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Special Issue Reprint

New Challenges and Directions in the Development of Human Resource Management

Edited by
Augustín Stareček, Zdenka Gyurák Babeľová and Natália Vraňaková

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About the Editors

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Augustín Stareček is a researcher at the Institute of Industrial Engineering and Management at the Faculty of Materials Science and Technology in Trnava. His area of expertise is human resource management with a focus on employee motivation and sustainable performance management, and he focuses on process optimisation in the field of logistics and production. His scientific work also deals with issues of the impact of digitisation on the working environment, where he examines the link between automation, human resources and technological development. He has published numerous scientific articles in renowned journals and is actively involved in international research projects focused on digital transformation and Industry 4.0. The dominant areas of his pedagogical scope are the subjects: Operational Analysis, Information and Knowledge Management, Managerial Skills, and Intercultural management.

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Preface

This Reprint, entitled "New Challenges and Directions in the Development of Human Resource Management", addresses the urgent need for contemporary Human Resource Management (HRM) practices to adapt to a world defined by volatility and rapid change. Our primary motivation for compiling this collection was the recognition that conventional HRM models are insufficient to manage the current challenges posed by digital transformation, the shift to hybrid work, and the imperative to foster inclusive and healthy working environments.

The subject of this Reprint is the intersection of technological change, societal pressures, and employee diversity, focusing on their collective impact on sustainable employability and organisational resilience. The scope is deliberately transversal, including studies on ethical considerations of AI, the practicalities of remote work implementation, the influence of well-being on leadership, and the crucial role of diversity in determining an employee's motivation and adaptability.

The aim and purpose of this scientific work is to offer academics, researchers, and practitioners a synthesised view of current research, providing robust evidence and theoretical frameworks necessary to navigate these complex challenges. We intend for this collection to serve as a vital resource for developing adaptive and ethical HR strategies that ensure the long-term sustainability of the workforce.

This Reprint is addressed primarily to HR professionals, senior managers, academic researchers, and students in the fields of Human Resource Management, Organisational Behaviour, and Business Ethics who seek to understand and influence the future direction of work.

Augustín Stareček, Zdenka Gyurák Babeľová, and Natália Vraňaková
Guest Editors

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Editorial

Development of Human Resource Management Due to Technological, Social, and Legal Changes: Editorial for the Special Issue "New Challenges and Directions in the Development of Human Resource Management"

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1. Current Trends and Challenges in Human Resource Management

Human Resource Management (HRM) is evolving rapidly due to various challenges and opportunities. Key areas that are fundamentally changing the face of HRM today include technological advancements; remote work; diversity and inclusion; employee well-being and mental health; talent acquisition and retention strategies; and legal and ethical challenges. Each of these areas contributes to the transformation of HRM and shapes its development. Among the significant changes that HRM has undergone are technological advancements, with the integration of artificial intelligence (AI) in HRM transforming recruitment processes, employee engagement, and decision-making. While these AI tools enhance efficiency, they raise ethical concerns regarding issues such as algorithmic bias and data privacy (Antoniuk et al., 2025; Iancu & Oprea, 2025). Advanced analytics support strategic human resource (HR) decision-making, offering insights into employee attrition and performance (Narkbunnum & Hinthaw, 2025). The COVID-19 pandemic triggered another change in HRM; it accelerated research on and adaptation to remote work, emphasizing leadership, communication, and technology's role in maintaining productivity and work–life balance (Martins et al., 2025; Wagan & Sidra, 2025). Effective management of hybrid teams is crucial, focusing on trust, communication, and adaptability (Bouisse-Bloigu & Chamakiotis, 2025). Diversity and inclusion are an integral part of modern HRM because they promote equal opportunities, improve organizational culture, and contribute to the long-term success of an organization. Diversity positively impacts performance, moderated by HR practices like training and appraisal (Khassawneh & Mohammad, 2025). Organizations are developing models to enhance workplace inclusivity, addressing diversity through tailored HR strategies (Sanabria et al., 2025; Manthar et al., 2025).

Currently, several areas of human resource management require special attention. The topic of employee well-being and mental health is becoming increasingly important within HRM, as organizations emphasize comprehensive support for the physical and psychological well-being of employees as a key prerequisite for their satisfaction and performance. Digital tools and structured interventions are crucial for assessing and improving workplace well-being (Floridou et al., 2025; Wen et al., 2025). Work–life balance, a critical factor in employee satisfaction and productivity, is increasingly prioritized in HR strategies (Kamboj et al., 2025). Talent acquisition and retention strategies play a crucial role in HRM, as effectively acquiring and retaining talented employees is crucial for the long-term

growth, innovation, and competitiveness of an organization. AI enhances recruitment efficiency and diversity, although it presents challenges in terms of bias and ethical considerations (Choudhari et al., 2025). Organizations are focusing on flexible work practices and employee engagement to retain talent (Deery & Jago, 2015). The topic of legal and ethical challenges in HRM is gaining importance, as organizations must ensure responsible and transparent management of human resources in accordance with legal regulations and ethical principles, especially in the context of the growing use of technology and artificial intelligence. The deployment of AI in HRM raises ethical concerns, including bias in algorithmic decision-making and privacy issues (Benzel & Rege, 2025). Organizations face challenges in maintaining compliance with evolving legal standards in HR practices (Antoniuk et al., 2025). Transformations in HRM emphasize the need for adaptable strategies and innovative approaches to human resource management. Organizations that effectively combine technology, employee support, and ethical principles achieve better engagement and performance. Thus, HRM is gradually redefining its role in the modern workplace.

2. Articles in the Special Issue

The Special Issue "New Challenges and Directions in the Development of Human Resource Management" offers a collection of current, relevant, and scientific articles that address the dynamically changing HRM environment, technological innovations, workforce diversity, and the challenges of sustainable employability.

The COVID-19 pandemic's impacts on working life have highlighted the need for adaptation and resilience in both organizations and individuals. In the article "*Applying IS-Enabled Telework during COVID-19 Lockdown Periods and Beyond: Insights from Employees in a Greek Banking Institution*", Stamos and Kotsopoulos analyze the implementation of information system-enabled telework and show how flexible digital solutions can support the continuity of work processes whilst requiring new competencies and adaptability.

Employee well-being and its connection to work effectiveness is explored by Ortiz-Meillon et al. in the article "*The Level of Happiness and Its Relationship with Personal and Occupational Well-Being in Women Leaders at a Mexican University: An Exploratory Study*". Their results show that subjective well-being and happiness significantly influence performance and leadership ability, highlighting the importance of diversity and gender equality in HR management.

In the context of digital transformation, Krejnus et al., in the article "*Measuring Efficiency and Satisfaction in the Context of Digital Transformation*", examine how the implementation of digital tools affects employee performance and satisfaction and identify key factors for the successful adoption of technological change.

In the article "*Preferences of Generations of Customers in Slovakia in the Field of Marketing Communication and Their Impact on Consumer Behaviour*", Cagala and Babcanova analyze how different generations of customers and employees respond to organizational strategies, and they provide practical recommendations for HR managers *Behaviour*.

Digital innovations for improving employee motivation, engagement, and productivity are addressed by Stachova et al. in the article "*The Impact of E-HRM Tools on Employee Engagement*". They provide a framework for understanding how digital HRM tools, such as digital interaction platforms and big data analytics, can be strategically implemented to enhance organizational performance whilst highlighting the complex relationship between technology and employee engagement.

Organizational structures and control mechanisms are examined by Vranakova et al. in the article "*Incorporation of Controlling into the Organizational Structures of Industrial Enterprises*", who show that effective integration of controlling functions supports decision-making and modernizes HR processes.

The benefits of ergonomic design and its impact on employee productivity and satisfaction are the subject of the study by Markova et al., "*The Impact of Ergonomic Rationalisation on the Efficiency and Productivity of the Production Process*", which proves that improvements to the working environment lead to higher performance and reduce the risk of occupational accidents *Rationalisation*.

An overview of systemic resilience and adaptation during crises is presented in the article "*Resilience During Crisis: COVID-19 and the New Age of Remote Work in Higher Education—A Systematic Literature Review*" by Okeke-Uzodike and Ngo Henha, which summarizes factors for a successful transition to distance learning and recommendations for future crisis situations.

An analysis of the labor market and digital competencies is conducted in the article "*Analysis of Labour Market Expectations in the Digital World Based on Job Advertisements*" by Musinszki et al., which examines the requirements of employers in the digital age and provides an overview of the key skills that are currently in demand in the labor market *Labour*.

Finally, in the article "*Selected Attributes of Human Resources Diversity Predicting Locus of Control from a Management Perspective*", Gyurak Babelova et al. examine how different aspects of diversity influence perceptions of control over one's work and highlight the importance of diversity for employee adaptability and motivation.

We would like to thank the authors, reviewers, and editorial team for their contributions to this Special Issue. We believe it will provide inspiration and practical insights for research and practice in the field of HRM.

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Article

Selected Attributes of Human Resources Diversity Predicting Locus of Control from a Management Perspective

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Abstract: Locus of control refers to the way in which people perceive whether they have control over situations in their lives or whether these situations are the result of external circumstances. Locus of control subsequently influences individuals' motivation, decision-making, and ability to accept responsibility. How locus of control manifests itself in the behavior of a particular individual can be influenced by several factors. In this article, we focused on how elements of different dimensions of human resource diversity can influence locus of control. For the research, we chose a quantitative approach using a questionnaire measuring the locus of control, along with additional questions. The main aim of the presented research was to identify the relationship between sociodemographic variables and the locus of control orientation of individual groups of respondents. The research sample consisted of N = 384 participants who completed the reduced standardized Rotter locus of control scale. The results focused on differences in individuals' locus of control in terms of age, gender, type of work experience, and marital status and to what extent these sociodemographic variables can be a predictor of individuals' locus of control. Hypotheses testing was performed using IBM SPSS 23 software. Th theoretical application of the research findings lies in the discovery that the locus of control (LoC) is not influenced by simple characteristics but must be understood in a more complex way. The practical application lies in the fact that professional experience can influence how employees perceive their level of control over their ability to affect their work and outcomes.

Keywords: behavior; diversity; human resources; locus of control; motivation

1. Introduction

The locus of control (LoC) is a concept that expresses the extent to which individuals attribute the results of their behavior to their own actions, i.e., they perceive an internal locus of control, or to external circumstances, thus preferring an external locus of control. It represents an important framework for understanding whether people attribute responsibility to their successes and failures to their own abilities and decisions or to external circumstances, such as chance, luck, or the interventions of other people. The study of LoC has significant applications in various fields, especially psychological research. Its structure and functioning are related to the ways in which individuals respond to stress, plan their goals, cope with difficult situations, and regulate their behavior. LoC is thus an important factor in shaping life attitudes, motivation, and decision-making strategies. At the same time, it influences cognitive and emotional processes that shape the everyday perception

of situations and adaptation to changing conditions. In the context of increasing uncertainty and workplace demands, understanding LoC is becoming particularly relevant for organizations, as it relates to motivation, decision-making, adaptability, and performance.

