical institutes. These institutes play a key role in classifying PPP contracts according to the rules and guidelines set out in the European System of National and Regional Accounts (ESA 2010) and the Manual of Eurostat on Government Deficit and Debt (MGDD).

The classification of PPP contracts is not a simple technical exercise but is vital for understanding how these contracts impact a country's public sector accounts, particularly concerning the calculation of government deficit and debt. The rules set out in ESA 2010 provide a comprehensive framework for this classification, ensuring that all EU member states apply consistent accounting standards. The MGDD further elaborates on how specific contracts, particularly those under the PPP model, should be treated in national accounts. These guidelines ensure that PPP contracts, which often involve long-term commitments and complex financial arrangements, are recorded in a way that accurately reflects their economic impact. By adhering to these standards, national statistical institutes ensure that the economic implications of PPP contracts are transparently and consistently reported, enabling better fiscal management and policy formulation.

The ESA 2010 framework is a legal act adopted by all European Union (EU) member states, providing a systematic and detailed description of a country's economy. It aligns with international accounting guidelines, specifically the United Nations System of National Accounts (2008 SNA), ensuring consistency in economic reporting across countries. Within this framework, fiscal indicators like deficit and public debt, which are critical for the Excessive Deficit Procedure (EDP), are defined. PPP contracts and concessions are particularly important in this context because they can significantly affect these indicators.

The need for clear terminology and standardized treatment of PPP contracts in national accounts has been highlighted in various studies. For instance, the European PPP Expertise Centre (EPEC) and Eurostat collaborated to produce the "Guidelines for the Statistical Treatment of PPPs," which became applicable on September 29, 2016. These guidelines provide a standardized approach to recording PPP contracts in public sector accounts, ensuring that countries within the EU adhere to consistent practices. This consistency is crucial for accurate economic comparisons and assessments across the EU.

According to the MGDD manual, different forms of contracts between government units and corporations, especially under the umbrella of "public-private partnerships" or "concessions," require careful classification within national accounts. This classification determines whether the financial commitments and liabilities associated with PPPs are included in the annual balance sheet of the relevant public sector units. The decision to record PPP-related information on the balance sheet can have significant implications for a country's reported deficit and debt levels, influencing both domestic fiscal policy and compliance with EU regulations.

The "Guide to the Statistical Treatment of PPPs," developed by Eurostat and the World Bank (n.d.) further elaborates on these issues. The guide emphasizes the importance of transparency and consistency in the statistical treatment of PPPs, ensuring that these contracts are recorded in a way that accurately reflects their economic impact. This guide also addresses the challenges posed by the complex nature of PPP contracts, which often involve long-term commitments and significant financial obligations.

The statistical treatment of PPPs according to Eurostat "Rules" has sometimes been considered one of the obstacles to undertaking a PPP and has therefore been the subject of much debate (worldbank.org). Stakeholders involved in specific projects have argued that the rules make it difficult to understand how PPPs can impact the financial balance of EU member states and how they affect the fiscal criteria set out in the Maastricht Treaty. The Maastricht Treaty, signed in 1992, foresaw the creation of the Euro. This treaty defined the tools and appropriate methods for fiscal supervision within the European Union. Provisions regarding the EDP (Excessive Deficit Procedure) are set out in the consolidated version of the 2012 Treaty on the Functioning of the European Union (TFEU). The TFEU requires EU Member States to respect budgetary discipline by adhering to two criteria: the deficit-to-GDP ratio

and the debt-to-GDP ratio, which should not exceed reference values of 3% and 60% respectively, as stipulated in Protocol (3) of the EDP.

In the absence of sufficient financial resources, public institutions increasingly rely on Public-Private Partnerships (PPPs) to finance or manage public services aimed at promoting social welfare. Unlike traditional methods of public sector service provision, PPPs are being recognized globally as efficient tools with substantial impacts on a country's economic development. PPPs facilitate collaboration between public and private entities to execute large-scale infrastructure projects, including roads, railways, hospitals, and schools, while ensuring efficient management and risk-sharing. This collaboration allows governments to achieve key development goals without overburdening public finances (Farquharson & Yescombe, 2018; Sarmento & Renneboog, 2016).

The concept of PPP contracts is relatively new in Albania. The Albanian Government has created a flexible and attractive legal framework to demonstrate its firm commitment to encourage local and international private investment and to ensure greater cooperation between private partners and the Contracting Authority. Law no. 125/2013 "On Concessions and Public Private Partnership" (amended by Law no. 50, dated 18/07/2019), which defines the general rules of the procedure applicable by contracting authorities for awarding, executing, monitoring and evaluating contracts of public-private partnership.

According to Law no. 125/2013 "On concessions/PPP in the Republic of Albania" as amended, the definition of concessions is given as follows: "*A concession is an agreement with financial interest, concluded in writing between the contracting authority and one or more economic operators, the object of which is the performance of works, where the remuneration for the works/services to be performed consists of the right to use the works/services that are the subject of the contract or this right together with the payment", while the Public Private Partnership is defined as: "...a public works contract or a public service contract that meets the conditions that define it as a public private partnership, as regulated in this law and that is signed between the contracting authority on the one hand and the economic operator selected as the most successful bidder.*"

Albania is currently in the early stages of implementing both the ESA 2010 and International Public Sector Accounting Standards (IPSAS) frameworks, both of which provide standardized methods for assessing the fiscal impact of Public-Private Partnership (PPP) contracts. According to ESA 2010, PPP arrangements where the public sector retains significant control over assets and revenue streams are to be consolidated within the government's accounts (Eurostat, 2016). This alignment with ESA 2010 is critical for Albania to ensure a more accurate representation of public liabilities and assets arising from PPP agreements, contributing to improved fiscal reporting.

In addition to ESA 2010, the adoption of IPSAS is a key part of Albania's broader public sector accounting reform. IPSAS provides an internationally recognized framework for determining whether PPP assets should appear on government balance sheets, with the focus on the distribution of control and risk (IMF & World Bank, 2013). By adopting both ESA 2010 and IPSAS 32, Albania aims to enhance transparency, fiscal discipline, and the effective classification and monitoring of PPP contracts.

It is important to note that ESA 2010 requires national accounts to use a standard, agreed-upon reporting system. Therefore, the asset of a PPP must be recorded as either a whole government asset or a wholly non-governmental asset (ie its economic ownership cannot be shared between the government and the partner). As a result, when a PPP asset is found to be on the government's balance sheet, the total value of the asset (and related liabilities)

3. CONCLUSION

The treatment of PPP contracts has already been discussed by many scholars. A review of the literature regarding PPPs provides an opportunity to understand the current situation, which includes the nature of PPPs, the sectors where these contracts are most efficient, as well as to assess the trends in research. It is necessary to study the origin of an idea before reflecting on the current key topics and discussing the potential future direction of PPPs.

A PPP project generally involves long-term collaboration and a contractual relationship between the public and private sectors, which can last up to 25 or 30 years (Girth, 2014; Hodge & Greve, 2007). A short-term contract is not a PPP. Private sectors in a PPP project usually participate in certain phases of that project, including design, construction, operation and maintenance. These phases often involve large capital expenditures, typically millions of dollars or more (Newman & Perl, 2014). Thus, a long-term contract allows both partners to benefit from cooperation (Silvestre & de Araujo, 2012). At the same time, the long-term contract makes it possible for the private sectors to get a return on the initial investment and actually make a profit.

PPP focuses on the sharing of risks, costs, benefits, resources and responsibilities (Koppenjan, 2005). PPP will not transfer all risks or costs to private sector partners.

PPP is often a complex process (Ross & Yan, 2015). Due to the long-term nature of the contract and the multi-phase collaboration required (in terms of design, construction, operation and maintenance), the goals of the PPP partners and the political environment can be dynamic. These factors entail a requirement for partners to negotiate and interact throughout cooperation. This makes the process of cooperation in the PPP project potentially complex. In addition, each of the PPP partners has its own strategy and institutionalized background. This can make the decision-making process in PPP projects extremely complex (Klijn & Teisman, 2003). Finally, PPP projects have mutual goals.

Everything mentioned above will help to identify the sectors or sub-sectors where further PPP contracts can be concluded, their proper classification with the main goal of measuring the impact on the public debt and the deficit following methodological standards defined in manuals and instructions.

In conclusion, the statistical treatment of PPP contracts, as outlined by ESA 2010, the MGDD manual, and the guidelines from Eurostat and EPEC, is essential for ensuring that the financial implications of these partnerships are accurately captured in national accounts. This treatment not only affects how countries report their fiscal positions but also influences policy decisions and compliance with EU fiscal rules.

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The Role and Importance of Public Policies. How Do Governments Should Intervene to Protect the Rights of Employees in Digital Labour Platforms

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Abstract: *Platform work has gained policy attention in recent years due to the expansion and diversification of business models and their growth in terms of employment and income. Today, we are all facing new forms of employment, which are directly influencing employment policies, the labour market, the informality of the economy, and the creation of new jobs. Working on digital platforms is one of the new forms of employment created in recent years, as a result of the development of technology and digitalization. Employees engaged in digital work platforms are encountering major challenges, such as obtaining employee status, employment contracts, and the lack of a legal framework. On the other hand, states with their law enforcement bodies are facing challenges in designing appropriate policies for this category of employees. The purpose of this paper is to address the importance of public policies and the role played by governments, together with law enforcement bodies, to create the right package of public policies and the legal framework, in order to respect the principle of decent work in digital work platforms. . Using the qualitative method, in this paper, the purpose of drafting public policies by governments, to guarantee the rights at work for employees of digital platforms, will be mainly related to the work contract, working time, payments, insurance at work, the storage of personal data, and the evaluation of work through algorithms.*

1. INTRODUCTION

Today we all talk about digital work, and digital work is a very important part of digitalization of work. Digital platforms are directly affecting the country's economy, the formalization and informality of the economy, and a re-dimension of the concept of work and the performance of work. All types of platforms, such as delivery platforms, location-based platforms, and platforms that operate online affect the business process of a country's production, distribution, demand, supply, and matching operations. Location-based platforms, including the delivery sector and the taxi sector, play a special role in delivering goods or providing services, with customers booking taxis through the application and paying for the driver's vehicle.

Work in digital platforms is often organized in the request to perform some small tasks that directly affect the production process in a certain country. The European Commission has defined digital work platforms as internet-based companies that facilitate and organize work provided by employees or self-employed, for third-party clients, the model of creating such a business is based on technology and algorithms (European Commission, 2021). This has created what is widely known as "work on digital platforms" which refers to a wide range of agreement/arrangement such as casual work, dependent self-employment, informal work, piecework, workplace, group work, a wide range of sectors (Work, 2019). A platform creates a collaborative environment and

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sets the rules for all participants. The ecosystem created by digital work platforms includes parties that use the platform to engage in value-creating interactions, however, the ecosystem may also include other actors, such as data partners or industry actors that do not participate directly in the platform (Parker et al., 2016). Digital labour platforms are designed to act as intermediaries between producers and consumers, facilitating a direct connection between them. Platforms also provide the infrastructure and governance conditions for labour exchange and facilitate related compensation (Parker et al., 2016).

Digital labour platforms have a very wide geographical spread, statistical data shows that more than 500 digital work platforms are operating in Europe, and more than 28 million people within the EU work through these platforms and it is expected that this number is likely to reach 43 million people by 2025 (Eurofound, 2018). The main problem or challenge faced by employees engaged in digital platforms is closely related to their legal status. Digital platforms classify workers as self-employed and conclude service contracts with them and not employment contracts. Referring to labour legislation in almost every country, the legal status of the employee is closely related to the benefits of the rights at work, rights guaranteed in the labour law. Being classified as self-employed, these workers are excluded from benefiting from social schemes. The ineffectiveness of the social protection scheme affects labor costs that are unfairly charged to be paid by the employee and not by the employer. All these are in open contradiction with the international principles of decent work.

According to the guidelines of the National Organization for Labour and Employment, workers have informal work if their employment relationship, in law or practice, is not subject to national labour legislation, income tax, social protection or rights to employment benefits such as notice, severance pay, etc (International Labour Conference, 2015). For these reasons, it is necessary to create the right policies by the states in an independent manner in their national legislations, as well as the drafting of a regulatory framework at an international level. Drafting a legal framework would help not only in guaranteeing the rights of work for these categories of employees but also in regulating employment policies for digital employees. The purpose of this article is to identify the problems in digital platforms, the challenges faced by employees and the proposals for the drafting of appropriate policies that should be drawn up by the governments of the countries and why not the drafting of an international convention by the International Labour Organization. The International Labour Organization is a United Nations agency that aims to establish international labour standards, promote rights at work, social dialogue, and increase social protection. The challenge for all of us is to implement and take measures to guarantee the standards set by the ILO, but respecting them in the digital world of work and in the time of the development of artificial intelligence is challenging.

2. THE CHALLENGES OF WORKING ON DIGITAL LABOUR PLATFORMS

The biggest challenge that paves the way for other challenges and the lack of enjoyment of rights at work, is the legal status of the employee. Employees of digital platforms are classified as self-employed and are therefore exempt from any legal benefits enjoyed by employers who are in a traditional employment relationship. This shows that the whole world was unprepared for this new crowd of workers, who are not really enjoying any of the rights at work provided for in the national legislation. Although they are classified as self-employed, they actually have very little control over their work, they cannot set prices, they are required to wear uniforms, they cannot choose the order of their tasks, or they are dependent on the client in different ways (Lane, 2020). Control can be exercised through technology-enabled monitoring, with the algorithm taking the place of a traditional manager (Lane, 2020). The only reason why the workers of the digital labour

platforms are classified as self-employed by the digital platforms is to avoid these platforms from the obligations that the employers have according to the legal provisions in the labor legislation. Treating them as self-employed creates what today is called the grey area of employment or false self-employment (Dieuaide & Azaïs, 2020).

Due to the lack of classification as employed, employees of digital platforms are also excluded from social insurance schemes, they cannot benefit from a minimum wage, maternity leave, medical report, unemployment compensation in case of accidents at work, unpaid vacations, they do not contribute to the future pension scheme, etc (Behrendt & Nguyen, 2019). Failure to benefit from social protection schemes leaves workers vulnerable to labour market excesses, undermines their rights and dignity, exacerbates poverty and inequality, and threatens the implicit social contract of modern societies (Behrendt & Nguyen, 2019). Another challenge for working on digital platforms is the unstable salary and the lack of minimum wage guarantee. This comes as a result of the organization of work in some sectors of digital platforms, for example, the employees of the platforms that operate online, perform small, frequent tasks but in a short time frame, this leads to a lack of calculation in the right way of their remuneration for these employees, their remuneration is calculated in work volume and not in regular hours (Stefano, 2016).

According to delivery or taxi digital labour platforms, the employees are paid only for the delivery without counting the route that the taxi driver or motorbike takes to deliver the order or the client, or not calculating the time it takes to wait for the client. This situation will bring instability in income for the workers of the digital platforms, creating other challenges for the state bodies in drafting the appropriate policies. One day there may be a lot of work, but the next day very little, making financial planning difficult (Wood et al., 2019). Guaranteeing the minimum wage for employees of digital platforms would bring many changes in their employment contracts. The minimum wage guarantees a standard of living at a minimum level, for all employees who have an individual employment contract, guaranteeing them an income to meet the basic needs for food, shelter, and health care. On December 14, 2022, the European Parliament adopted the Directive (EU) 2022/2041 (European Parliament and Council, 2022) on minimum wages, which guarantees the appropriate legal standards for the minimum wage for all member countries of the European Union, intending to improve working conditions and protection of employees. The purpose of this directive is to promote the connection of collective contracts, or organizations of workers in digital platforms, to help them have access to salary forecasts in this sector of the economy. The conclusion of collective contracts and the engagement of employees in different unions will orient more towards the increase of demands to have a minimum wage. All member countries of the European Union must have a system of minimum wages, the level of which must cover the expenses and basic demands of the employees. The Directive(EU) 2022/2041 (European Parliament and Council, 2022) encourages all member states to create clear mechanisms for guaranteeing the minimum wage, including, in addition to employees, trade unions.

Work on digital platforms is closely related to the operation of algorithms. Algorithms are used in these platforms for many work processes, for example in the division of tasks, in the evaluation of the employee for the work done, the analysis of the data of the users of the platform, etc. Algorithms serve as mediators and connectors between customers and workers in a fast and efficient way. When a customer is looking for a taxi, the algorithm helps him to find and contact the taxi that is located closest or the taxi employee that has the best ratings from customers. However, this working relationship related to algorithms makes some work processes in digital platforms to be automated, such as employee evaluation, dismissal, and exit from the profile in the application, all of these are challenges to be solved in such a way that the rights at work for platform employees are respected and

developed (Möhlmann et al., 2021). These algorithms play a key role in how digital platforms such as Uber, Upwork, Fiverr, and other gig economy platforms operate, often replacing the traditional role of human managers (Rosenblat & Stark, 2017). The right to organize in a union and the conclusion of collective contracts are two of the basic rights in the work that the employees of the digital platforms are not in conditions to enjoy. The lack of benefit from these rights is directly related to their classification as independent workers and not as employees. Even these rights are mainly related to the traditional employment contract which is regulated by the contracts provided for in the labour law. Employees often work independently from each other, they do not have an office or an area where they gather, physical interaction is limited, and in many cases, they do not know each other and do not even know where they have colleagues. This type of organization prevents the workers of the platforms from being organized in a union or collective talks since the unity of the unions is solidarity and joint action (Aloisi, 2016). For these reasons, public policy intervention is necessary and in au urgent need to ensure more equal rights for employees of digital platforms.

3. THE IMPORTANCE OF DRAFTING PUBLIC AND LEGAL POLICIES TO REGULATE WORK ON DIGITAL PLATFORMS.

The importance of proposing and adopting appropriate legal policies and measures to regulate the labour relationship in digital work platforms is of vital importance. First of all, it is important to guarantee a safe, fair working environment, with opportunities for all employees. Secondly, it is important to create an economy with low levels of informality, the more workers are employed on digital platforms and without employment contracts, the more informality we will have in the labour market, and therefore in the economy of a country. The inclusion of platform workers in social protection schemes means more monetary income for the state budget, which translates into more social protection for the entire population. The use of platforms and new employment modalities in general generates not only challenges but also opportunities for increasing social protection, the fact that the platforms work through electronic means of payment means that income is often observable, thus preventing informal transactions (Apella et al., 2023). The new labour agreements that have recently emerged should be seen as new opportunities to design more worthy and comprehensive policies to benefit from social protection. In this context, the first initiative that should be taken is precisely the determination of the legal status of these employees. States in their national legislations, by drafting specific legal provisions, must recognize these employees with the legal status of employees. This legal provision carries in itself great importance in the definition of legal agreements in digital work platforms. Recognition as an employer before the law means the guarantee of all basic rights at work. Thus, these employees have the right to benefit from a minimum wage, rights to paid vacations, and protection against unfair dismissal from the platform.

An opening in legal terms would be the drafting of a convention by the International Labour Organization, which would aim to regulate labour contracts on digital platforms. The drafting of a convention would oblige the member states of the ILO through ratification to adopt a legal framework that would meet the standards established in the convention. The drafting of a convention by the ILO is closely related to the mission of creating this organization at an international level, the ILO has been subject to criticism on many fronts, it remains the main body of the UN charged with establishing labour standards, with the unique quality of tripartism, and therefore a key factor in ensuring a framework of decent work standards in this field (Fredman et al., 2021). The drafting of policies to regulate employment in digital platforms should focus on three important issues, firstly empowering the employees of digital platforms by classifying them as employed and not self-employed, secondly guaranteeing basic rights and freedoms at work and finally providing concrete legal measures for fair competition between digital platforms.

Concerning safety and health at work, platform workers encounter difficulties in their work environment. The problems of the lack of health and safety are also related to the fact of lack of an employment contract, and a legal framework for welfare, otherwise, since this employment agreement is not regulated, in cases of job insecurity, these employees have nowhere to direct their complaints. The delivery and transport sectors are more at risk and they face more security risks at work. According to studies, a large number of workers on digital platforms are excluded from occupational health and safety insurance schemes, "facing significant risks without adequate support for their physical and mental well-being" (Aloisi & De Stefano, 2022). The pressure that these employees have to accomplish as quickly as possible, hurrying to deliver orders and having a high ranking in a job affects and causes high levels of stress and fatigue (Aloisi & De Stefano, 2022). The nature of algorithm-based work pushes workers to high intensity, increasing the risks of accidents due to reduced concentration and fatigue (Huws et al., 2017).

For the reasons added above, the intervention of state bodies is necessary in the drafting of legal provisions that regulate accidents at work, workloads at work, benefits in cases of accidents at work, and the establishment of a special body to monitor working conditions. A helpful policy for the control of work in digital platforms is the expansion of the powers of the Labour Inspectorate to monitor working conditions, safety and health in digital work. A more important step in designing the right policies for the employees of digital platforms is the collection of data and the analysis that should be done on the characteristics and needs of the employees. Being that the work on these platforms is something new, the collection of data can be difficult, however, it can be a good instrument to orient policies towards more urgent issues, where the intervention of state bodies is necessary. A new series of policy briefs will address the economic rationale for platform work regulation, reviewing ad-hoc regulations of platform jobs around the world, considering the evidence on the impact of platform regulation on employment and discussing how the regulation of the work of the platform can coordinate and inform the general policy of the labor market (World Bank, 2023).

4. INTERNATIONAL PRACTICES AND LESSONS FOR PUBLIC POLICY

In 2021, Spain adopted legislation known as the "Rider Law" (Spain, 2021), which aimed to regulate the employment status of digital platform workers, addressing issues such as the lack of social protection, unstable income, and lack of employment stability. This law aims to classify platform workers as employed, earning the right to benefit from the rights and freedoms in the employment relationship. The law has addressed the element of the algorithm in this work relationship, forcing the platforms to be transparent in the way the algorithm will work for the evaluation of the employee, how the work will be distributed to all employees and above all the conclusion of the work contract. After the approval of the law, there was an improvement in working conditions because some platforms implemented the law and changed the work structure by adapting it to the legal provisions, even though some platforms and employees expressed their opposition saying that the flexibility they had before was very necessary. This law constitutes one of the first cases in Europe where a state forces such a classification for platform workers, creating a precedent that can be followed in other countries (Todolí-Signes, 2021).