Despite the extensive research on LoC in clinical and educational settings, its role in work-related contexts and its connection to demographic and experiential variables remains insufficiently explored. The theoretical and empirical significance LoC also lies in its ability to mediate relationships between personality traits and behavior. Individuals with a predominant internal locus of control more often perceive their behavior as effective and meaningful, while individuals with an external locus of control may feel powerless over external circumstances. These differences have an impact on various life domains, from lifestyle and health to work performance and stress management. From a methodological point of view, LoC research is also important for its applicability in different population groups and cultural contexts and in conditions of changing social challenges. Its importance is growing especially in a period of increased demands for independence, flexibility, and the ability to navigate in uncertain situations. Based on the above, LoC represents not only a certain personality characteristic, but also a dynamic framework for understanding individual differences in approaches to the world, responsibility, and personal development. This study addresses this gap by examining the relationship between selected demographic variables and LoC within a working population. By doing so, it aims to contribute to the understanding of how life circumstances and job roles influence one's sense of control. The originality of this study lies in its integration of individual and situational variables in the context of organizational behavior.

2. Theoretical Background

Locus of control (LoC) is a key psychological construct that reflects an individual's belief in the degree of personal control over life situations. A distinction is made between internal and external locus of control. This construct was defined by Rotter (1966) in his work in such a way that if an individual perceives reinforcement as something that is not completely dependent on his actions, then this event is perceived as the result of luck, chance, fate, as something that is under the control of others, as something unpredictable. He refers to this as a belief in external control. If a person perceives that an event depends on his own behavior or his own relatively permanent characteristics, he refers to it as a belief in internal control. LoC can then be understood as a construct that distinguishes the extent to which an individual believes that the results of his behavior depend on his own actions (internal locus) or, conversely, on external forces (external locus). It is a person's belief about whether he can influence the course of situations in his life (Schepisi, 2024; Lloyd & Hastings, 2009). It is a belief that outcomes in life depend either on one's own actions or on the influence of external circumstances (Visdómine-Lozano & Luciano, 2006). This construct takes the form of a continuous spectrum, with individuals exhibiting different levels of internal or external control in different areas of life. The LoC continuum is illustrated in Figure 1.

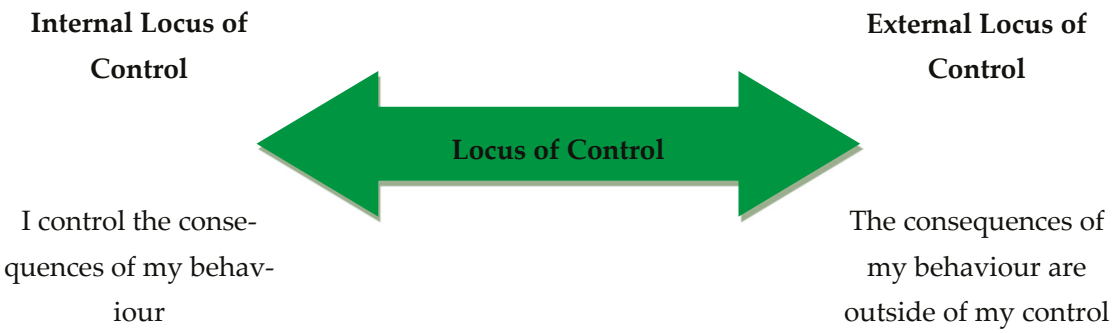

Figure 1. The continuum of locus of control (Shojaee & French, 2014).

The multidimensional nature of the locus of control construct is among the psychological constructs for which research has a tradition of more than 50 years. This construct primarily consists of two foci, namely internal control and external control (Figure 1), which are currently considered significant predictors of attitudes, behavior, and work outcomes, including motivation (Galvin et al., 2018). Originally, LoC was defined as an individual's generalized expectation that the outcomes of their behavior are either the result of their own efforts or are influenced by external factors beyond their control (Rotter, 1966, 1975). LoC is also closely related to constructs such as self-efficacy and perceived control (Visdómine-Lozano & Luciano, 2006).

3. Literature Review

Research findings confirm the importance of the practical consequences of locus of control in various areas of life. Research shows that differences in the perception of control can affect overall psychological well-being, behavior in interpersonal relationships, and attitudes towards health or education. This makes LoC a key element in the design of interventions aimed at promoting personal responsibility, self-regulation, and the development of adaptive skills. Research also shows that successful manifestations of self-control, such as quitting smoking, are more often associated with an internal locus of control, which points to the importance of personal responsibility in changing behavior (Rosenbaum & Argon, 1979). Individuals with an internal locus of control reported better health (Botha & Dahmann, 2024). Some research suggests that LoC may also be related to physical health and self-perception in this area. Overweight or obese individuals have higher external locus of control scores, which may be related to the belief that they do not have sufficient control over certain aspects of their lives (Thomason, 1983). External locus of control is associated with higher levels of depression as it is related to lower self-esteem among college students (Yu & Fan, 2016). Studies suggest that an internal locus of control is associated with positive outcomes, such as academic success and resilience to negative behavior (Golding et al., 2019). An external locus of control is often associated with a belief in the power of others or chance, which can negatively affect perceptions of one's own effectiveness—for example, in the area of economic decisions (Baguma & Chireshe, 2012; Ai et al., 2005). Previous research has often focused on LoC in relation to personality or mental health, but less attention has been paid to how demographic factors such as age, gender, marital status, or work experience shape individuals' perception of control in professional settings.

Locus of control can vary depending on personality traits and specific situations (Ogunyemi, 2013). It can also vary depending on the area of life in which it is assessed (Graybill, 1978). The relationship between beliefs and conformity is further explored, with findings suggesting that control beliefs may mediate the relationship between needs and personality traits (Mussel, 2019). The connection between LoC and the environment is also confirmed by research that has shown that a disordered environment increases the

tendency to cheat, especially in people with an external locus of control (Jansen et al., 2017). An internal locus of control is associated with greater immersion in an activity and lower anxiety (Mosing et al., 2012). In workplace bullying scenarios, an internal locus of control does not provide the expected protective effect against psychological distress, while an external locus of control may offer some benefits (Reknes et al., 2019). These findings support the view that LoC is a dynamic and context-sensitive construct that can be influenced by various personal and social characteristics.

The importance of locus of control is also evident in the context of organizations and careers. LoC is perceived as a control mechanism and is used in organizations, especially in the environment of flexible organizational cultures (Heinicke et al., 2016). Individuals with an internal locus of control are more motivated to engage in entrepreneurial activity and proactive behavior (Antwi-Boasiako, 2017). The relationship between LoC and behaviors such as conformity and entrepreneurial orientation is significant, with internal locus of control supporting positive entrepreneurial traits (Knezevic et al., 2021). A significant relationship between LoC and employability has been confirmed (Drazic et al., 2018). According to the study, career ambitions mediate the relationship between internal locus of control and employability (Lin & Ding, 2003). Individual's LoC may develop in interactions with personal and contextual life experiences—such as the career stage, type of work experience, or family responsibilities.

Considering the review of studies focused on the investigation of LoC, it follows that LoC has a significant impact on the attitudes and subsequent behavior of individuals in certain situations. It is a certain personality trait that influences situationally conditioned behavior based on past experiences. In these cases, LoC is an independent variable that shapes attitudes and influences the behavior of individuals. Given that LoC is influenced by past experience, it is also necessary to examine it as a dependent variable, which may depend on several factors.

From this perspective, personality diversity plays an important role. Individual attributes of diversity contribute to the complexity of the perspective from which people perceive themselves, but also to the perspective from which they perceive others. The connection of individual dimensions contributes to the formation of values, priorities, and perceptions of each individual. Several authors define multidimensional models of diversity, in which they connect several levels of diversity, but in principle, we can distinguish primary and secondary diversity or otherwise referred to as internal and external dimensions of diversity (Vlas et al., 2022; Østergaard & Timmermans, 2023; Hulková, 2024; Verwijs & Russo, 2023). The primary or internal dimension is defined by attributes such as gender, age, race, ethnicity, mental and physical abilities, sexual orientation, and others. These are physical or social characteristics that are impossible or not easily changed. The secondary or external dimension of diversity represents attributes such as work experience, marital status, education, religion, language of communication, geographical location, work status, work style, military experience, and others. These are elements of personal identity that can be more easily changed. Both dimensions of diversity represent major areas of research or are considered an important factor in a wide range of research directions. Given the factors influencing locus of control, differences in LoC may also be manifested depending on age or life or work experience. Managers showed higher scores for internal locus of control, while the group of managerial employees can be assumed to be more experienced in terms of age, which suggests a possible relationship between age and locus of control (Harris & Hartman, 1992). LoC can therefore also be influenced by generation, as different social conditions have shaped different attitudes towards responsibility and control over life. In the workplace, differences in LoC have been identified according to position in the organizational hierarchy. Managers scored higher on the internal locus of

control than non-managerial employees (Harris & Hartman, 1992). The results presented suggest that job classification may be related to preferred LoC. Regardless of gender, a tendency toward external locus of control has been shown to play a more significant role in shaping entrepreneurial intentions than internal LoC (Arkorful & Hilton, 2022). The association between LoC and marital quality is influenced by contextual factors such as the length of the marriage and the presence of marital instability. These findings suggest that an individual's perceived effectiveness in managing interpersonal conflicts plays a key role in determining marital satisfaction (Sakotic-Kurbalija et al., 2017). Based on these insights, it can be assumed that marital status alone does not significantly influence LoC, as other contextual variables also appear to play an important role.

An important area of research is interventions aimed at supporting the internal locus of control. Targeted intervention programs can effectively strengthen the internal locus of control (Kaynak et al., 2024). Interventions aimed at promoting internal locus of control are effective (Williams et al., 2016). The importance of individually focused interventions in strengthening the internal locus of control has also been confirmed (Markovizky & Shafran, 2024). Another study confirmed that positive psychology interventions can effectively increase individuals' internal locus of control (Choi & Heo, 2021).

In relation to individual characteristics, it was found that in certain situations, men were more conformist than women, suggesting a possible difference in beliefs about control over life situations depending on gender (Maadal, 2020). It can be assumed that sex (both biological and gender aspects) can have an impact on the perception of control and consequently on the behavior of individuals. The influence of the environment has also been shown in the family context. Young people with a positive family environment and supportive parenting practices showed higher scores for the internal locus of control (Ahlin & Antunes, 2015). The family environment or family status may be relevant in relation to emotional support, the perception of LoC, or other social factors, where the presence of a loved one may play a role.