France approved the "Status of Professional Mediation" in 2016 (République française, 2016), the purpose of this legal act is to provide employees of digital platforms with access to their rights at work. This act emphasizes the importance of collective bargaining to reach an agreement in determining wages and other working conditions. It also implies that employees should have access to information and training, as well as the opportunity to form unions to protect their interests (Gomes, 2022). Regarding the right to benefit from social schemes, the law provides that all

employees, regardless of employment status, must be subject to the benefit of the right to social protection (European Agency for Safety and Health at Work, 2022). However, even in the case of the French law, there were cases from platforms and workers who opposed these changes in the law. Some even went to court while others challenged the law by rejecting its implementation and classifying the jobs as independent. This has caused a wide debate at the political and social level in France, about how this new sector should be regulated (Guinea et al., 2024)

In 2021, Italy adopted Law No. 128/2021 "Provision regarding the protection of the rights of workers of digital platforms (Italy, 2021)"[3], the purpose of this law is to classify them as self-employed and to provide these workers with social, economic and legal protection. Italian law has been clearer in the provision of legal provisions, both in relation to legal status and the benefit of the right to social protection. As for the functioning of the algorithm, the law provided mandatory provisions that forced the platforms to take all measures to increase the transparency of how the algorithm works and the evaluation of the work and the distribution of their work daily. This legal provision related to algorithms is a step towards reducing the asymmetry of information and power between employees and platforms (Aloisi, 2020). Also, some employees prefer the flexibility offered by self-employment status, giving rise to a wide-ranging debate on balancing flexibility and protection (Ratti, 2021).

The United Kingdom does not yet have a specific law that regulates detailed working conditions and rights for employees of digital platforms, however, some attempts and court decisions have had a role in regulating this employment contract. One of the issues that has marked the history of the legal classification of digital employees, is the decision given by the Court of Appeal of the United Kingdom, which recognized Uber employees as employees (Court of Appeal (Civil Division) Uber BV v. Aslam, 2019). A group of drivers of the Uber platform asked to know the status of the employee, they emphasized that it is necessary to have the right to enjoy the legal provisions for employees, to have better working conditions, to have rights at work, specifying the need minimum wage and paid holidays. These include the creation of a national registry for work platforms and the standardization of working conditions to ensure better protection for employees (Adams-Prassl, 2022).

5. CONCLUSION

The drafting of policies by law enforcement bodies in the country has a special importance in the promotion of rights at work, in the promotion and implementation of basic principles at work, the implementation of the concept of decent work. Respecting the rights at work is a legal obligation for every country governed by the rule of law. The importance of drafting appropriate policies for labour relations on the platform is also of great importance for the development of the economy of a country, to fight not only poor working conditions but also to control the informality of the economy. Employment policies are another important element that should be oriented towards regulating the technology element in labour relations and be seen as inclusive. Work on digital platforms is developing at a high speed, while all this development is accompanied by the lack of determination of legal status, bringing legal gaps regarding minimum protection, regular salary, social security and paid vacations. Well-structured policies also have an impact on the proper taxation of these employees and the correct declaration of the population that is employed on digital platforms. Moreover, these policies create a stable basis for economic development, promoting a fair and stable labour market, where workers' rights are protected and working conditions are safe and predictable.

[3] Law No. 128/2021. Provisions regarding the protection of workers on digital platforms. Official Gazette of the Italian Republic, August 12, 2021.

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Invalidity of Employee Resignation in Albanian and European Employment Law: A Comparative Analysis of Legal Frameworks and Judicial Interpretations

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Abstract: *This research article comprehensively analyses the concept of "constructive dismissal" within the framework of European and Albanian employment laws, alongside pertinent case law. The findings, which shed light on this complex legal concept, will provide a deeper understanding and enlightenment to legal scholars, practitioners, and students interested in employment law.*

Constructive dismissal, where an employee resigns due to the employer's conduct rendering continued employment untenable, presents complex legal interpretation and application challenges and poses significant implications for employee rights and employer responsibilities. This study critically examines the statutory provisions and case law governing these aspects of employment law in Albania. Through a doctrinal and case law analysis, the paper identifies the conditions under which resignations may be classified as constructive dismissals, exploring the threshold of intolerable conduct required to substantiate such claims. The research highlights the influence that the European Union directives and comparative legal principles should have on the development of Albanian employment law. By providing a detailed examination of the legal landscape surrounding employee resignation, this study contributes to the broader understanding of employment protections and the need for legal reforms to enhance labour rights.

The study employs a comparative legal methodology, scrutinising statutory provisions and judicial interpretations across various European jurisdictions and Albania. The analysis reveals the doctrinal evolution and practical application of constructive dismissal, highlighting the convergence and divergence in legal standards. While many European legal systems recognise constructive dismissal as a mechanism for employees to resign in response to intolerable employer conduct, Albanian employment law lacks a comprehensive statutory or doctrinal basis for this concept. Through a detailed examination of landmark cases and legislative texts, this article discusses the critical elements constituting constructive dismissal, including employer conduct, employee resignation, and the requisite threshold of intolerability.

The paper strongly advocates for legislative reform to align Albanian employment protections with European standards, ensuring that employees are safeguarded against detrimental employer actions that effectively force resignation. The findings underscore the urgent need for a harmonised legal framework to ensure consistent and fair adjudication of constructive dismissal claims, advocating for reforms that align Albanian laws more closely with European standards. This study contributes to the broader discourse on employment law by providing insights into shaping employee protections against constructive dismissal.

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1. CONSTRUCTIVE DISMISSAL IN EUROPEAN UNION COUNTRIES

A resignation occurs when an employee tenders their resignation from their employment and provides the relevant notice period, and the employer accepts that resignation. In doing so, the parties end the employment relationship. The amount of notice an employee must provide on terminating their employment can vary from employee to employee. It may be set out in the

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employee's employment contract, an industrial instrument applicable to their employment, or in the employer's policies.

One of the most significant risks attached to a resignation arises in circumstances where there is doubt as to whether the employee resigned from their employment voluntarily—that is, where it may be arguable that the employee was "forced" to resign as a consequence of the employer's conduct or a course of conduct in which the employer has engaged.

This distinction is important because if it is determined that an employee was "forced" to resign, the termination will be characterised as being at the employer's initiative. The employee may then be eligible to make an unfair dismissal claim.

Constructive dismissal is widely recognised in European employment law and other countries. It occurs when an employee resigns due to the employer's conduct, making continued employment intolerable. In other words, the employee resigns and claims that the resignation occurred not because the employee wanted to leave but because of the employer's intolerable conduct. Because the employee alleges that the employer involuntarily and intentionally or unintentionally coerced the resignation, the resignation becomes a constructive dismissal. The terminology originates from the idea that such a resignation submitted under duress can be seen to have been "constructed" or "created" by the employer.

To convince an arbitrator or judge that unfair constructive dismissal has taken place, the employee must show that:

- The employment circumstances were so intolerable that the employee could not continue to stay on.
- The unbearable circumstances were the cause of the employee's resignation.
- There was no reasonable alternative at the time but for the employee to resign to escape the circumstances.
- The employer must have caused the unbearable situation.
- The employer must have been in control of the unbearable circumstances.

Constructive dismissal generally arises from principles of contract law and employment protection, which seek to balance the rights and duties of employers and employees. While the specifics can vary across EU member states, the core elements of constructive dismissal typically include:

a) *Employer's Breach of Contract*: The employer must have fundamentally breached an essential employment contract term.
b) *Intolerable Working Conditions*: The breach must result in working conditions that a reasonable employee would find intolerable.
c) *Causal Link*: The resignation must be directly linked to the employer's conduct.
d) *Prompt Resignation*: To claim constructive dismissal, the employee must resign within a reasonable time after the breach.

Below are some case law examples in European countries regarding constructive dismissal or cases involving a constructively dismissed employee. All these cases have in common the four criteria mentioned above: the employer's breach of contract, intolerable working conditions, a causal link, and prompt resignation.

In the United Kingdom, to resign and bring a successful complaint of constructive dismissal, an employee must show that the resignation was in response to a serious breach of contract by the employer.

Employees frequently rely on the last straw doctrine to seek to do so. This involves relying upon a series of acts by the employer which, taken cumulatively, amount to a sufficiently serious breach of the employment contract so that the employer can treat the contract as having been repudiated.

The case of Morrow v Safeway Stores plc [2002] EWCA Civ 1539 highlighted that an accumulation of less severe breaches could collectively amount to constructive dismissal, provided they undermine the trust and confidence in the employment relationship.

In Germany, constructive dismissal is addressed under the broader concept of "unjustified termination". In the case of Bundesarbeitsgericht (BAG) Decision 2 AZR 400/08, the Federal Labour Court ruled that if an employer's conduct severely breaches the mutual trust required for the employment relationship, an employee's resignation may be treated as a constructive dismissal. The court requires a detailed assessment of the employer's behaviour and the employee's response.

In Italy, the law addresses constructive dismissal under "dimissioni per giusta causa" (resignation for just cause). The Corte di Cassazione, in Decision No. 8290/2005, stated and recognised that an employee could resign immediately if the employer's conduct constitutes a serious breach of the employment contract, rendering continuation of work intolerable. The decision requires a clear demonstration of the employer's fault and the severity of the breach.

Although the concept of constructive dismissal across EU countries shares commonalities, particularly in requiring a fundamental breach of contract by the employer and creating intolerable working conditions, there are notable differences, for example, when standards of proof are considered. Some countries, like the UK and Germany, require a higher threshold of evidence, emphasising the severity and impact of the breach. Others, like France and Italy, may adopt a more flexible approach, focusing on the overall context of the employer's behaviour.

Another discussed element is the accumulation of breaches, where jurisdictions differ on whether a series of minor violations can collectively constitute constructive dismissal. The UK and Netherlands are more open to considering cumulative effects, whereas Germany and Italy often require a singular significant breach.

In addition, regarding the employee's response time, the promptness of the employee's resignation after the breach is critical. While most EU countries expect timely action, the exact timeframe can vary, with some allowing more leniency depending on circumstances. However, the fact that the resignation occurred immediately or shortly after the employer's breach should be undeniable.

2. EUROPEAN COURT OF HUMAN RIGHTS (ECTHR) CASES ON CONSTRUCTIVE DISMISSAL

The European Court of Human Rights (ECtHR) has addressed various aspects of employment rights, including constructive dismissal, under the European Convention on Human Rights (ECHR) (Council of Europe, 1950). Constructive dismissal cases often involve issues related to Articles 3 (prohibition of inhuman or degrading treatment), 6 (right to a fair trial), 8 (right to respect for private and family life), and 13 (right to an effective remedy). Below are a few ECtHR cases that have contributed to the understanding and development of constructive dismissal jurisprudence.

Saliyev v. Russia (2010)**.** The applicant, a schoolteacher, resigned from his position due to a sustained campaign of harassment by his employer. He claimed that the harassment constituted constructive

dismissal and sought judicial redress. The ECtHR held that the harassment suffered by the applicant violated Article 3 of the ECHR, as it amounted to degrading treatment. The Court emphasised that the right to work in a safe and dignified environment is fundamental and that employers must protect employees from harassment and degrading treatment. This case underscores the ECtHR's recognition that severe workplace harassment can violate human rights, potentially leading to a constructive dismissal claim.