Based on the theoretical background, the authors of the article subsequently derived the following four research hypotheses (RHs):

RH1: *There is a statistically significant difference between age and the specified LoC.*

RH2: *There is a statistically significant difference between gender and the specified LoC.*

RH3: *There is a statistically significant relationship between the type of work experience and the specified LoC.*

RH4: *There is a statistically significant difference between current marital status and the specified LoC.*

To test the hypotheses, the research methods and tools described in the following part of the paper were chosen. Figure 2 displays a model of the relationship between the primary and secondary dimensions of diversity and the locus of control variable, which serves as the basis for the formulation of research hypotheses RH1 to RH4. The model assumes that the variables age and gender (primary dimension of diversity) and marital status and type of work experience (secondary dimension of diversity) can influence the internal or external locus of control of an individual. Each of these four variables is directly linked to the LoC through a separate research hypothesis.

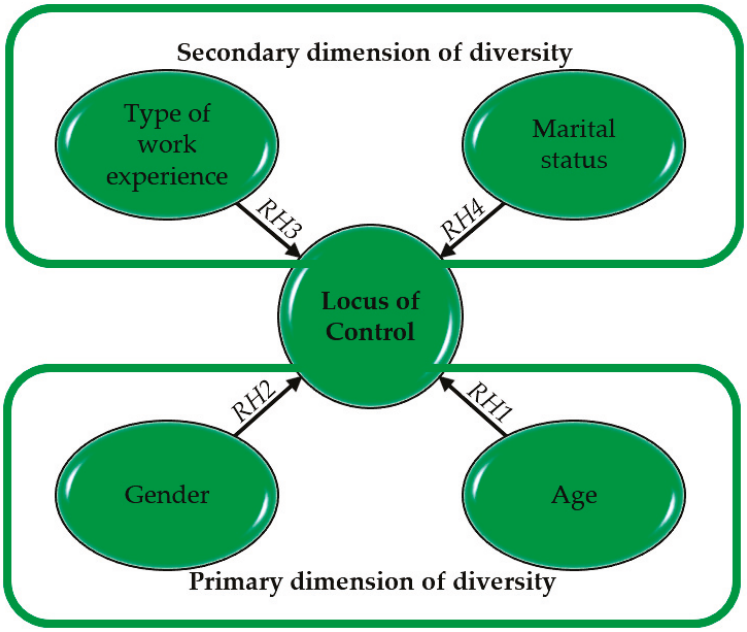

Figure 2. Research framework for examining LoC and diversity dimensions (own elaboration, 2025).

Figure 2 contains the structure of the research framework, where locus of control is the central element, potentially influenced by four variables representing diversity. At the bottom are the two primary dimensions of diversity: "Gender" and "Age", linked by hypotheses RH2 and RH1. At the top are the secondary dimensions: "Type of work experience" and "Marital status", linked by hypotheses RH3 and RH4. The research framework visually distinguishes between the two categories of diversity and their potential impact on LoC.

4. Materials and Methodology

The following part of the article is divided into two parts. The first part contains a description of the research collection instrument (questionnaire) and a brief description of the methods used in the research. The second part contains a description of the research sample.

4.1. Description of the Research Instrument and Methods Used

How individuals perceive their locus of control can be measured through several tests. The tests used are focused on mental health, e.g., Multidimensional Health Locus of Control scale (Kassianos et al., 2016), autonomy, e.g., Schepers's Locus of Control Questionnaire (Schepers, 2004), mental well-being through The Ryff Scales of Psychological Well-being (Ryff & Keyes, 1995), or Rotter's Locus of Control Scale (Rotter, 1966). Rotter developed the Internal-External Locus of Control Scale (I-E Scale), which was designed to measure individuals' general belief that the outcomes of their actions are determined by their own efforts and abilities (internal locus) or by external forces such as luck, fate, or other people (external locus). The scale consisted of 29 items, of which 6 were filler items, and the remaining 23 items were used to assess the individual's orientation. This scale or some modification of this scale has been used in several studies (Falco, 2007; Ojukwu & Onuoha, 2012; Botha & Dahmann, 2024). For the purposes of our research, we chose 10 items of this scale selected according to (Harris & Hartman, 1992). According to these authors and based on research focused on locus of control, several different types of behavior can be identified in internal and external individuals, as shown in Table 1.

Table 1. Comparing the behavior of internal and external individuals (Harris & Hartman, 1992).

Inner Individual (I Control My Destiny)	External Individual (Factors in My Environment Control Me)
Is more satisfied with the results of personal efforts	Is less satisfied with the results of personal efforts
Feel more satisfied working under a participatory leader and less satisfied with directive leadership	Feels less satisfied with a participative leader is more satisfied with a directive
Sees a strong relationship between personal effort and personal performance	Sees a weak relationship between personal efforts and personal performance
Uses personal persuasion and rewards to influence others	Will use coercive power to influence others
Will be more sensitive to situations that involve individual decisions	Will be less confident in individual decisions
Will be more open to environmental influences	Will be more concerned with changes in the environment
Will be more considerate of the needs of others	Will be more concerned with personal well-being than the well-being of others

Table 1 shows that an internal individual should be more sensitive to motivational processes aimed at satisfying needs. Based on the above, we constructed a questionnaire that included, in addition to demographic questions, a 10-item reduced Rotter scale for measuring locus of control.

For research purposes, the authors of the article used a quantitative approach based on a standardized questionnaire tool, which is valid and reliable. Data collection was carried out in the form of an online questionnaire distributed via Google Forms. This method enabled simple and quick distribution of the questionnaire among respondents and at the same time ensured the automatic digitization of responses, thereby minimizing the risk of errors in manual data transcription. In order to minimize the potential bias of common methods during data collection, several procedural (methodological) measures were used. Before data collection, a measure was introduced to ensure the anonymity of respondents in order to minimize the pressure on respondents, as well as a measure that the questionnaire contained detailed instructions that ensured the minimization of common bias. The invitation to participate in the research also included an email contact for a scholar to whom respondents could direct their questions and any ambiguities. Another measure is that a standardized questionnaire was used, which is valid and reliable, and statistical methods (ANOVA, Chi-square tests, and Pearson correlation test) were used, which are suitable for testing due to the cross-sectional nature of the study to examine differences and associations in the locus of control between other variables. Data collection was carried out in the territory of the Slovak Republic using non-probability random sampling. We chose this type of sampling mainly because it is the fastest and easiest way to obtain a sample of respondents, does not require a large budget to reach a large number of respondents, and the research can be carried out even when it is not possible or practical to do a random sample. This method is also suitable when financial or human resources are limited. The questionnaire was distributed to a broad range of respondents without targeted selection. The collected data were subsequently exported to Microsoft Excel, where basic data quality control, aggregation, and preliminary descriptive analysis (calculation of frequencies, percentages, basic statistical indicators) were performed. The above-mentioned data processing phase was necessary to ensure data consistency and prepare data for statistical testing. For statistical analysis (evaluation of the stated research hypotheses), we used IBM SPSS Statistics version 23 software. We used the following statistical methods: descriptive statistics (arithmetic mean, standard deviation, relative and absolute frequency), Levene's test of homogeneity of variances to verify the assumptions for the use of parametric tests, one-way analysis of variance (ANOVA) to test differences in mean values between multiple groups (e.g., by year of birth), Chi-square test of independence (Pearson test) to verify associations between categorized variables (e.g., type of control and gender or employment status).

4.2. Characteristics of the Research Sample

The research sample consisted of respondents selected randomly to ensure a diverse demographic structure of the research sample. The only condition for selecting the research sample was that the respondents were adults who confirmed their informed consent to participate in the research. The first sociodemographic question was the question that asked about the gender of the respondents. In Table 2 we can see the evaluation.

Table 2. Respondents' gender (own elaboration, 2025).

Gender	Absolute Frequency	Relative Frequency [%]
Men	199	51.82
Women	185	48.18
Total	384	100.00

According to the Table 2, the research sample is gender-balanced. Out of the total set of 384 respondents, 199 were male (51.82%) and 185 were female (48.18%). The second question was a question that asked respondents about their year of birth. The results are presented in Figure 3.

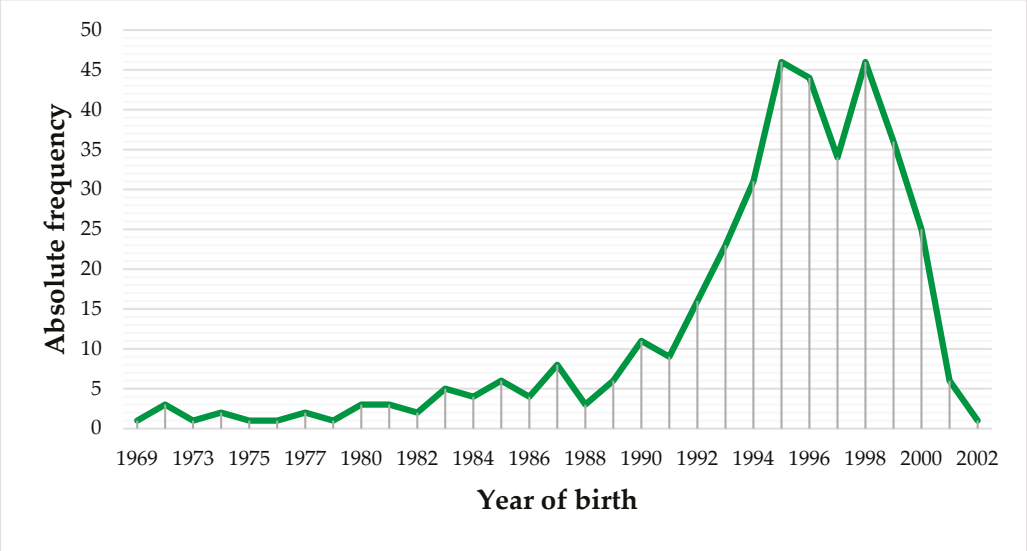

Figure 3. Respondents by year of birth (own elaboration, 2025).

Figure 3 shows the data of N = 384 respondents and their year of birth. The oldest respondent was a person born in 1969. On the other hand, the youngest person who participated in the research was a person born in 2002. In terms of generational affiliation, we can state that generation X (1961–1980) has a low representation of only 15 respondents (3.91%). Generation Y (1981–1995) has a representation of 177 respondents (46.09%). The most numerous groups of respondents were respondents who can be characterized as generation Z (1996–2010), which consisted of up to 50.00% of respondents (192 respondents). Due to the low representation of generation X, it is not possible to examine the differences between generational groups.

Another question that served to characterize the research sample was a question focused on the current marital status of the respondents. Respondents could indicate one of three answer options (married, single but in a relationship, and the last option single, not in a relationship). The results are provided in Table 3.