Kudra v. Croatia (2008)**.** The applicant, a public sector employee, resigned after being subjected to prolonged bullying and unjustified disciplinary actions. He argued that his resignation resulted from constructive dismissal and sought compensation. The ECtHR found that the applicant's treatment by his employer amounted to a violation of Article 8 of the ECHR, which protects the right to respect for private and family life. The Court highlighted that unfair treatment and bullying in the workplace can severely impact an individual's personal and professional life. This decision highlights the ECtHR's recognition of the impact of workplace bullying on an individual's dignity and private life, supporting claims of constructive dismissal under Article 8.

Volkov v. Ukraine (2013)**.** A judge was subjected to undue pressure and interference in his judicial functions by state authorities, leading him to resign. He claimed constructive dismissal due to the hostile work environment. The ECtHR ruled that the undue pressure and interference violated Article 6 of the ECHR, which guarantees the right to a fair trial. The Court found that the applicant's resignation directly resulted from the state's actions, amounting to constructive dismissal. This case illustrates the ECtHR's stance that interference with professional duties and creating a hostile work environment can amount to constructive dismissal, particularly in judicial independence cases.

Palomo Sánchez and Others v. Spain (2011). The applicants, trade union members, faced retaliatory actions by their employer, including demotions and changes in job duties, following their union activities. They argued that these actions forced them to resign, constituting constructive dismissal. The ECtHR held that the retaliatory actions violated Article 11 of the ECHR, which protects the right to freedom of association. The Court found that the employer's actions were intended to undermine the applicants' union activities and forced their resignation. This ruling emphasises the protection of employees' rights to unionise and engage in union activities without fear of retaliation, supporting claims of constructive dismissal when employers create intolerable conditions to suppress these rights.

Grand Chamber Judgment in Demir and Baykara v. Turkey (2008). The applicants, trade union officials, were dismissed from their positions following their involvement in union activities. They claimed constructive dismissal due to their employer's hostile and retaliatory actions. The Grand Chamber held that the actions against the applicants violated Articles 11 and 14 of the ECHR, emphasising the importance of protecting trade union rights and prohibiting discrimination. The Court recognised that creating a hostile work environment to suppress union activities could constitute constructive dismissal. This landmark case reinforces the ECtHR's commitment to protecting trade union rights. It supports the principle that creating intolerable working conditions to suppress these rights can lead to constructive dismissal claims. The ECtHR's case law on constructive dismissal demonstrates a broad interpretation of human rights protections in the workplace, where the key implications include the recognition of severe workplace harassment, the protection of private and family life, reasonable and realistic job performance targets, etc. These decisions should serve as a background for the national jurisdictions so that the national courts incorporate ECtHR standards into their jurisprudence, ensuring that harassment, bullying, unsolved grievances or retaliatory actions in the workplace are recognised as grounds for constructive dismissal. Legislators should

create a comprehensive framework strengthening the legal protections of employees and provide clear remedies when constructive dismissal claims arise.

Constructive Dismissal within Albanian Employment Law. While "constructive dismissal" is a well-established concept in many European employment law systems, protecting employees who resign due to intolerable working conditions created by their employer, the Albanian employment law almost lacks the concept of constructive dismissal, particularly its criteria compared with the broader European context. Albanian employment law is primarily governed by the Labour Code of the Republic of Albania, Law No. 7961, dated 12.07.1995, amended. The Labour Code outlines employers' and employees' rights and obligations, but does not explicitly mention the term "constructive dismissal."

The Labour Code allows either party to terminate employment contracts with or without cause, subject to specific notice periods and conditions (Articles 140-147). Regarding unfair dismissal, Article 144 of the Labour Code protects against unfair dismissal, stipulating that an employee can challenge a dismissal that is not based on valid grounds such as serious misconduct or poor performance. The Labour Code outlines the employer's duty to respect the employee's dignity and ensure safe and healthy working conditions.

Nevertheless, the Labour Code does not explicitly address situations where an employee resigns due to the employer's conduct. Article 143 allows employees to resign with notice, but does not detail the circumstances under which resignation could be considered constructive dismissal. Article 154, paragraph 2, stipulates the immediate termination of the job contracts for both the employer and the employee but does not provide situations when the termination of the job contract made by the employee is justified.

A more distinct and elaborated view is needed if attempting to make a comparative analysis with European employment law, using the latter's concepts, doctrine, and case law in Albanian employment law. This is because, usually, for not saying most of the time, in cases where an employee resigns, he cannot claim constructive dismissal. However, specific provisions could be leveraged to argue a case resembling constructive dismissal, drawn from principles found in other European jurisdictions.

a) *Employer's breach of contract:* In many EU countries, constructive dismissal involves a significant violation of the employment contract by the employer. Albanian law's provisions on the employer's duties (Article 38) could be interpreted to support such claims, although this is not explicitly stated.
b) *Intolerable Working Conditions:* The requirement for employers to provide safe and dignified working conditions can serve as a basis for claims that intolerable conditions forced a resignation, aligning with the principles of constructive dismissal.
c) *Judicial Interpretation:* Without explicit statutory recognition, the concept of constructive dismissal in Albania would rely heavily on judicial interpretation. These interpretations should align with the international standards and the precedents from European Court of Human Rights (ECtHR) rulings.

To date, limited case law in Albania directly addresses the concept of constructive dismissal. The absence of explicit statutory provisions means that cases involving intolerable working conditions typically fall under broader claims of unfair dismissal or breach of contract.

However, Albania is a party to several international conventions that impact its employment law framework, which influences its domestic rules in compliance with its international obligations.

Albania is a member of the Council of Europe and is bound by the ECHR, which includes protections against inhumane or degrading treatment (Article 3) and the right to a fair trial (Article 6). These provisions can indirectly support arguments related to constructive dismissal.

Albania has ratified various ILO conventions that emphasise decent working conditions and the protection of workers' rights, which can influence the interpretation and application of national labour laws.

To comply with international obligations and standards, the Labour Code must be amended to recognise constructive dismissal explicitly. This would define a situation where an employee resigns because the employer's conduct makes continued employment untenable. The consequences of this kind of dismissal must also be regulated.

3. CONCLUSION

While Albanian employment law does not currently explicitly recognise constructive dismissal, provisions within the Labour Code can be interpreted to provide some protection against intolerable working conditions. Albania could benefit from legislative reforms addressing constructive dismissal to align more closely with European standards and better protect workers' rights. Enhanced judicial interpretation and public awareness are also crucial in ensuring adequate protection for employees facing adverse working conditions.

Some of the recommendations that could be made to ensure consistent and fair treatment of constructive dismissal claims that may arise in Albania may include the establishment of a harmonised definition of constructive dismissal in Albanian law that encompasses the essential elements recognised by other jurisdictions that are far more developed both on its legal doctrine and relevant employment case law. It is also necessary to establish guidelines detailing types of employer conduct that can lead to constructive dismissal and implement procedural safeguards to protect employees who claim constructive dismissal, including access to legal representation and expedited hearing processes. In addition, promoting awareness and training programs for employers and employees on constructive dismissal rights and obligations will foster a better workplace for everyone.

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AI vs. Transnational Crime: Harnessing Intelligent Technologies to Disrupt Global Criminal Networks

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Abstract: *Transnational organized crime (TOC) poses severe threats to global security, economies, and human rights, with criminal networks leveraging technology and financial systems to engage in activities like drug trafficking, money laundering, and cybercrime. Traditional methods struggle to keep pace, but artificial intelligence (AI) offers powerful tools to combat TOC. This article explores AI technologies such as machine learning and predictive analytics by enabling real-time data analysis, enhancing the detection of suspicious activities, and acting as threat prediction. Additionally, AI enhances international cooperation by facilitating intelligence sharing and improving anti-money laundering efforts. However, challenges like data privacy, ethical concerns, and AI bias must be addressed. Criminals also exploit AI, requiring law enforcement to stay ahead. A multi-stakeholder approach involving governments, law enforcement, and academia is crucial for developing ethical, effective AI solutions to disrupt and prosecute TOC.*

1. INTRODUCTION

Transnational organized crime (TOC) poses an increasing threat to global security, economic stability, and human rights. Criminal networks exploit technological advancements to enhance illicit activities such as drug trafficking, human trafficking, money laundering, and cybercrime, crossing borders and defying traditional law enforcement methods (Interpol, 2020). As these networks grow more complex and sophisticated, new tools are needed to counter them effectively. Artificial intelligence (AI) has emerged as a transformative tool in this fight, offering unprecedented capabilities for detecting, disrupting, and preventing TOC activities, even though criminals have also benefited from its advancements.

The present article explores the role of AI in combating TOC, focusing on how intelligent technologies such as machine learning, natural language processing (NLP), and predictive analytics are reshaping law enforcement strategies. It also discusses the challenges and ethical considerations of AI use, the importance of international cooperation, and how AI can help governments and institutions strengthen their anti-money laundering (AML) measures.

2. STATISTICAL EVIDENCE SUPPORTING AI IN COMBATING INTERNATIONAL CRIME

AI technologies such as machine learning, natural language processing (NLP), and predictive analytics allow law enforcement agencies to analyze vast amounts of data in real-time, detect

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suspicious activities, and predict emerging criminal trends. Interpol (2020) reports that AI-driven crime analytics could improve crime detection rates by as much as 30%, particularly in cybercrime, human trafficking, and financial crimes. This improvement is due to AI's ability to process large datasets and identify patterns that might be missed by human investigators, reducing the manual burden and increasing the accuracy of law enforcement responses.

A report deployed by Europol (2020) also provides compelling evidence of AI's role in disrupting criminal organizations, particularly in the areas of drug trafficking and financial crime. AI applications in data analysis, pattern recognition, and threat prediction have increased the efficiency of cross-border operations, with Europol estimating that AI can reduce investigation times by 40%, allowing faster responses to criminal activities. The use of AI in predictive policing, for instance, has allowed law enforcement agencies to preempt criminal activities by identifying and disrupting drug trafficking routes before criminal organizations can fully establish them.

Furthermore, the United Nations Office on Drugs and Crime (UNODC, 2021) highlights AI's potential in anti-money laundering (AML) efforts. AI technologies can analyze financial data at unprecedented scales, identifying suspicious patterns of financial transactions that are indicative of money laundering. According to the UNODC, the implementation of AI in AML systems has led to a 15–20% increase in the detection of illicit financial flows. In the case of human trafficking networks, AI has been instrumental in mapping criminal organizations by analyzing social media, online communication, and dark web activity, allowing law enforcement agencies to uncover hidden connections between actors and dismantle trafficking rings.

Besides all the above-mentioned reports, a study led by PwC (2020) emphasizes that the adoption of AI in law enforcement could lead to a reduction in international crime incidents by 15–20% by 2030 (enhacing potential), with significant impacts on border security, cybercrime prevention, and the disruption of illicit trade and smuggling networks. PwC's projections are based on the increasing use of AI-powered surveillance technologies, which can monitor and analyze vast amounts of digital communications, as well as the growing capabilities of AI-driven systems to predict and counter criminal strategies. These advancements enable a proactive approach to law enforcement, where AI is used not only to respond to crimes after they occur but also to prevent them from happening.

With that said, we definitely have set the grounds for the current research, where we will dedicate this first phase of the study to defining the main tools and mechanisms applicable to both police and judicial activity.

3. THE ROLE OF AI IN COMBATING TRANSNATIONAL ORGANIZED CRIME

3.1. Machine Learning and Predictive Analytics

AI technologies, particularly machine learning and predictive analytics, have revolutionized the detection and prevention of criminal activities. Machine learning algorithms can process vast amounts of data in real-time, identifying patterns and connections that human investigators might overlook. For example, AI systems are used to detect suspicious financial transactions, helping to uncover money laundering schemes and track the flow of funds through international networks (UNODC, 2021).

Predictive analytics further enhance law enforcement capabilities by forecasting emerging threats. These models analyze historical crime data and real-time intelligence to anticipate the movements of criminal organizations, allowing authorities to proactively target networks before they execute

their operations. The effectiveness of these tools is already visible in cases where AI has been used to disrupt major drug trafficking and human trafficking rings (Europol, 2022).

Therefore, machine learning (ML) and predictive analytics have become critical tools in combating transnational crime by enhancing data processing, threat identification, and crime forecasting. Based on the Europol's report (Europol, 2020) data we were able to acknowledge that predictive analytics could improve law enforcement's ability to anticipate criminal activities, reducing response times by up to 40% and preventing crimes in high-risk areas by 25%. Moreover, machine learning algorithms would play a crucial role in helping the analysis of financial transactions, identifying and isolating up to 15% more suspicious activities linked to money laundering and illicit financial flows (UNODC, 2021). In addition to that, (Campedelli et al., 2020) highlighted that ML models can detect hidden patterns in crime networks, contributing to faster dismantling of organized crime rings, especially in drug and human trafficking. These statistics illustrate the growing significance of ML and predictive analytics in modern law enforcement strategies.

3.2. Enhancing International Cooperation and Intelligence Sharing

TOC networks operate across borders, making international cooperation essential for effective crime prevention. AI can facilitate the sharing of intelligence between nations, enhancing the ability of law enforcement agencies to track and dismantle cross-border criminal organizations. By leveraging AI-powered platforms, countries can share real-time data on suspicious transactions, cybercrime activities, and trafficking routes, improving coordination in global investigations (Interpol, 2020).

AI can also automate legal and regulatory compliance processes, helping governments and businesses detect and prevent illicit financial flows. This is particularly relevant in anti-money laundering efforts, where AI systems can identify potential violations and ensure that AML measures are implemented efficiently (PwC, 2020).

We take for granted that beyond the inellingence sharing as a *modus operandi*, another main aspect to validate is the international cooperation in police and judicial data sharing as a crucial *systematization* in addressing the complex and cross-border nature of transnational crime. Through initiatives such as Europol's *Secure Information Exchange Network Application (SIENA)* and Interpol's *I-24/7* communication system, law enforcement agencies are able to share intelligence in real-time, improving the coordination of investigations and the apprehension of criminals operating across jurisdictions. Judicial cooperation, facilitated by networks like Eurojust and the International Criminal Court (ICC), further enhances the ability to prosecute transnational criminals by harmonizing legal frameworks and ensuring the timely exchange of evidence. This collaboration has proven essential in tackling organized crime, human trafficking, and cybercrime, as it enables faster and more comprehensive responses to global criminal threats.

States need to prioritize cooperative public policies within their national police and judicial bodies when addressing transnational crime. By fostering collaboration and enhancing data sharing, national agencies can contribute valuable intelligence that accelerates the resolution of criminal cases and improves the accuracy of investigations. This cooperation not only strengthens law enforcement capabilities but also aligns efforts across borders, helping dismantle criminal networks that operate internationally. States that invest in such coordinated approaches ensure that their judicial and policing frameworks are better equipped to tackle complex crimes like human trafficking, drug smuggling, and cybercrime, which no single nation can effectively combat alone.

3.3. AI as a Tool for Crime Prediction and Threat Prevention

Predictive analytics, powered by AI, allows law enforcement agencies to anticipate criminal activities and proactively target criminal networks before they execute their operations. AI-driven models, trained on historical crime data and real-time intelligence inputs, can predict future hotspots of criminal activity and alert authorities to emerging threats. Interpol (2020) estimates that the use of predictive policing models could reduce crime rates in high-risk areas by up to 25%, particularly in regions with high levels of organized crime. This predictive capability is essential in identifying smuggling routes, criminal hideouts, and potential areas of conflict before they escalate into full-blown criminal operations.

For instance, Europol (2020) has utilized predictive analytics to anticipate trends in drug trafficking across Europe, allowing law enforcement to intervene in key smuggling corridors and reduce the influx of narcotics into major cities. Similarly, AI systems have been deployed to predict cyberattacks, allowing cybersecurity teams to reinforce defenses before criminal organizations can launch coordinated attacks on critical infrastructure.

4. CHALLENGES IN THE USE OF AI FOR LAW ENFORCEMENT

While AI offers significant advantages in combating TOC, several challenges must be addressed. One primary concern is regarding the issue of data privacy. The use of AI for surveillance and monitoring raises ethical questions about the balance between security and individual privacy rights. AI systems must operate within the bounds of national and international privacy laws to avoid infringing on civil liberties.

Another major concern is the potential for bias in AI algorithms. AI systems are only as good as the data they are trained on, and if that data is biased, the outcomes could lead to discriminatory practices in law enforcement. For example, biased algorithms might disproportionately target certain ethnic or social groups, leading to unjustified surveillance or arrests. As UNODC (2021) points out, addressing bias in AI is critical to ensuring that law enforcement practices remain fair and just.

Furthermore, as criminals increasingly adopt AI to enhance their operations—such as automating cyberattacks or using AI to evade law enforcement—governments must continuously innovate to stay ahead of these developments. Criminal organizations are already using AI to shield their activities, making it more difficult for authorities to track and disrupt them. Law enforcement agencies need to invest in advanced AI systems and training programs to ensure they can effectively counter the use of AI by criminal groups (Europol, 2020).

5. CHALLENGES AND ETHICAL CONSIDERATIONS

Despite the potential benefits, the use of AI in combating TOC raises several challenges. One key concern is data privacy, especially when AI is used for surveillance and monitoring purposes. Ensuring that AI systems respect individual privacy while maintaining security is a delicate balance that must be addressed through stringent data protection regulations (GDPR and Right to Privacy).

Another issue is the risk of bias in AI algorithms. If not properly managed, AI systems can produce biased outcomes, leading to false positives or disproportionately targeting certain groups (UNODC, 2021). This is particularly problematic in criminal justice, where biased algorithms could contribute to unfair treatment or wrongful accusations (inaccuracy factor).

Moreover, criminals are increasingly adopting AI to enhance their operations. From automating cyberattacks to using AI tools to evade detection, organized crime groups are leveraging the same technologies intended to stop them. Law enforcement agencies must stay ahead of these developments, investing in research and training to counter the use of AI by criminal networks (Europol, 2020).

Lastly, it is well-known that artificial intelligence (AI) and robotics are advancing rapidly in their ability to replicate human skills, with the potential to fundamentally reshape the workforce in the coming decades (LEAs and Police activity included). These technological developments could significantly impact the current role of education in fostering skill development and preparing students for future employment. As highlighted by the OECD's Artificial Intelligence and the Future of Skills initiative (OECD, 2021), the evolving nature of AI demands that educational systems adapt to ensure learners are equipped with the necessary skills to thrive in increasingly automated and technology-driven industries, but most important, on how to drive these technologies for the sake of society maintenance.

6. THE FUTURE OF AI IN COMBATING TOC

To maximize the effectiveness of AI in the fight against TOC, a comprehensive, multi-stakeholder approach is essential. Governments, law enforcement agencies, the private sector, and academia must collaborate to develop AI tools that are both effective and ethically sound. Investment in technological infrastructure, cross-border intelligence sharing, and training programs will be crucial in fully realizing AI's potential in combating TOC (Europol, 2022; OECD, 2021).

The benefits of AI in crime prevention are evident in its ability to process massive amounts of data, identify hidden connections, and predict emerging threats. However, without proper safeguards, AI could also exacerbate existing issues such as privacy violations, discrimination, and the misuse of technology by criminal groups.

7. FUTURE RESEARCH DIRECTIONS

A compelling future research direction for the current matter could focus on the promissing integration of AI-driven predictive analytics and blockchain technologies to enhance international cooperation and transparency in disrupting illicit financial flows.

As a matter of fact, the technology advancement and all the cross tech-tools could offer our police forces the ability to apply advanced AI algorithms, such as machine learning and neural networks, to enhance predictive models for identifying and preventing emerging criminal threats, particularly in areas like human trafficking, drug smuggling, and cybercrime. This research could explore the use of AI to detect patterns of criminal behavior across borders in real-time, allowing law enforcement agencies to act proactively (currently entitled by scientists and theorists as *Predictive Analytics for Crime Prevention*).

Beyond that, a second scope of this insightful research would aim at how AI and blockchain can work together to trace and disrupt the financial networks that fuel global crime. By integrating AI with blockchain, authorities could create immutable and transparent records of financial transactions that allow for better monitoring of cross-border money laundering and the funding of criminal activities. This aspect could also highlight the challenges and benefits of anonymization in blockchain versus the need for transparency in law enforcement. The blockchain for transparency in

financial transactions would depend directly on the state public will to reduce printed currencies in the market that could enhance the financial transactions monitoring, as well as the continuous oversight in cross activities such as private luxury goods purchases (*e.g.* yachties, sports cars, private aircraft, etc.), business agreements and real estate investments.

As a tradeoff agreement, civil society shall stay flexible and open for the sake of public security, as another challenge that will arise in dealing with all the AI ethics and privacy implications in law enforcement. In this sense, a future research direction could investigate the ethical implications of using AI to monitor criminal networks. Research must analyze how to balance the use of surveillance technologies with protecting civil liberties and privacy, ensuring AI systems are employed responsibly and do not lead to overreach by authorities (boundaries of public security over the right to privacy and GDPR).

Lastly, a research path might address the need for harmonizing international legal frameworks to govern the use of AI in transnational crime prevention. This could explore how different countries' legal systems can cooperate in creating standardized protocols and how AI can be adapted to respect jurisdictional boundaries while fostering global law enforcement cooperation.

8. CONCLUSION

Artificial intelligence offers a powerful tool in the global fight against transnational organized crime. By harnessing AI technologies such as machine learning, predictive analytics, and natural language processing, law enforcement agencies can enhance their ability to detect, disrupt, and prevent criminal activities. At the same time, the challenges and ethical considerations surrounding AI use must be carefully managed to ensure that these technologies are used responsibly and effectively.

The application of AI in law enforcement offers transformative potential in combating crime and enhancing public safety, but it must be carefully balanced with respect for privacy to uphold democratic values and fundamental rights. By implementing AI systems within clear legal frameworks that prioritize data protection, transparency, and accountability, law enforcement agencies can effectively utilize intelligent technologies without infringing on individual liberties. This balance is essential to maintain public trust and ensure that technological advancements serve to strengthen, rather than undermine, the principles of democracy and the protection of human rights.

International cooperation and collaboration between multiple sectors will be key to ensuring AI's success in combating TOC. With the right investments in technology, training, and regulation, AI has the potential to be a game-changer in the fight against global criminal networks.