Table 3. Marital status of respondents (own elaboration, 2025).

Marital Status	Absolute Frequency	Relative Frequency [%]
Married	59	15.37
Single, but in a relationship	198	51.56
Single, not in a relationship	127	33.07
Total	384	100.00

Table 3 above shows that the sample is unbalanced in terms of current marital status. The data show that the largest group in the sample was respondents who are single but currently in a relationship—represented by 198 respondents, what corresponds to 51.56% of the total. In second place were respondents who are single and without a partner, who were 127 (33.07%). The lowest representation was that of married people, who numbered 59, which represents 15.37%. This distribution indicates that the sample is significantly dominated by people who are not legally married, while more than half of them are currently in a partner relationship. The last socio-demographic question was a question focused on the respondents' current work experience (Table 4), which offered three answer options.

Table 4. Type of respondents' work experience (own elaboration, 2025).

Employment Status	Absolute Frequency	Relative Frequency [%]
Employee/self-employed person	91	23.70
Working student	274	71.35
Unemployed	19	04.95
Total	384	100.00

Table 4 presents the distribution of respondents according to their current work experience. Of the total number of 384 respondents, the largest part of the sample was made up of working students, who represented 274 people, which corresponds to 71.35%. The second largest group was made up of respondents who are employed or self-employed—91 (23.70%). The least represented category was the unemployed, who numbered 19, which represents 4.95% of the respondents. The above distribution indicates that the research sample is strongly oriented towards the student population, who are also active in the labor market, which may have an impact on their lifestyle, self-regulation, and perception of locus of control.

5. Results

In the following part of the article, four research hypotheses formulated in the previous part of the article are evaluated.

RH1: *There is a statistically significant difference between age and the specified LoC.*

First, we created Table 5, which shows the descriptive statistics for LoC results in the context of age (year of birth). As we can see, there is no significant difference between the LoC results within the research sample in terms of average age and LoC results (I—internal control = 1993.92; E—external control = 1994.38; and B—balanced control = 1994.78).

Table 5. Descriptive statistics for LoC and year of birth (own elaboration, 2025).

Descriptives Statistics								
LoC	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum**	**Maximum**
					Lower Bound	**Upper Bound**		
I	273	1993.92	5.750	0.348	1993.24	1994.61	1969	2001
E	52	1994.38	6.402	0.888	1992.60	1996.17	1972	2002
B	59	1994.78	4.650	0.605	1993.57	1995.99	1978	2001
Total	384	1994.12	5.685	0.290	1993.55	1994.69	1969	2002

Next, we proceeded to test the homogeneity of variances (Levene's test), which showed that sig. = 0.313, which implies that the equality of variances is met, based on which we can proceed to the ANOVA test, the results of which are displayed in Table 6.

Table 6. Levene's test of homogeneity of variance (own elaboration, 2025).

Test of Homogeneity of Variances		**Levene Statistic**	**df1**	**df2**	**Sig.**
Year	Based on Mean	1.166	2	381	0.313
	Based on Median	0.825	2	381	0.439
	Based on Median and with adjusted df	0.825	2	366.143	0.439
	Based on trimmed mean	0.963	2	381	0.382

The last step was to perform ANOVA testing to show whether there was a statistically significant difference between year of birth and LoC score. The results are presented in Table 7.

Table 7. ANOVA testing result for RH1 (own elaboration, 2025).

ANOVA					
Year of Birth	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	39.899	2	19.949	0.616	0.541
Within Groups	12,337.828	381	32.383	-	-
Total	12,377.727	383	-	-	-

From the results according to Table 7, it can be concluded that there is no statistically significant difference in the average year of birth between the LoC results (I—internal control, E—external control, and B—balanced control) (F (2,381) = 0.616 and $p = 0.541$). In other words, the LoC (internal, external, or balanced control) does not depend on when the respondent was born, and therefore, we do not confirm the tested RH1.

RH2: *There is a statistically significant difference between gender and the specified LoC.*

Before the actual testing, we present the results of the descriptive statistics in Table 8 below.

Table 8. LoC result by gender (own elaboration, 2025).

Result LoC/Gender	**Result I—Internal Control**		**Result E—External Control**		**Result B—Balanced Control**	
	Absolute Frequency	**Relative Frequency [%]**	**Absolute Frequency**	**Relative Frequency [%]**	**Absolute Frequency**	**Relative Frequency [%]**
Men	143	52.38	22	42.31	34	57.63
Women	130	47.62	30	57.69	25	42.37
Total	273	100.00	52	100.00	59	100.00

Based on the data in Table 8, the most common LoC result in the research sample for the male group is internal control (143 men), and the least common type of control is external control (22). For the female group, the most common type of control is internal control (130 women) and the least common type of control is balanced control (25 women). We then proceeded to statistical testing using SPSS 23, namely testing via the chi-square test, which can be seen in Table 9. The initial analysis showed that all expected frequencies were sufficiently high (minimum expected frequency = 25.05), thus meeting the requirements for using the chi-square test.

Table 9. RH2 result using chi-square tests (own elaboration, 2025).

Chi-Square Tests	Value	df	Asymptotic Significance (2-Sided)
Pearson Chi-Square	2.716	2	0.257
Likelihood Ratio	2.723	2	0.256
Linear-by-Linear Association	0.068	1	0.794
N of Valid Cases	384	-	-
0 cells (0.0%) have expected count less than 5. The minimum expected count is 25.05.			

As part of the evaluation, we tested RH2 (Table 9) that there is a statistically significant difference between gender and the result of LoC. For the analysis (we used SPSS 23 for testing), and specifically, we used the chi-square test of independence, the results of which are as follows: χ^2 (2) = 2.716, p = 0.257. The test result did not show a statistically significant difference between gender and the result of the LoC. In other words, gender does not have a significant effect on the type of control (I—internal, E—external and B—balanced). Based on these results, we do not confirm the second research hypothesis about a statistically significant difference between gender and LoC.

RH3: *There is a statistically significant relationship between the type of work experience and the specified LoC.*

Table 10 summarizes the descriptive statistics, which are presented ahead of the testing phase.

Table 10. LoC results by type of work experience (own elaboration, 2025).

Result LoC/Employment Status	Result I—Internal Control		Result E—External Control		Result B—Balanced Control	
	Absolute Frequency	Relative Frequency [%]	Absolute Frequency	Relative Frequency [%]	Absolute Frequency	Relative Frequency [%]
Employee/Self-employed person	72	26.37	7	13.46	12	20.33
Working student	191	69.96	41	78.85	42	71.19
Unemployed	10	03.67	4	07.69	5	08.48
Total	273	100.00	52	100.00	59	100.00

As displayed in Table 10, the distribution of control among employees and self-employed persons reveals that internal control is the most common type (72 respondents), with the same trend observed among matching students (191 respondents). The most numerous groups among the unemployed is also internal control (10 respondents). The results of statistical testing can be seen in Table 11. Pearson correlation analysis was used to test the third hypothesis.

Table 11. Testing RH3 using the Pearson correlation test (own elaboration, 2025).

Correlations		Result LoC	Type of Work Experience
Result LoC	Pearson Correlation	1	0.354 *
	Sig. (2-tailed)	-	0.042
	N	384	384
Type of work experience	Pearson Correlation	0.354 *	1
	Sig. (2-tailed)	0.042	-
	N	0384	384

* Correlation is significant at the 0.05 level (2-tailed).

The results showed a positive statistically significant correlation between the variables "LoC scale score" and "type of work experience" (r = 0.354, p = 0.042, N = 384). The correlation coefficient can be considered a moderate dependence based on the standard interpretation (Cohen, 1988), with a p value < 0.05, which can be interpreted as a statistically significant relationship at the 5% significance level. The findings (Table 11) suggest that the type of work experience may be related, to some extent, to the tendency of individuals to prefer a certain type of control over situations in their lives (internal, external, or balanced locus of control). In other words, people with different work experiences may have different preferences in the way they attribute control over their own life or work outcomes.

RH4: *There is a statistically significant difference between current marital status and the specified LoC.*

Prior to conducting the actual testing, Table 12 below provides the descriptive statistics for LoC results by current marital status.

Table 12. LoC results by type of current marital status (own elaboration, 2025).

Result LoC/Marital Status	Result I—Internal Control		Result E—External Control		Result B—Balanced Control	
	Absolute Frequency	Relative Frequency [%]	Absolute Frequency	Absolute Frequency	Relative Frequency [%]	Absolute Frequency
Married	40	14.65	8	15.38	11	18.65
Single, but in a relationship	149	54.58	20	38.47	29	49.15
Single, not in a relationship	84	30.77	24	46.15	19	32.20
Total	273	100.00	52	100.00	59	100.00

The results of the descriptive statistics in Table 12 illustrate that internal control prevails in all types of marital status. Similarly, in all three types of marital status, external control is the least numerous type of control. The results of the statistical testing of the fourth experimental hypothesis are in Table 13. The initial analysis showed that all expected frequencies were sufficiently high (minimum expected frequency = 7.99), thus meeting the requirements for using the chi-square test.

Table 13. Testing RH4 using chi-square tests (own elaboration, 2025).

Chi-Square Tests	Value	df	Asymptotic Significance (2-Sided)
Pearson Chi-Square	5.924	4	0.205
Likelihood Ratio	5.772	4	0.217
Linear-by-Linear Association	0.037	1	0.847
N of Valid Cases	384	-	-
0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.99.			

As part of the evaluation, we tested the hypothesis (Table 13) that there is a statistically significant difference between current marital status and the result of the locus of control. For the analysis (testing, we used SPSS 23), and specifically, we used the chi-square test of independence, the results of which are as follows: χ^2 (2) = 5.924, p = 0.205. The test result did not show a statistically significant difference between current marital status and the result of the LoC. In other words, marital status does not have a significant effect on the type of control (I—internal, E—external, and B—balanced). Based on these results, we do not confirm the hypothesis.

6. Discussion

When formulating the research framework, we based our work on previously validated studies and findings that locus of control is understood as a continuum, with internal locus of control on one side and external locus of control on the other (Wu et al., 2020). Internal locus of control refers to the belief that individuals can influence their life situations through their actions, while external locus of control suggests that outcomes are determined by external factors (Henninger et al., 2012). Individuals with an internal locus of control attribute the outcomes of situations to their abilities, decisions, and effort, while those with an external locus of control perceive outcomes as the result of luck, chance, or external influences (Stones, 1983). The term "internal locus of control" is closely related to concepts such as "self-control," "self-regulation," and "ego depletion." All these terms refer to how individuals perceive their ability to influence the outcomes of their lives and how effectively they can regulate their behavior and impulses. Self-control refers to the mental processes that enable an individual to suppress impulses and adapt behavior to the current demands of the situation (Inzlicht et al., 2014). However, this resource is not inexhaustible. The prolonged exercise of self-control can lead to psychological exhaustion, known as ego depletion, which in turn reduces the ability to exert further self-control (Moller et al., 2006; Kazén & Kuhl, 2022).

Nevertheless, there are situational self-control strategies that can effectively limit negative impulses by allowing the individual to purposefully change their environment and minimize the effects of temptations (Duckworth et al., 2016). Self-regulation, which is closely related to the concept of self-control, has a different nature, as it is often associated with the promotion of positive behavior rather than exhaustion, especially in goal-oriented individuals (Kazén & Kuhl, 2022). At the same time, it proves to be an important mediator in the formation of internal motives, for example in the field of education (Hanfstingl et al., 2010). The relationship between self-control demands and ego depletion is influenced by several factors, such as the satisfaction of basic psychological needs, which may mitigate the risk of self-control failure (Carey et al., 2019). These constructs suggested that LoC is influenced not only by individual predispositions, but also by situational factors. In our research, we focused on differences in individual dimensions of human diversity. Our assumptions were based on the premise that certain elements that shape personality diversity may influence how individuals perceive their LoC.

Our results confirmed that the relationships between locus of control and individual or situational factors are complex and cannot be predicted based on simple characteristics. We assumed that the result on the LoC scale could be influenced by age, gender, type of work experience, or marital status. These findings correspond with the results reported by the authors (Arkorful & Hilton, 2022; Sakotic-Kurbalija et al., 2017; Verwijs & Russo, 2023). Hypothesis RH1, which assumed a significant difference between year of birth and LoC, was not confirmed (p = 0.541, which is higher than the required value of $p \leq 0.05$, which confirms the statistical insignificance of the difference between the investigated variables), indicating that there is no relationship between age and preferred LoC in our sample. This

result is interesting considering the findings from previous studies, according to which age or experience can be related to higher internal control scores, especially among managers (Harris & Hartman, 1992).

Hypothesis RH2, that there is a difference between gender and LoC, was also not confirmed. Although some research points to possible differences in conformity or perception of control depending on gender (Maadal, 2020), our results do not confirm this relationship (p = 0.257, which means that it is higher than the required value of $p \leq 0.05$ and thus confirms the statistical insignificance of the difference between the investigated variables). Hypothesis RH4 on the relationship between current marital status and locus of control was also not supported (p = 0.205, which is higher than the required value of $p \leq 0.05$, which confirms the statistical insignificance of the difference between the investigated variables). This suggests that in our sample, marital status is not a significant factor influencing preferences in the area of control over life situations. On the contrary, hypothesis RH3 was confirmed (p = 0.042, and thus is lower than the required value of $p \leq 0.05$, which confirms the statistical significance of the relationship between the investigated variables), which demonstrated a slightly statistically significant relationship between current job classification and LoC. This result corresponds to the findings that people with different work experience or positions in the organizational hierarchy may perceive control over their own outcomes differently (Harris & Hartman, 1992; Heinicke et al., 2016). This is consistent with the findings that LoC can be influenced by past experience, as experience with a certain type of supervisor or leadership style can influence how an individual perceives their ability to influence the outcome of their work or achieve work success. This may subsequently affect the preference for choosing a job in which the superior demonstrates a preferred management style, i.e., more authoritative for employees with external LoC and more participative for individuals with internal LoC. These findings may be beneficial for the field of management, since dissonance between employee expectations and the approach of the superior is often a reason for their resignation, leaving the organization.

Our findings also follow the broader framework of external locus of control research, which points to its multidimensional connection with various psychological factors, behavior, and cultural contexts. In summary, it can be stated that LoC as a psychological construct is closely related to the ability to self-control, perception of self-efficacy, and preferences of individuals in the area of regulating their behavior. At the same time, it is sensitive to environmental influences, job classification, and cultural and social factors. Our results confirm this complexity, pointing, in particular, to the connection between work experience and LoC, while individual characteristics such as age, gender, or marital status did not appear to be significant determinants in our sample.

7. Conclusions

Based on the obtained results, it can be concluded that age, gender, and marital status do not show a statistically significant relationship with the preferred locus of control, which indicates that these demographic variables are not a decisive factor influencing the perception of control over life situations in our sample. On the contrary, the results confirmed a statistically significant, moderately strong correlation between the current job title and the result based on the LoC scale. This points to a possible connection between the professional status of an individual and his tendency to attribute control over situations to himself or external circumstances. The findings also correspond to theoretical premises according to which higher job positions can support an internal locus of control. The results expand knowledge about the factors influencing LoC and underline the importance of work environment experiences in the context of the perception of control.

Theoretical implications: These findings contribute to the ongoing theoretical debate about the dynamic nature of LoC and its sensitivity to contextual and experiential variables. They support existing models that suggest LoC is not a static personality trait but a construct shaped by situational inputs, such as one's role and responsibilities in the workplace. The results also invite further exploration of the mechanisms through which professional experience influences perceived control and psychological functioning. Specifically, the findings are consistent with social cognitive theory, which posits that self-efficacy and perceived control are shaped through experience, social modeling, and feedback. It also suggests that job position may act as a key experiential variable reinforcing these processes. Furthermore, the results challenge the exclusively trait-oriented understanding of internal locus of control, as they suggest that interventions targeting workplace structure and job role clarity can significantly influence this construct over time.

Practical implications: Organizations can use knowledge about the connection between job title and internal LoC to support employee development, build autonomy, and increase performance. Understanding how work roles shape perceptions of control can help design more effective leadership development programs, training interventions, and motivation strategies. In career counselling and occupational psychology, these insights can be applied to better assess client needs and tailor support for improving resilience, decision-making, and stress management. From a managerial perspective, specific measures can include the introduction of structured job rotation programs that expose employees to diverse responsibilities. Another measure can include providing targeted mentoring for employees in positions with low autonomy and introducing mechanisms that allow for effective feedback and strengthen employees' sense of influence over results. Human resources departments, in collaboration with management, could also develop performance appraisal systems that take into account not only the results achieved, but also proactive problem solving, which ultimately strengthens the internal locus of control. In addition, leadership training can include support for employees' independent decision-making, such as participatory decision-making, communication oriented towards strengthening competencies, and clear delegation of authority.

The presented research has several limitations that need to be taken into account when interpreting the results. First of all, the research sample consisted exclusively of respondents from Slovakia, which limits the possibilities of generalizing the findings to other cultural and social environments. Cultural norms, societal values, and labor market conditions can significantly influence individuals' perception of control and their responses to internal or external stimuli. For example, locus of control may manifest differently in collectivist versus individualist cultures or in societies with varying levels of economic stability and institutional trust. As a result, the conclusions drawn from this study may not fully apply to populations in different national or regional contexts. Another limitation is the unbalanced generational representation of respondents, which could have affected the results in relation to the age variable. The research also worked with a relatively limited sample of 384 respondents, which reduces the statistical power of the analyses and may limit the accuracy of the conclusions. Another limitation of the research is the uneven representation of respondent generations (a predominance of Generation Z and Y), which may have an impact on the presented findings. This generational imbalance could limit the generalizability of the results, as it has a direct impact on career experiences, reactions, flexibility, and dynamism. Considering the above factors, it is recommended to supplement the research sample, which should be broader and more diverse. It would be appropriate to expand the research to the international level in order to verify whether the relationship between professional status and LoC is also manifested in other cultures with different social norms and work structures.

Since the current job title was the only variable with a statistically significant relationship to locus of control, this opens up the possibility of examining the impact of managerial approaches on the formation of LoC in employees. It is likely that leadership style, the degree of delegation of responsibility, or the provision of autonomy can significantly influence whether an employee perceives control over situations as internal or external. This also implies that employees' expectations of management, such as the need for a directive versus supportive management style, may be conditioned by their LoC. Future research could therefore focus on the relationship between LoC and preferred management styles, as well as on the possibilities of influencing it through organizational interventions. Future research could also examine other factors, such as the level of education, type of work sector, or personality traits that may interact with the perception of control. Likewise, quantitative research could be complemented in the future with qualitative methods such as interviews or case studies, which could yield a deeper understanding of the mechanisms by which work experience influences LoC. Future studies could also benefit from using longitudinal research designs to observe changes in LoC over time or from conducting cross-cultural comparisons to examine the influence of different societal contexts. In future research, we want to look at the locus of control from a different perspective and focus on how it influences people's behavior in critical situations. This could include examining its role in work environments and job positions with different levels of stress, in crisis decision-making, or in adapting to rapid organizational change. In addition, future work could examine how different organizational interventions (such as leadership coaching or job design changes) influence changes in LoC and whether these effects vary across industries, career stages, or demographic groups.

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Article

Analysis of Labour Market Expectations in the Digital World Based on Job Advertisements

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Abstract: Job advertisements play a key role in human resource management as they are the first contact between employers and potential employees. A well-written job advertisement communicates not only the requirements and expectations of the position but also the culture, values, and goals of the organisation. Transparent and attractive advertisements increase the number of applicants and help to select the right candidates, leading to more efficient recruitment and selection processes in the long run. From a human resource management perspective, effective job advertising can give organisations a competitive advantage. Continuous changes in the labour market and technological developments require new competencies. Digitalisation, automation, and data-driven decision-making have brought IT, analytical, and communication skills to the fore. There is a growing emphasis on soft skills such as problem solving, flexibility, and teamwork, which are essential in a fast-changing work environment. Job advertisements should reflect these expectations so that candidates are aware of the competencies and skills required for the position. The aim of the study is to carry out a cross-country comparative analysis for a few pre-selected jobs based on data extracted from the CEDEFOP database as it is assumed that there are differences between countries in the European Union in terms of the expectations of workers for the same jobs.

Keywords: competencies; job advertisement; employees

1. Introduction

Since the economic crisis of 2008, one of the main objectives of the European Union's economic policy has been to increase employment in order to achieve both economic stability and growth. Thanks to successful economic policy reforms over the past decade, the number of people in employment in the European Union now exceeds 200.6 million. This means an employment rate of 75.6% in May 2025. For each country, it is important to examine and pay attention to the potential labour supply for policymakers. The potential labour reserve can be divided into four groups: the economically inactive who would like to work but have not looked for work, or the economically inactive who have looked for work but for some reason have not been able to find a job, or the unemployed or underemployed (Tóth et al., 2023). The available labour reserve is low and concentrated in Central and Eastern European countries, with more than three-quarters of new entrants to the labour force being either young women with low-to-medium skills or women over 55 with upper secondary education (Götz & Jankowska, 2020). The ageing of society is also a serious problem for European countries. In the coming decades, the number of people of working age is expected to fall by several hundred thousand. This will also make the situation for employers very difficult in the future (Piątkowski, 2020; Csehné Papp & Hajós, 2011).