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The Desertification Phenomenon in Southern Romania

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Abstract: *In the south of Romania, it is located in Dolj County, where there are areas where the sand forms desert dunes. This area is the Oltenia Sahara and is slowly but surely turning into a desert. Vegetation disappears, and hot sand remains in its place. Approximately one hundred thousand hectares are covered with sand. According to specialists, the phenomenon of desertification has increased in recent years, due to the climatic conditions and the lack of precipitation. Dolj county is the county affected by the desertification phenomenon, due to the drought and sandy soil, but also to the chaotic deforestation of recent years. Nothing grows on these sandy lands anymore. According to the specialists - Sandy soils can only be cultivated in conditions where they have water.*

1. INTRODUCTION AND OVERVIEW OF DESERTIFICATION: CHALLENGES AND SOLUTIONS

In 2010, the UN described the phenomenon of desertification as the biggest challenge of the 22nd century. From the data provided, 25% of the habitable surface of the Planet is affected by this phenomenon, and the surfaces are continuously increasing. China is the most affected country, the area affected by desertification is 30% of the country's surface. The magnitude of the phenomenon is maximum on the African continent, where many countries are affected by this phenomenon. The Sahara Desert has an annual expansion of 47 kilometres towards the southern part of the continent.

For the first time, the issues related to the desertification phenomenon were discussed in Paris in 1994, within the UNCCD17 Convention on Combating Desertification. The convention was signed by the Government of Romania and ratified by the Romanian Parliament through Law no. 629/1997.

Romania represents one of the European countries with major problems with the danger of desertification. In Romania, over 1000 hectares are covered by sand every year, the first effects of the desertification process appeared in the 20th century (United Nations Convention to Combat Desertification, n.d.).

According to IPCC (Intergovernmental Panel on Climate Change) data, the Romanian authorities declared that "the area subject to desertification, characterized by an arid, semi-arid climate or dry sub-humid, is approximately 30% of Romania's total area. The most affected areas are located in Dobrogea, Moldova, the south of the Romanian Plain and the Western Plain". Over 7 million

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hectares of Romania's surface are at risk of desertification and 40% of the agricultural surface is in areas at risk of desertification, there are already sandy areas in Dolj and Olt counties.

The Joint Research Center of the European Commission published the latest edition of the World Atlas of Desertification in 2018. The Atlas is a tool that can provide solutions for problems related to desertification.

The atlas presents a reasoned evaluation for the observation of land demarcation and presents solutions for the adoption of measures to stop the phenomenon of desertification.

The Atlas proposes solutions to problems related to the extinction of animal species due to human activity, food security, problems related to climate change, and displacing people from their homes.

In the mathematical models, it is estimated that population growth and climate change cause pressure on the planet's natural resources.

Over 75% of the earth's surface is degraded, in 2050 it is estimated that the surface will reach 90%. Annually, an area equal to half of the European Union (4.18 million km^2) is degraded, the most affected by this phenomenon are Africa and Asia. The costs of this degradation are tens of billions of euros annually. In 2050, climate change and land degradation will cause harvests to decrease by 10%. The most affected will be India, China and sub-Saharan Africa, where land degradation will lead to severe reductions in agricultural production.

By 2050, it is estimated that about 700 million people will be displaced due to problems related to limited land resources. By the end of the century, it will reach 10 billion people.

The atlas proposes solutions on how human activity has led to the extinction of some animal species, threatens food security, intensifies climate change and displaces people from their homes. The phenomenon of desertification affects 8% of the territory of the European Union, Southern, Eastern and Central Europe. The area represents approximately 14 million hectares, these areas show a high sensitivity to desertification.

Thirteen member states are affected by desertification under the UNCCD: Bulgaria, Croatia, Cyprus, Greece, Hungary, Italy, Latvia, Malta, Portugal, Romania, Slovakia, Slovenia and Spain. EU member states have policies for soil protection encouraging sustainable land use and take commitments into account when drawing up proposals on energy, agriculture, forestry, climate change, research and other areas.

Tibor Navracsics, Commissioner for Education, Culture, Youth and Sport, responsible for the Joint Research Centre (JRC), said: "Over the past twenty years, since the publication of the last edition of the World Atlas of Desertification, pressures on land and soil have increased dramatically. To preserve our planet for future generations, we urgently need to change the way we treat these precious resources. This new and much more advanced edition of the Atlas gives policymakers worldwide comprehensive and easily accessible insights into land degradation, its causes and potential remedies to tackle desertification and restoring degraded land."

In 2015, the United Nations adopted The 2030 Agenda for Sustainable Development, including a commitment to achieve all Sustainable Development Goals (ODD) of the United Nations. Of these, SDG 15 aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainable

forest management, combating desertification and halting soil degradation and restoring them, as well as combating the decline of biodiversity"; this includes a combat objective desertification, rehabilitation of degraded lands and soils, including affected lands of desertification, drought and floods, and making efforts to establish worlds characterized by land degradation neutrality by 2030. Romania joined the UNCCD through Law no. 111/1998 ratified by the Parliament of Romania. The responsibility for national implementation of the Convention rests with the Ministry of Waters and Forests through the General Directorate of Forests. Based on Government Decision no. 474/2004, the National Committee for Combating Drought, Land Degradation and Desertification, which was developed and adopted in 2008, under the coordination of the Ministry of Agriculture and Rural Development, "The national strategy for reducing the effects of drought, preventing and combating land degradation and desertification". The general purpose of the strategy was to reduce the vulnerability of local communities, natural ecosystems and socio-economic activities and to reduce social, economic and environmental effects, in the short, medium and long term. To achieve this major desire, they established several strategic objectives to be achieved through the Strategy, among which we mention:

- restructuring and improving the activity of the institutions and bodies involved in proactive action to improve drought prevention and response capacity and desertification;
- reducing the risks and damages caused by drought and desertification on the socio-economic activity and the environment, through concrete actions and measures provided for it was taken at the local (municipal), regional (development regions), national and international.

2. DESERTIFICATION AND AGRICULTURAL LAND USE DYNAMICS IN DOLJ COUNTY, SOUTHERN ROMANIA

Desertification of southern Romania is a major problem. The most important region affected by this phenomenon is the Oltenia region. From a geographic point of view, the surface is located between Calafat and Dabuleni. It represents an area of 80,000 ha, approximately 6% of the area of Dolj county.

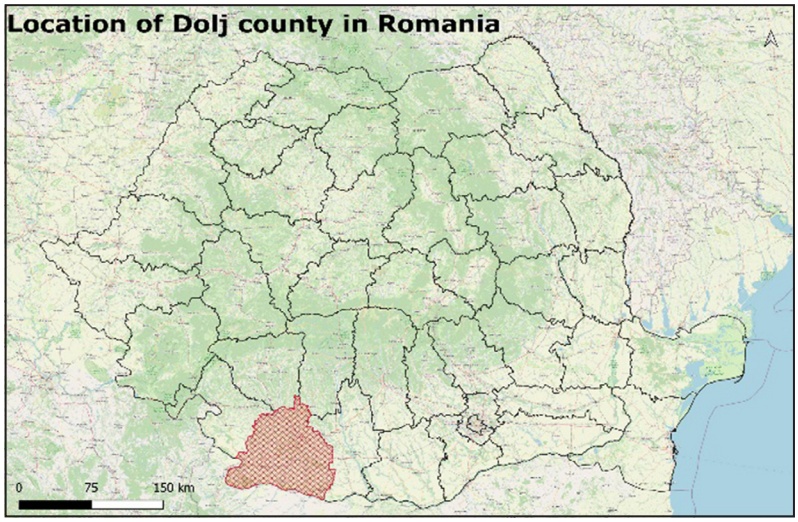

Figure 1. Location of Dolj County in Romania

Source: Own research

The banks of the Danube would be, they represent the starting point from which the sandy land of Romania expands year after year. The first work that dealt with the phenomenon at a scientific level was the study "Research on the sands of southern Oltenia", signed by the authors Dr. Constantin D. Chiriță and Eng. Teodor P. Bălănică and published in 1938.

The speed of expansion of sandy surfaces has been alarming in the last period. In Dolj county, the sandy land is 30-40 kilometers from the Danube River. Dolj is now the area most affected by desertification, with approximately 1,000 hectares of fertile soils turning into dunes every year (Mutihac, 1990).

The main threats affecting the quality of soils are: drought, excessive moisture, erosion, compaction, impoverishment of soil in organic matter and nutrients, salinization, acidification, pollution, expansion of areas with soils in lower quality classes, degradation of land improvement works and expansion of areas affected by drought, the uncovering of fertile horizons for commercialization, etc.," explains Olga Vizitiu, the director of the Institute for Research in Agriculture.

Dolj County is located in the South-South West part of Romania. It is located in the lower basin of the Jiu River, on the left side of the Danube River, on the border with Bulgaria. Between 43°43′ and 44°42′ north latitude and 22°50′ and 24°16′ east longitude. It is bordered to the west and north-west by Mehedinţi counties, to the north by Gorj and the northeast by Vâlcea (North East) and in the eastern part by Olt. The south represents the border with Bulgaria, separated by the Danube River, over a distance of 150 km. The area of the county is: 7,414 km2 representing 3.11% of the Romania area.

The relief of Dolj county is predominantly plain, it belongs to the western sector of the Romanian Plain, represented by its subunits - Desnătui Plain (or Bailestilor Plain), Romanaţi Plain and the eastern extremity of Blahniţa Plain), which occupies the central-southern part of Dolj county. The plain region is represented by the Oltenia Plain, formed by the terraces of the Danube River. The terraces are smooth surfaces, slightly inclined to the South. In the North-West and North-East of Dolj county there are higher areas, with a hilly appearance and Piedmont plateaus (Mutihac, 1990; Rusu & Niță, 2004).

The climate of the area is temperate-continental, with very hot summers and moderate winters and with annual thermal values that vary between 10°C (in the North) and 11.5°C (in the South). The absolute maximum temperature (44.3°C) was recorded at the weather station in Calafat (July 24, 2007).

In the warm season of the year, in the southern part of Dolj county, the higher intensity of the winds blowing from the West determines the increased mobility of the dunes in the Calafat-Bistreţ-Dăbuleni sector.

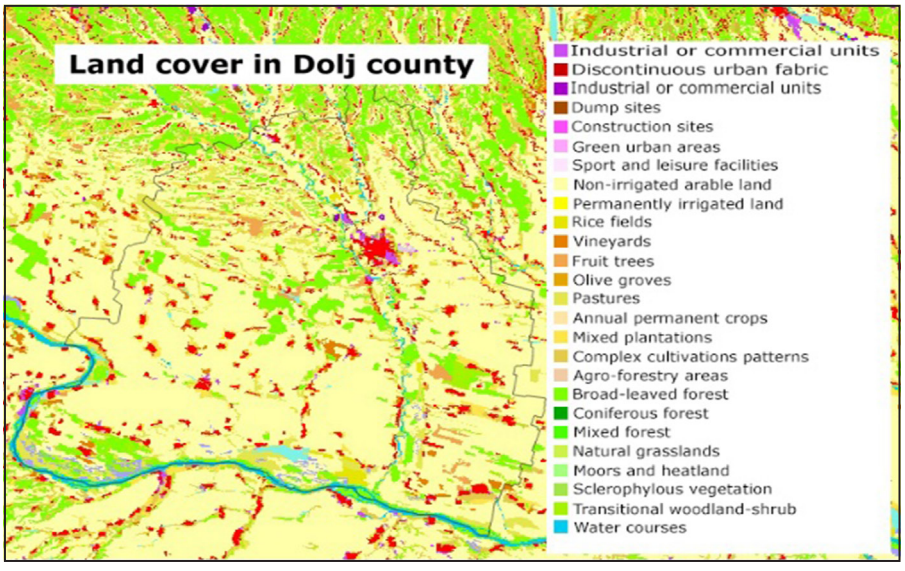

Figure 2. Land cover in Dolj country

Source: Copernicus Land Monitoring Service (n.d.)

Table 1. The land use in Dolj County (in hectares)

The land use	Years							
	2016	2017	2018	2019	2020	2021	2022	2023
	Ha							
The total landscaped area	142532	142532	142532	142532	142532	142532	142532	142532
Arranged agricultural area	124459	124459	124458	124458	124447	124447	124445	124444
Arable land	112858	112858	112857	112857	112846	112846	112844	112843
Natural pastures	7185	7185	7185	7185	7185	7185	7185	7185
Natural grass	711	711	711	711	711	711	711	711
Vineyards, wine nurseries	3077	3077	3077	3077	3077	3077	3077	3077
Orchards fruit trees	628	628	628	628	628	628	628	628

Source: National Institute of Statistics (n.d.)

Table 1 presents the land use distribution in Dolj County based on surface area, highlighting that there were no significant changes in land use during the analyzed period from 2016 to 2023. The total area of the county is 142,532 hectares. According to official data from the National Institute of Statistics, the organized agricultural area was 124,459 ha in 2016 and slightly decreased to 124,444 ha in 2023. Arable land measured 112,858 ha in 2016 and 112,843 ha in 2023. Natural pastures covered 7,185 ha in 2016 and 7,125 ha in 2023. The surface of natural meadows remained unchanged at 711 ha, as did vineyards and wine nurseries, which stayed at 3,077 ha between 2016 and 2023. Orchards and fruit tree plantations maintained a stable surface area of 628 ha from 2019 to 2023. Overall, the data confirms that agricultural land use in Dolj County remained stable throughout the analyzed period.

Table 2. The most important crops in Dolj County between 2016 -2023

The main crops	Ownership forms	Years							
		2016	2017	2018	2019	2020	2021	2022	2023
		Hectares							
Total	**Total**	493159	478872	482226	513832	481868	484101	476745	477664
-	**Private sector**	489390	474794	478189	511506	479410	478079	471124	472907
-	**of which: Individual farms**	314526	308648	309939	331792	282257	283701	279240	229249
Sunflower	**Total**	91007	77329	74132	112769	89937	93151	101297	96779
-	**Private sector**	90220	76476	73420	112264	89633	91720	99819	95617
-	**of which: Individual farms**	52490	37937	38124	59453	38453	49195	49332	34409
Green and yellow watermelons	**Total**	4560	4558	4559	4569	2106	1662	1539	1582
-	**Private sector**	4560	4555	4559	4545	2086	1662	1539	1572
-	**of which: Individual farms**	4491	4522	4522	4522	1981	1540	1497	1495
Fruit orchards	**Total**	1383	1365	1231	1220	1346	2034	1980	2061
-	**Private sector**	1381	1365	1231	1220	1346	2034	1980	2054
-	**of which: Individual farms**	1124	1122	1124	1124	1124	1876	1872	1870
Rest arable land	**Total**	**14911**	9831	8884	11213	9608	9124	8134	10091
-	**Private sector**	**12033**	9295	8517	9213	9031	8717	7825	9692
-	**of which: Individual farms**	**11140**	7140	7138	7138	7177	7100	7068	7069

Source: National Institute of Statistics (n.d.)

Table 2 highlights the most important crops in Dolj County based on ownership (private sector and individual farms). Sunflower ranks first in terms of cultivated area, with a peak in 2019 at 112,769 hectares, of which 112,264 ha were in the private sector. However, by 2023, the sunflower

cultivation area significantly decreased to 34,409 ha. Watermelons (both green and yellow) also showed a declining trend, from 4,560 ha in 2016 to just 1,582 ha in 2023. In contrast, fruit orchards experienced growth, with 2023 marking the year with the largest cultivated area at 2,061 ha. Arable land started at 14,911 ha in 2016 but gradually declined, reaching 10,091 ha by 2023.

3. CONCLUSION

Desertification means "land degradation in arid, semi-arid and dry-subhumid areas, produced by various factors. These factors include climate variations and human activities. The effects of desertification produce negative effects on the population. Through impoverishment, health problems caused by wind-blown dust, and a decline in biodiversity. The consequences are demographic and economic, forcing the population of the affected areas to migrate. Desertification does not describe conditions in geographical areas as "deserts", it specifically refers to dry areas. [4]

Long-term effects of desertification. Desertification can lead to reduced food production, soil infertility, and reduced natural resilience of land and its capacity to store carbon. These phenomena, in turn, can lead to poverty, aggravated health problems due to wind-blown dust, and a decline in biodiversity. Also, soil erosion, increasingly high temperatures and soil water scarcity amplify the phenomenon of desertification. The consequences of desertification are: a decrease in food production, a reduction in soil productivity and a decrease in land regeneration capacity; an increase in flooding in areas downstream of rivers, reduction of water quality, sedimentation in rivers and lakes and clogging of reservoirs and waterways; aggravation of health problems due to sand and dust storms, especially eye infections, breathing difficulties, allergies and stress; reducing livelihoods, forcing the affected population to migrate.

Analysing the effects produced by the desertification of soils in Romania, the following long-term manifestations were observed: reduction of areas covered with vegetation; intensification of soil erosion by water and wind and salinization; soil crusting and compaction; impoverishment of the soil in organic matter and nutrients; increasing the frequency, duration and intensity of drought periods; the progressive increase in the intensity of solar radiation.

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Possibilities of Phytoremediation of Chromium in Tuzla, Bosnia and Herzegovina

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Abstract: *The paper presents the results of geoecological - pedological research on chromium (Cr) concentrations in the soil of Tuzla and the possibility of its remediation via phytoextraction, phytostabilisation and phytoreduction methods. The terrain work included the collection of 240 soil samples from an area of 303 km2. The samples were analysed by Inductively Coupled Plasma–Mass Spectrometry (ICP-MS), and the results were used to examine the concentrations and to show the spatial distribution of chromium in the area of Tuzla.*

Chromium concentrations in the soil of the city of Tuzla range from 67 ppm-1592 ppm, and out of 240 in total of the analyzed soil samples, chromium concentrations were elevated in 239 of them. The possibility of phytoremediation was evaluated and the results were presented in this paper.

1. INTRODUCTION

The City of Tuzla has an area of 303 km^2 and is located in Northeastern Bosnia and Herzegovina between 18°17' and 18°37'E and 44°32' and 44°38' N, at an altitude between 200 and 760 m asl. It has 110.979 inhabitants in 66 settlements.

The most common types of soil in the researched area are yellowish-brown soils on sands and sandstones, brown degraded soil on clays and loams, brown medium deep and deep soil on limestones, grey-brown carbonate soil, grey-brown deeply soaked soils, pelosols and vertisols. A high percentage of this soil is covered with urban infrastructure and isn't used for agricultural purposes.

Chromium-contaminated soils are a threat to the development of respiratory, cardiovascular, and cancerous diseases in humans and animals, which indicates the need for phytoremediation of these soils. Based on the terrain work and the analysis of soil samples it was concluded that chromium contamination in Tuzla is a significant environmental issue.

According to the Rulebook on determination of permitted amounts of harmful and dangerous substances in soil and their testing methods in Bosnia and Herzegovina, the maximum permitted chromium concentrations in soils vary from 50 ppm for sandy soils, 80 ppm for silt-clayey soils and 100 ppm for heavy clay soils.

Chromium concentrations in the soil of the city of Tuzla range from 67 ppm-1592 ppm. Out of a total of 240 analyzed soil samples, chromium concentrations were elevated in 239 of them, in some cases by a few tenths of a milligram more than allowed.

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Considering the amount of chromium in the soil of the city of Tuzla and its harmfulness to the health of the inhabitants, phytomining is imposed as a method of phytoremediation, which is visually inoffensive, non-destructive, ecological, aesthetic, and to some extent, a profitable method of obtaining valuable raw materials.

In this paper, the potential of phytoremediation as a sustainable and cost-effective method to remediate chromium-contaminated soils in Tuzla was explored.

2. METHODS OF RESEARCH

The results of previous research were considered in order to define the concept of work and the order of research.

The terrain work included the collection of soil samples (240 samples) from 303 km^2 (within the city borders of Tuzla). The sampling network in the urban part is 1km x 1km, and in the rural part 1.5km x 1.5km. The samples were collected from the designated locations by a process of composite sampling (five soil subsamples were taken and mixed in one sample. Soil sampling was conducted according to the geochemical expert group (The Urban Geochemistry Project (URGE)). The sampling plan is shown in Figure 1.

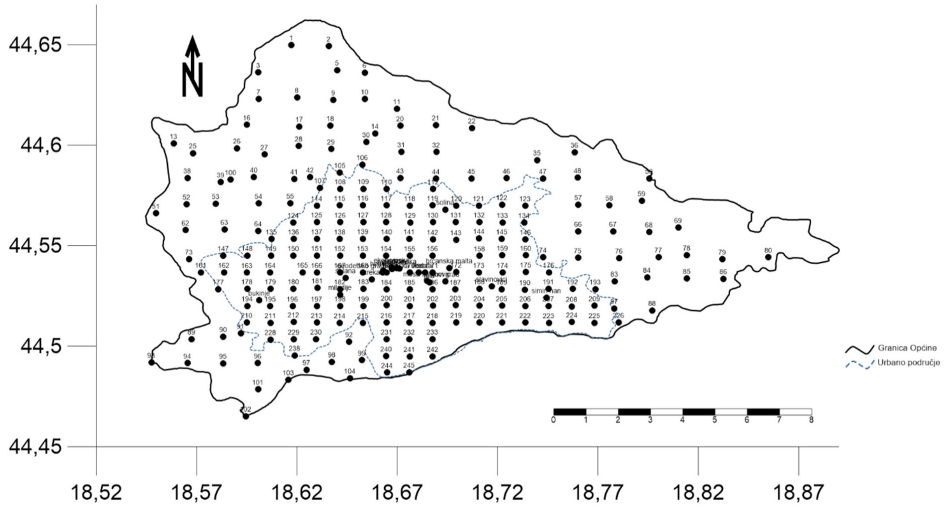

Figure 1. Sampling plan in the Tuzla area
Source: Own processing

Laboratory analysis was performed at Bureau Veritas Commodities Canada Ltd., Laboratory in Vancouver - Canada, by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS), with a highly sensitive detection threshold (0.1 to 10,000 ppm).

The data were processed and maps were drafted with the Golden Software Surfer 16 software package.

3. RESEARCH RESULTS

The 240 samples were analyzed and chromium was detected in all samples. In 239 samples the concentrations were above the threshold, which are shown in Table 1 and in only one sample the concentration was slightly below the threshold.