The current and future evolution of the labour market is influenced by several factors, including technological developments, digitalisation, economic trends, demographic changes, and social changes. Poland is one of the most dynamically developing economies in the European Union; however, in terms of technology, it lags behind the Czech Republic and Germany. This is due to the structure of the economy and the position of Polish companies within value chains. In Poland, very small enterprises dominate, often operating in local markets, and for them, technological investments pose a significant challenge. Poland builds its competitive advantage on low unit labour costs rather than on technological potential (Hetmańczyk, 2024).

Technological developments are increasingly dominating the labour market today and have caused several changes in job roles and job tasks. The spread of automation and artificial intelligence is leading to the transformation of some jobs and the emergence of new ones in others. Among the positive effects of digitalisation, the most cited is the increase in efficiency and productivity as software allows tasks to be completed much faster and reduces the administrative burden (Adams, 2018). Atypical forms of work (e.g., home office and flexible working hours) have spread faster than before thanks to digitalisation processes. The rapid development of digital technologies means that workers need to continuously improve their skills to remain competitive in the labour market (Mosteanu, 2020).

2. Literature Review

2.1. The Relationship Between Digitalisation and the Labour Market

One of the defining social and economic processes of the 21st century is digitalisation, a phenomenon that is fundamentally transforming the world of work, the structure of the economy, and the expectations placed upon the workforce (Javaid et al., 2023). The globalisation of labour markets, combined with the rapid advancement of technological innovation, demands new skill sets and a heightened level of adaptability from employees. Digitalisation not only gives rise to new occupations but also contributes to the transformation or obsolescence of many traditional professions (Rainnie & Dean, 2020).

Digitalisation refers to the conversion of analogue information into digital formats, as well as the proliferation of technologies, processes, and business models built upon this transformation (Omol, 2024). It constitutes not merely a technological shift but also a structural and functional transformation within both economic and societal systems. The integration of artificial intelligence, machine learning, robotics, automation, and big data analytics is rendering production and service processes more efficient, faster, and more flexible (Rashid & Kausik, 2024; Sjödin et al., 2023).

The impact of digitalisation is most pronounced in the restructuring of labour demand and supply (Feng et al., 2024). The declining labour needs in traditional industries are being counterbalanced by the growth of sectors that require information technology, engineering, and other forms of digital expertise. Simultaneously, there is a growing emphasis on so-called soft skills—such as problem-solving, critical thinking, collaboration, and adaptability—which are becoming increasingly valuable alongside technical knowledge (Li et al., 2024).

Because of the digitalisation, labour market expectations are undergoing a profound transformation (Richiardi et al., 2025). Employers are placing increasing importance on digital competencies, which have become fundamental not only in IT-related professions but across virtually all areas of employment. They expect workers to quickly acquire new technologies, engage in autonomous learning, and adapt flexibly to changing demands. These evolving expectations necessitate a corresponding response from educational and

vocational training systems, which must provide knowledge and skills that are relevant and aligned with contemporary labour market needs.

Nevertheless, the benefits of digitalisation are not equally distributed across society. The so-called digital divide—which refers to disparities in access to and ability to use digital technologies—can exacerbate labour market inequalities (Heeks, 2022). Individuals and groups with limited access to digital tools or with lower levels of digital literacy are particularly vulnerable to the disruptive effects of technological change.

At the same time, digitalisation presents opportunities to foster inclusive economic growth. Remote work, online education, and digital entrepreneurship can enable the participation of social groups that have previously faced barriers to labour market integration due to geographical location, health issues, or family responsibilities. While technological change generates new opportunities, it also brings challenges—especially in terms of workforce adaptability and ensuring that individuals possess the appropriate level of education and qualifications.

2.2. The Importance of Competencies for Intellectual Jobs

To excel in intellectual jobs in the labour market, a variety of competencies are essential. These competencies can be broadly categorised into cognitive, non-cognitive, and technical skills, each playing a crucial role in different contexts. The cognitive skills are as follows: problem-solving (this is a critical skill across various sectors, especially in technology-rich environments; it involves the ability to address complex issues and find effective solutions), creative thinking (the ability to think outside the box and generate innovative ideas is increasingly valued), and planning and organisation (effective planning and organisational skills are necessary for managing tasks and projects efficiently) (Grigorescu et al., 2022; Korshunov et al., 2023; Lekashvili & Jamagidze, 2023).

The non-cognitive skills are the following: communication (strong language and communication skills are frequently demanded by employers as they are essential for effective collaboration and information exchange), adaptability (the ability to adapt to changing environments and new challenges is highly valued, especially in dynamic and innovative sectors), interpersonal skills (these include the ability to work well with others, which is crucial for teamwork and maintaining professional relationships) (Heijke et al., 2003; Pater et al., 2019; Poszytek et al., 2023).

In the literature, the concept of Industry 4.0 Competencies is becoming more and more common (Müller et al., 2018). The concept of competencies 4.0 highlights the need for skills that align with the demands of Industry 4.0, including advanced technical and cognitive skills. Industry 4.0 Competencies refers to the knowledge, skills, and abilities required to effectively operate, manage, and innovate within the context of Industry 4.0—the fourth industrial revolution characterised by the integration of cyber–physical systems, IoT, AI, and advanced data analytics in manufacturing and industrial processes. These competencies are generally grouped into three main categories: Technical, Methodological, and Social/Personal skills (Vrchota et al., 2020; Pokrovskaia et al., 2021; Poszytek et al., 2023).

Intellectual jobs in the labour market require a blend of cognitive, non-cognitive, and technical skills. Continuous learning, practical experience, and flexible education systems are key to developing these competencies and ensuring that individuals are well prepared to meet the demands of modern and future job markets.

The digital transformation of the economy is reshaping the labour market in several significant ways. There is a growing demand for workers with advanced qualifications and digital competencies. High-tech companies particularly need employees with ICT skills to manage digital technologies and knowledge systems (Ligonenko et al., 2022).

The rise of automation and AI is leading to structural technological unemployment, where certain jobs are replaced by machines (Dzobelova et al., 2023).

Digital labour platforms are becoming more prevalent, offering flexible work opportunities but also presenting challenges such as job instability, exploitation, and reduced social security (Graham & Anwar, 2019). These platforms simplify interactions between workers and clients, boosting productivity but also necessitating new regulatory frameworks to protect workers.

Developing digital skills is crucial for the future labour market. Higher levels of digital competencies improve the quality of life and job satisfaction for workers. Educational systems must focus on both technical and soft skills to prepare workers for the digital economy (Dieguez, 2024; Ojan et al., 2025).

2.3. Differences in Job Advertising Across the EU

Job vacancies for intellectual job managers in the European Union (EU) exhibit significant differences influenced by various factors such as cultural differences, national legislation, and market characteristics. These factors impact the requirements, recognition of qualifications, and career progression for managers across different EU member states (Stek et al., 2022).

Research on managers' career factors in the UK, Germany, Malta, Spain, and Lithuania revealed both similarities and divergences. For instance, knowledge of languages is crucial in Spain, Lithuania, and Malta but less so in the UK and Germany. Geographical mobility is more important in the UK and Germany compared to Malta (Zakarevičius & Žukauskas, 2008).

Directive 2005/36/EC and Directive 2013/55/EU aim to extend the rights of employees and self-employed persons to practice their profession across different EU member states. However, differences between regulated and unregulated professions and national legislation pose challenges to labour mobility (Reci & Kokaj, 2023).

Establishing transparency and comparability of qualifications across member states is vital for the free movement of labour. The European Qualifications Framework aims to address these issues, but differences in how qualifications are understood nationally and trans-nationally persist (Brockmann et al., 2011).

The European Working Conditions Survey highlights diversity in job quality indicators across EU countries. Factors such as skills utilisation, task discretion, and employee participation vary significantly, impacting job vacancies and career progression for intellectual job managers (Kornelakis & Veliziotis, 2018).

Public spending on research and development positively impacts employment in creative industries. This sector employs a significant portion of the EU's economically active population, highlighting the importance of public support for science and research (Baculakova & Harakalova, 2017).

Job vacancies for intellectual job managers in the EU are shaped by a complex interplay of cultural differences, legislative frameworks, and market characteristics. These factors result in varied job requirements, recognition of qualifications, and career progression opportunities across different member states. Understanding these differences is crucial for effective job search and career development in the EU.

2.4. Research Questions

Our research group focuses on how employer expectations have changed in recent years. We primarily analyse managerial, decision-support, and administrative job roles. Our investigation centres on identifying where and how today's major trends and significant events (such as digitalisation and Generation Z) are reflected. In our study, we seek to answer three research questions:

- RQ1: What similarities and differences can be observed between managerial and administrative business occupations across EU countries? If we did not know the exact position, could we determine whether a job advertisement refers to a managerial or a subordinate role based solely on the competencies listed in the ad?
- RQ2: Among the competencies listed in job advertisements, which can be considered general, and which are occupation-specific across EU countries?
- RQ3: Are there country-specific characteristics that can be identified in the examined occupations?

3. Materials and Methods

3.1. Description of the Database

To answer these research questions, we collected data from the website of CEDEFOP. CEDEFOP is the European Union's decentralised agency specialised in vocational education and training. It supports EU policymakers in developing and implementing vocational education policies. It monitors labour market trends and serves as a bridge between the world of learning and the world of work. A joint project of CEDEFOP and Eurostat is Skills-OVATE. Skills-OVATE provides information on job vacancies and skills demanded by employers, based on online job advertisements (OJAs) in 27 EU countries and five other European countries. The data are collected from thousands of sources, including private job portals, public employment service portals, recruitment agencies, and company websites. The database covers millions of OJAs across four quarters and is updated four times a year.

This study uses data from the period Q2 2024 to Q1 2025. Skills-OVATE classifies skills based on ESCO version 1.2.0 and occupations based on ISCO-08. In ESCO v1.2.0, the classification of competencies follows a hierarchical structure. The framework includes the following four main categories: Knowledge, Language skills and knowledge, Skills, and Transversal skills. These categories can be further subdivided. The structure and content of the categories were accessed from https://esco.ec.europa.eu/en/classification/skill_main (accessed on 10 June 2025). The classification and content are under continuous development. For our research, we used the categorisation that was current as of 10 June 2025.

To help understand our analysis, we find it important to present the content of the transversal skills category. "Learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity." (https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary/transversale-faehigkeiten-und-kompetenzen (accessed on 10 June 2025))

ESCO identifies six main categories of transversal skills and competencies:

- Core skills and competencies;
- Thinking skills and competencies;
- Self-management skills and competencies;
- Social and communication skills and competencies;
- Physical and manual skills and competencies;
- Life skills and competencies.

The database categorises occupations based on the current version of the International Classification of Occupations, i.e., ISCO-08. In our work, we, therefore, adopt the ISCO definition of an occupation. According to this, "The concept of occupation is defined as a set of jobs whose main tasks and duties are characterised by a high degree of similarity."

The occupational groups examined are the following:

- 121. Business services and administration managers (e.g., Finance Managers, Human Resource Managers, Policy and Planning Managers, and Business Services and Administration Managers Not Elsewhere Classified).

- 241. Finance professionals (e.g., Accountants, Financial and Investment Advisers, and Financial Analysts).
- 242. Administration professionals (e.g., Management and Organisation Analysts, Policy Administration Professionals, Personnel and Careers Professionals, and Training and Staff Development Professionals).
- 331. Financial and mathematical associate professionals (e.g., Securities and Finance Dealers and Brokers, Credit and Loans Officers, Accounting Associate Professionals, Statistical, Mathematical and Related Associate Professionals, and Valuers and Loss Assessors).
- 333. Business services agents (e.g., Clearing and Forwarding Agents, Conference and Event Planners, Employment Agents and Contractors, Real Estate Agents, and Property Managers).
- 334. Administrative and specialised secretaries (e.g., Office Supervisors, Legal Secretaries, Administrative and Executive Secretaries, and Medical Secretaries).

The most recent data download was carried out on 11 June 2025. We downloaded data for the EU27 countries, based on the ESCO skill classification, at the 3-digit ISCO and level 3 ESCO skill depth. The data were downloaded in two phases. For answering RQ1 and RQ2, we downloaded data for the six occupational groups across all EU member states combined. Competencies were retrieved at both level 0 and level 3. The dataset includes, at the 3-digit ISCO and level 3 ESCO skill depth, the number of online job advertisements (OJAs) and the number of OJAs within each occupational group that mentioned a given skill. The second dataset was used for addressing RQ3. In this query, we repeated the first data request with the exception that the data were collected separately for each EU member state, rather than for the EU as a whole. For both datasets, we divided the number of mentions by the number of OJAs, thus obtaining the mention ratio. The available period for download was Q2 2024 to Q1 2025. The number of available OJAs during the examined period is shown in Table 1.

Table 1. Number of online job advertisements surveyed by country and occupation.

Country Code/Occupation Code	OC121	OC241	OC242	OC331	OC333	OC334	Total
AT	2681	2971	5170	5091	2709	5773	24,395
BE	6870	12,297	18,029	23,163	10,886	19,275	90,520
BG	277	337	957	988	726	174	3459
CY	7	11	13	15	13	11	70
CZ	1536	4973	1415	3551	1571	1795	14,841
DE	44,499	59,150	101,502	63,267	40,159	141,584	450,161
DK	4144	1321	2764	3568	1583	3006	16,386
EE	54	33	286	225	83	148	829
EL	516	1038	695	869	1848	1101	6067
ES	1921	7327	3726	3885	22,390	10,830	50,079
FI	12	22	30	13	12	12	101
FR	50,253	57,862	46,547	146,223	112,139	92,803	505,827
HR	386	92	202	237	272	365	1554
HU	2890	2627	1645	6610	1669	3831	19,272
IE	748	443	798	255	262	893	3399
IT	5773	6223	14,922	8812	14,901	32,746	83,377
LT	2018	1937	1189	2227	1635	1907	10,913
LU	7	3	5	25	5	11	56
LV	182	509	428	570	189	201	2079
MT	352	528	213	254	213	326	1886
NL	1930	1418	4849	3215	5066	5229	21,707
PL	9895	13,411	7297	9170	6112	2158	48,043

Table 1. *Cont.*

Country Code/Occupation Code	OC121	OC241	OC242	OC331	OC333	OC334	Total
PT	668	730	1691	1065	1780	884	6818
RO	19	43	54	62	124	80	382
SE	12,576	2443	10,092	11,408	2652	6059	45,230
SI	199	83	311	337	81	105	1116
SK	2141	1665	2389	4373	2378	2012	14,958
Total	152,554	179,497	227,219	299,478	231,458	333,319	1,423,525

3.2. Limitation of the Research

Occupations can be extracted from the database based on at most the first three digits of the ISCO code. As a result, we are only able to examine groups of occupations, not specific individual occupations. This naturally represents a limitation of our research. In our study, we compared six occupational groups from the first three ISCO major groups (1. Managers, 2. Professionals, 3. Technicians and Associate Professionals).

We analysed data from over 1.4 million job advertisements (Table 2). Of these, 32% were from Germany and 36% from France. The remaining 25 EU countries accounted for 32% of the advertisements. In total, 10.7% of the ads targeted managerial positions, 28.6% were for professional roles, and 60.7% for technicians and associate professionals. A limitation of our research is that the distribution of available OJAs by country does not reflect the actual employment structure of the countries studied. The most significant discrepancies can be observed in the cases of Romania and Finland. In 2023, the number of employed persons aged 15–64 was 2.532 million in Finland and 7.614 million in Romania. However, the number of Finnish OJAs was only 101, while the number of Romanian advertisements was 382. Our results, therefore, must be interpreted with this limitation in mind.

Table 2. Number of competencies tested by country and occupation.

Country Code/Occupation Code	OC121	OC241	OC242	OC331	OC333	OC334
AT	69	75	77	79	76	86
BE	99	95	112	122	119	137
BG	36	47	44	38	55	28
CY	7	48	12	28	26	29
CZ	53	69	54	55	53	48
DE	157	146	175	153	161	169
DK	82	66	83	85	78	99
EE	10	10	15	4	4	6
EL	40	49	41	34	64	41
ES	68	86	78	71	122	89
FI	24	26	35	19	13	21
FR	171	161	175	196	200	215
HR	28	29	8	26	30	27
HU	60	74	62	76	73	59
IE	52	59	54	42	69	68
IT	83	89	94	87	113	94
LT	52	73	47	57	47	53
LU	36	18	16	24	19	24
LV	22	35	30	37	32	25
MT	43	52	40	40	51	47
NL	77	86	104	104	129	119
PL	98	98	95	98	108	71

Table 2. *Cont.*

Country Code/Occupation Code	OC121	OC241	OC242	OC331	OC333	OC334
PT	51	64	64	58	71	57
RO	23	43	42	34	54	35
SE	113	94	110	123	100	116
SI	27	15	24	32	17	15
SK	58	77	70	76	69	62

The number of competencies covered per occupation is as follows: OC121: 224, OC241: 218, OC242: 242, OC331: 246, OC333: 257, and OC334: 264. An additional research limitation is that, in the case of several countries, the job advertisements included only a few of the competencies listed in the ESCO version 1.2.0. In the case of Estonia, six occupations, and in the case of Luxembourg, five occupations featured fewer competencies than 10% of those associated with the respective occupation in ESCO. For Finland and Slovenia, there are three such occupations each. Finally, our research possibilities are further limited by the fact that we were only able to download data aggregated over four quarters from the website https://www.cedefop.europa.eu/en/tools/skills-online-vacancies/occupations/skills (accessed on 10 June 2025), which means we are unable to conduct any time-based comparisons.

3.3. Description of the Methods Used

To answer RQ1, we conducted multidirectional association strength analyses. We examined the correlation values between occupations based on Pearson's correlation coefficient, using the average values across the EU-27. We performed cross-tabulation analysis between ESCO-1 levels (1. Managers, 2. Professionals, 3. Technicians and Associate Professionals) and the main competency groups (knowledge, language skills and knowledge, skills, transversal skills), as well as between the main competency groups and the six occupational groups included in the study. During the cross-tabulation analysis, we conducted Chi-square tests and calculated Cramér's V as a measure of association strength.

Using ANOVA tests, we calculated the F-test and Eta coefficient to measure the strength of association between the proportion of mentions and (1) ISCO-1 levels, (2) main competence groups, and (3) occupational groups. Analysis of variance is applicable in the case of mixed relationships. A mixed relationship is when we examine the connection between qualitative/categorical and quantitative variables. ISCO-1 levels, main competence groups, and occupational groups were considered as qualitative variables. In the case of mixed relationships, the measure of association is the Eta (η) coefficient. This coefficient ranges between 0 and 1, where 0 indicates no relationship and 1 indicates a functional relationship. In our calculations, we considered the strength of association as weak up to 0.3, moderate between 0.3 and 0.7, and strong above 0.7. The relationship analyses were carried out using SPSS 30.0 and Microsoft Excel 365.

In our cluster analysis, we included the examined occupational groups as variables and aimed to cluster the competencies. For this, we chose the method of hierarchical cluster analysis, specifically Ward's method. In hierarchical clustering, it is not necessary to define the number of clusters in advance. The number of clusters was determined using a dendrogram. Since we worked with more than two variables in all cases, we used descriptive statistics to characterise the clusters (Székelyi & Barna, 2002; Sajtos & Mitev, 2007; Jánosa, 2015).

To answer RQ3, we examined whether there was any correlation between the main competence groups for each of the six occupational groups. Using cross-tabulation analysis,

we examined how competencies are distributed across countries by competence groups. Independence tests were conducted in SPSS for these. The strength of association was assessed using Cramer's V.

As a first step in reducing the number of variables, we chose the method of factor analysis. During the runs, we checked the following threshold criteria:

- The value of Pearson correlation should be at least 0.3;
- The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) should be above 0.5;
- The diagonal values of the Anti-Image Correlation Matrix should be above 0.5;
- The cumulative explained variance should be at least 60%.

In the Bartlett's test, we considered a significance level of 0.05 as the critical threshold. The limited number of countries, as a finite and small sample size, restricted the number of variables that could be included in the principal component analysis. As a result, we were unable to group the competencies into factors while meeting the above conditions.

In the second step, we analysed each main competence group separately for each occupational group. For the knowledge, skills, and transversal skills categories, we determined the frequency of mention for each competence within each main group (see Table 3).

Table 3. Summary of the most frequently mentioned competencies by occupational group.

Occupational Group\Competence	Personal Skills and Development (Knowledge)	Accounting and Taxation (Knowledge)	Accessing and Analysing Digital Data (Skills)	Demonstrating Willingness to Learn (Transversal Skills)
OC121	1380.25%		1387.40%	1632.63%
OC241	1378.33%		1301.49%	1589.05%
OC242	1240.91%		1019.02%	1597.74%
OC331		1183.39%	849.91%	1230.89%
OC333	1121.36%		814.27%	1270.96%
OC334	821.83%		1053.97%	1431.43%

Personal skills are defined by the ESCO classification based on the effects on an individual's abilities. On this basis, it includes, among others, the following: Argumentation and presentation, Assertiveness training, Communication skills, Co-operation, Development of behavioural capacities, Development of mental skills, Job-seeking programmes, Parenting courses, Public speaking, Self-esteem skills, Social competence, and Time management.