Table 1. Maximum permitted concentrations of chromium in soil

Heavy metal	**Sandy soil (ppm)**	**Silt-cleyey soil (ppm)**	**Heavy clay soil (ppm)**
Cr	50	80	100

Source: Official Gazette of the Federation of Bosnia and Herzegovina No. 72/09 (2009)

Table 2. Chromium concentrations in the soils of Tuzla area

No.	Cr (ppm)	No.	Cr (ppm)	No.	Cr (ppm)	No.	Cr (ppm)	No.	Cr (ppm)	No.	Cr (ppm)
1	612	**48**	564	**97**	265	**140**	570	**182**	336	**223**	237
2	336	**50**	309	**98**	449	**141**	286	**183**	522	**224**	164
3	465	**51**	231	**99**	330	**142**	203	**184**	333	**225**	462
5	414	**52**	415	**100**	206	**143**	222	**185**	464	**226**	224
6	295	**53**	488	**101**	330	**144**	279	**186**	505	**228**	259
7	293	**54**	328	**102**	426	**145**	253	**187**	1307	**229**	237
8	258	**55**	220	**103**	337	**146**	145	**188**	531	**230**	380
9	314	**57**	333	**104**	312	**147**	437	**189**	1160	**231**	536
10	318	**58**	371	**106**	764	**148**	428	**190**	456	**232**	316
11	358	**59**	438	**107**	413	**149**	465	**191**	412	**233**	224
13	276	**62**	468	**105**	633	**150**	301	**192**	215	**238**	352
14	368	**63**	281	**108**	248	**151**	391	**193**	471	**240**	321
15	213	**64**	936	**109**	664	**152**	1582	**194**	399	**241**	375
16	507	**66**	278	**110**	165	**153**	430	**195**	337	**242**	461
17	807	**67**	216	**112**	251	**154**	295	**196**	547	**244**	412
18	416	**68**	205	**114**	528	**155**	451	**197**	1126	**245**	575
19	541	**69**	222	**115**	776	**156**	216	**198**	355	**246a**	318
19a	309	**71**	307	**116**	796	**158**	282	**199**	341	**247a**	405
20	328	**72**	192	**117**	223	**159**	224	**200**	567	**248a**	438
21	339	**73**	452	**118**	202	**160**	215	**201**	469	**249a**	581
22	204	**74**	398	**119**	211	**161**	412	**202**	453	**250a**	335
25	261	**75**	261	**120**	533	**162**	350	**203**	385	**251a**	386
26	383	**76**	180	**121**	618	**163**	521	**204**	332	**252a**	444
27	1162	**77**	691	**122**	178	**164**	504	**205**	359	**253a**	364
28	632	**78**	204	**123**	154	**165**	282	**206**	294	**254a**	336
29	393	**79**	182	**124**	253	**166**	410	**207**	193	**255a**	67
30	465	**80**	437	**125**	182	**167**	599	**208**	348	**256a**	462
31	303	**83**	459	**126**	649	**168**	488	**209**	450	**257a**	379
32	350	**84**	1132	**127**	599	**169**	384	**210**	281	**258a**	515
35	477	**85**	842	**128**	278	**170**	467	**211**	518	**259a**	466
36	267	**86**	216	**129**	284	**171**	555	**212**	179	**260a**	483
38	419	**87**	348	**130**	242	**172**	619	**213**	300	**261a**	429
39	338	**88**	279	**131**	185	**173**	509	**214**	520	**262a**	387
40	200	**89**	414	**132**	307	**174**	288	**215**	252	**263a**	485
41	361	**90**	460	**133**	247	**175**	940	**216**	166	**264a**	280
42	367	**91**	268	**134**	149	**176**	1159	**217**	693		
43	411	**92**	167	**135**	397	**177**	139	**218**	377	**Med.**	**356,5**
44	360	**93**	1592	**136**	492	**178**	423	**219**	422	**Avg.**	**409.1**
45	294	**94**	831	**137**	259	**179**	613	**220**	378		
46	195	**95**	138	**138**	359	**180**	393	**221**	485		
47	304	**96**	221	**139**	272	**181**	596	**222**	477		

Source: Own processing

Chromium concentrations in the soil of the city of Tuzla vary from 67ppm (sample 255a), in the very center of the city, to a maximum of 1592ppm (sample 93) in the extreme southwestern part of the city, in the area of the Kiseljak settlement (Table 2). Given that the limit values of chromium in soils according to the Regulation on the determination of permissible quantities of harmful and hazardous substances in soil and methods of their testing are 50-100ppm (Table 1), we can

conclude that the measured concentrations exceed the permissible values many times. Of the 240 samples collected, only one sample collected in the school yard in the very center of the city does not exceed 100ppm (sample 255a), while the other 239 samples exceed the permissible values. The highest concentrations were recorded in the area of Canici (sample 27 with 1162ppm), Pozarnica (sample 84 with 1132ppm), Kiseljak (sample 93 with 1592ppm), Moluhe (sample 152 with 1582ppm), Simin Han (sample 176 with 1159ppm), Brcanska Malta (sample 187 with 1307ppm), Slavinovici (sample 189 with 1160ppm) and Vilusici (sample 197 with 1126ppm).

Based on the concentrations and the coordinates of the sampled points, a map was drafted in order to show the spatial extent and the distribution of chromium concentrations, which is shown in Figure 2.

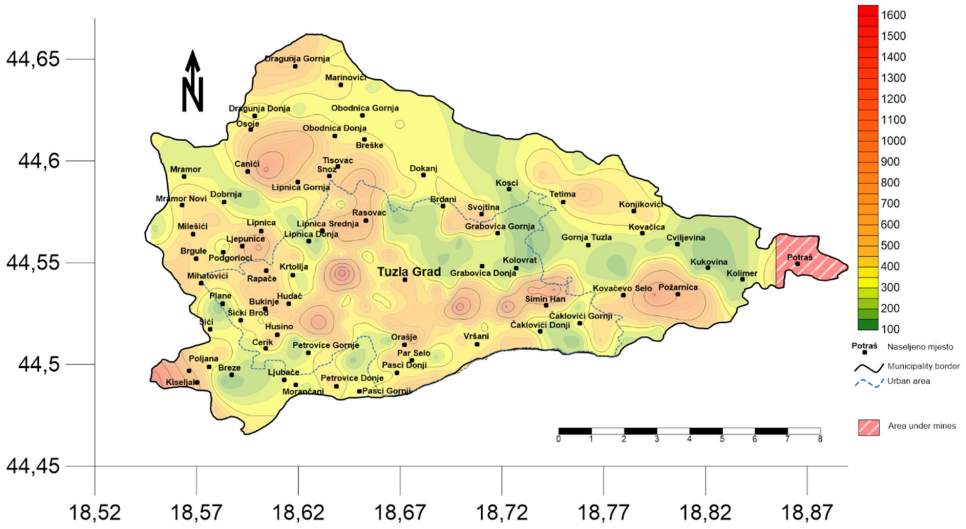

Figure 2. Spatial extent and the distribution of the chromium concentrations in soils of Tuzla area

Source: Own processing

4. HEALTH RISKS

It is generally accepted that chromium is an essential element for humans (Mertz, 1967). The World Health Organization estimates that the daily minimum intake of chromium to meet normal needs is approximately 33µg/person (WHO, 1996). Chromium compounds are toxic and carcinogenic.

Chromium is an essential micronutrient for the energy metabolism of organisms (plants, animals and humans). It pollutes the environment mainly through industrial wastewater, by breaking down alloys, coal-fired thermal power plants, and burning municipal waste (Halamić & Miko, 2009; Šorša & Halamić, 2014).

Chromium compounds are toxic and carcinogenic. Increased concentrations of chromium can cause problems in the respiratory tract, cardiovascular system, kidneys and liver in humans (Brieger, 1920; Langard & Norseth, 1986). High doses of chromium (10–20mg/kg) in the kidneys can cause necrosis of the proximal and distal tubules (Kaufaman et al., 1970; Langard & Norseth, 1986; Langard, 1983).

Disposal of chromium-containing commercial products and coal ash from electric utilities and other industries are major source of chromium releases into the soil (Barceloux, 1999; Nriagu & Pacyna, 1988). There is a large body of evidence indicating a risk of respiratory cancer among workers exposed to chromium, according to IARC reports (IARC, 2021).

5. PHYTOREMEDIATION POSSIBILITIES

Considering the amount of chromium in the soil of the city of Tuzla and its harmfulness to the health of the inhabitants, phytomining is imposed as a method of phytoremediation, which is visually inoffensive, non-destructive, ecological, aesthetic, and to some extent, a profitable method of obtaining valuable raw materials.

The results from Tuzla indicate a high level of chromium contamination across the sampled area and a large-scale phytoremediation effort would be necessary.

Phytoremediation involves several processes through which plants can remediate contaminated soils:

1. Phytoextraction: Plants absorb chromium through their roots and translocate it to their shoots and leaves. Hyperaccumulator plants, such as Common Thistle (Cirsium vulgare), Indian mustard (Brassica juncea) and sunflower (Helianthus annuus) – Figure 3, which are known for their high chromium uptake, could be effective in this region.
2. Phytostabilization: Plants stabilize chromium in the soil, preventing its mobility and reducing the risk of groundwater contamination. This involves the absorption and precipitation of chromium within the root zone.
3. Phytoreduction: Plants convert toxic hexavalent chromium (Cr (VI)) to the less toxic trivalent chromium (Cr (III)) through enzymatic and non-enzymatic reduction processes (Radić Lakoš & Radačić, 2010; Wuana & Okieimen, 2011; Baker & Brooks, 1989).

Cirsium vulgare
(Common Thistle)

Brassica juncea
(Indian mustard)

Helianthus annuus
(Sunflower)

Figure 3. Hyperaccumulator plants, which are most suitable for the process of phytoextraction of chromium

Source: University of Arizona (n.d.), CABI (n.d.), Gardenia.net (2023)

6. ECONOMIC BENEFITS

The advantages of phytoremediation are that, beneath the process of removal of contaminants from the soil, it also has economic benefits, which are reflected in the following:

- it is generally cheaper than traditional remediation methods,
- it requires minimal maintenance once established,
- the value of remediated land is increased, making it suitable for various uses,
- plants which were used can produce biomass for bioenergy or other economic purposes,
- beyond direct economic gains, phytoremediation can improve community well-being by enhancing green spaces and reducing pollution, and
- indirect economic benefits such as increased tourism and improved public health.

Calculating the soil mass for the first 0.3 m of soil profile (surface x depth x density) with the average price for raw chromium of 9 € per kg and the average concentration of chromium in the soils of Tuzla at 409 ppm, a conclusion can be derived that the soils of Tuzla contain chromium in order of 16.500 €/hectare. On the other side, the costs for the remediation would be in order from 3000-5000 €/ha per year. These costs are mainly due to ploughing and preparatory work, seeds and growing plants, long-term supervision and maintenance and harvest. There are also costs for burning the plants in order to produce chromium ore, but these costs can be equalized by the gain in heat for the heat network.

7. CONCLUSION

Phytoremediation presents a viable solution for the remediation of chromium-contaminated soils in Tuzla.

Although it offers several advantages, including economic and environmental friendliness, it also faces challenges that need to be addressed, such as economic benefits. However, economic gains should not be more important than the health of the residents of the area. The occurrence of a large number of cancerous diseases in the researched area are certainly the result of an environment polluted with heavy metals.

Continued research and development are essential to enhance the efficiency and applicability of phytoremediation, especially phytomining techniques in large-scale environmental cleanup efforts.

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