By ESCO, accounting and taxation is the study of maintaining, auditing, and recording financial transactions. Programmes and qualifications with the following main content are classified here: Accounting, Auditing, Bookkeeping, Tax Accounting, and Tax Management. Accessing and analysing digital data means using digital tools to browse, search, filter, organise, store, retrieve, and analyse data, information, and digital content, to collaborate and communicate with others, and create and edit new content. Finally, by demonstrating willingness to learn, ESCO means showing a positive attitude towards new and challenging demands and taking steps to learn from difficulties. A hierarchical cluster analysis was conducted using Ward's method, selecting the competencies with the highest overall value as cluster variables from each competence cluster. We used the tools of descriptive statistics to look at the mean, standard deviation, and number of elements for the resulting clusters.

4. Results

The CEDEFOP database contains 90 types of knowledge, 263 skills, and 40 different transversal skills and competencies for the period 2024Q2–2025Q1. Only one instance of language skills and knowledge appears. The data for the occupational groups that we examined are presented in Table 4. In the analysis of the six major groups, we examined a

total of 84 types of knowledge, 196 types of skills, and 34 different transversal skills and competencies. Thus, in each major competence category, at least 75% of the competencies are represented in our research as well.

Table 4. Number of competencies by occupational group and competence category.

ESCO_Hier_Level_0	OC121	OC241	OC242	OC331	OC333	OC334
knowledge	70	65	70	75	74	78
language skills and knowledge	1	1	1	1	1	1
skills	130	125	140	142	155	157
transversal skills and competencies	23	27	31	28	27	28

In those major competence categories where the number of competencies is significantly higher, we can observe very low average values and very high relative standard deviations. In the case of language, since only one competence is assigned to each job, the average occurrence value is much higher, and the standard deviation is minimal. Based on Table 5, it can be concluded that the more competencies a competence category contains, the lower its average mention value. Larger competence categories are associated with higher relative standard deviations.

Table 5. Average value, standard deviation, and relative standard deviation of mention rates by competence category.

Category	Mean	N	Std. Deviation	Relative Standard Deviation (RSD)
knowledge	0.0359	432	0.1001	279.0%
language skills and knowledge	0.4677	6	0.0315	6.7%
skills	0.0284	849	0.0664	234.1%
transversal skills and competencies	0.1113	164	0.1700	152.8%

There is a moderate (H = 0.071) but non-significant (p = 0.203) relationship between competencies and occupational groups. In this case, the average mention values per occupational group are very similar. For OC334, the average mention rate is below 3%, while for OC121, it is above 5%. For the other occupational groups, the average values range between 4 and 5%. The standard deviations are of a similar magnitude, typically around 0.1. In all cases, the relative standard deviation exceeds 200%.

As previously mentioned, our first research question was as follows: What similarities and differences can be observed between managerial and administrative/business support occupations across EU countries? If we were not aware of the specific job title, could we determine based on the competencies listed in a job advertisement whether the position is a managerial or non-managerial role?

To answer this question, we examined the strength of the relationship between competence categories and occupational groups. The relationship between competence categories and job hierarchy levels is very weak (Cramer's V = 0.022) and non-significant (p = 0.965). Due to the low number of language-related skills, the assumptions for independence testing are not met. Therefore, our computational result is not suitable for drawing general conclusions—it is only interpretable within the context of this specific dataset. The frequency of occurrence of individual competencies within competence categories, and across job levels (from manager to administrator), shows no meaningful relationship. Consequently, it is not possible to determine the job level being advertised based on the competence categories used in the examined postings.

Similarly, the relationship between competence categories and occupational groups is also very weak (Cramer's V = 0.036) and non-significant (p = 1.000). Here, too, the

assumptions for independence testing are not fulfilled due to the low number of language-related skills.

In the mixed-relationship analysis, our quantitative variable was the frequency of competence mentions. The qualitative variables were job level and occupational group. The relationship between competence mention frequency (quantitative) and job level (qualitative) is very weak (H = 0.071) and non-significant (p = 0.123). Likewise, the relationship between competence mention frequency and occupational groups is also very weak (H = 0.054) and non-significant (p = 0.203). Although we can only make statements about the given dataset, we can conclude the following:

- Competencies cannot be assigned to different job levels.
- Competencies cannot be assigned to specific occupational groups.

Therefore, it is not possible to determine either the job level or the occupational group based on the competencies listed. Based on the 1.4 million job advertisements analysed, there is no difference in the competencies expected for managerial versus non-managerial positions.

Which competencies are general, and which are occupation-specific? In the examination of RQ2, we attempted to reduce the occupational groups using principal component analysis (PCA). The result was a single component with an explanatory power of 84%. However, cluster analysis cannot be performed using only one quantitative variable. Therefore, in our cluster analysis, we treated all six occupational groups as separate variables. Based on this, we were able to classify the competencies into four clusters. Naturally, this was only possible for those competencies that appeared in all occupational groups. Out of the 84 types of knowledge, 54 were included in the clusters; out of the 196 types of skills, 90; and out of the 34 different transversal skills and competencies, 21 were included. The average values of each cluster by occupational group are shown in Table 6.

Table 6. Average values of clusters by occupational group.

Clusters	Number/Case	Average/OC121	Average/OC241	Average/OC242	Average/OC331	Average/OC333	Average/OC334
1	9	0.265	0.267	0.210	0.399	0.199	0.172
2	122	0.010	0.012	0.012	0.008	0.010	0.011
3	29	0.138	0.102	0.110	0.069	0.139	0.067
4	6	0.576	0.492	0.543	0.416	0.416	0.392
Total	166	0.066	0.059	0.059	0.054	0.058	0.043

Cluster 1 includes competencies with an average mention frequency three to seven times higher than the overall average. These are accounting and taxation, computer use, work skills, conducting gaming activities, managing, gathering and storing digital data, performing general clerical and administrative tasks, using digital tools for collaboration and productivity, and showing initiative and working efficiently. Due to the competencies included, we propose naming this cluster High-Level Efficiency and Digital Competencies. Cluster 4 contains those competencies whose occurrence frequency is at least seven times the average. The competencies included in this cluster and their average mention rates are shown in Table 7. It can be observed that, as ESCO levels decrease, the mention frequency of a given competence typically also decreases. We have named the fourth cluster Core Cross-cutting Competencies. These are the competencies that employers expect regardless of occupational group.

Cluster 2 is characterised by a dominance of skills. Of the 122 competencies included in the cluster, 57% are skills. The proportion of knowledge is also above average. The most frequently mentioned knowledge items are database and network design and administration, food processing, and law. The most frequently mentioned skills include accompanying

and welcoming people, allocating and controlling physical resources, installing interior or exterior infrastructure, monitoring and evaluating the performance of individuals, performing artistic or cultural activities, purchasing goods or services, teaching and training, and weighing. Among these, law, accompanying and welcoming people, allocating and controlling physical resources, and teaching and training have mentioned rates exceeding 2% across all occupational groups. Based on its characteristics, this cluster is proposed to be named "A Little Knowledge and Skill Go a Long Way".

Table 7. Cluster competencies and average mention rates.

Esco_Hier_Level_0	Esco_Hier_Level_3	OC121	OC241	OC242	OC331	OC333	OC334
knowledge	management and administration	0.650	0.443	0.514	0.324	0.398	0.088
knowledge	personal skills and development	0.570	0.448	0.545	0.139	0.391	0.273
language skills and knowledge	languages	0.478	0.477	0.512	0.453	0.417	0.470
skills	accessing and analysing digital data	0.557	0.454	0.451	0.414	0.372	0.374
transversal skills and competencies	collaborating in teams and networks	0.538	0.492	0.526	0.571	0.406	0.492
transversal skills and competencies	demonstrating willingness to learn	0.663	0.638	0.706	0.594	0.511	0.657

Cluster 3 features a prominent role of non-knowledge-based competencies. This cluster is dominated by competencies related to communication and creativity. In all occupational groups, the following competencies have a mention rate above 5%: economics (as knowledge) and communicating with colleagues and clients; communication, collaboration, and creativity; developing solutions; managing budgets or finances; planning events and programmes (as skills). Additionally, the following transversal skills and competencies appear to cope with stress, leading others, taking a proactive approach, and thinking creatively and innovatively.

Are the excluded competencies occupation-specific? In the case of managerial job vacancies, six competencies only appear in this occupational group. Three of these competencies have a mention rate of more than 2%. Within the skills category are the following:

- Complying with health and safety procedures (17.0%);
- Developing recipes or menus (2.6%);
- Promoting products, services, or programmes (2.8%);
- Records, reports, or budgets (2.2%).

Among non-managerial occupations, there is only one competence that is exclusive to a single occupational group and has a mention rate above 2%. This is found in group 242. Administration professionals: transversal skill and competence—instruct others, with a mention rate of 2.7%. Some competencies appear in multiple occupational groups but only exceed the 2% threshold in one of them. For group 242, administration professionals, such as competencies, include the following:

- Advising on educational or vocational matters (skills) (2.6%);
- Operating machinery for the manufacture and treatment of textiles, fur, and leather products (skills) (2.2%);
- Adapt to change (transversal skill and competence) (2.6%);
- Manage quality (transversal skill and competence) (7.6%).

In group 331, financial and mathematical associate professionals, there is one exclusive skill: marking materials or objects for identification (14.9%). In group 333, there is also a single skill for business services: providing information and support to the public and clients (2.9%). The remaining two occupational groups have no competencies that are exclusively characteristic of them. Competencies are specifically only to 2. Professionals or

only group 3. Technicians and associate professionals could not be identified. However, three competencies are typical for at least four out of the five non-managerial groups, with mention rates above 2%: documenting technical designs, procedures, problems, or activities—mention rates: 8.8%, 3.8%, 7.2%, 1.6%, and 2.8%. Two transversal skills and competencies occur: advise others: 40.7%, 1.5%, 50.3%, 57.4%, and 9.4%; attention to detail: 4.5%, 1.8%, 4.1%, 2.9%, and 4.4%.

Interestingly, the competence ensuring compliance with legislation appears not only in group 1 (Table 6) (Managers) but also in several non-managerial occupations (121. Business services and administration managers 5.6%, 242. Administration professionals 5.7%, and 331. Financial and mathematical associate professionals 6.5%).

RQ3 is as follows: Are there country-specific characteristics observable in the case of the examined occupations? Except for Estonia, in all EU member states, skills represent the largest share within the major competence groups. However, the situation differs by occupational group. For occupational group 121. Business services and administration managers, the OJAs (Occupation and Job Analyses) contain at least as many knowledge elements as skills in Cyprus, Estonia, Lithuania, and Romania (see Figure 1). In the occupational groups 241. Finance professionals and 333. Business services agents, the number of listed knowledge items also reaches or exceeds that of skills in Estonia, Luxembourg, and Slovenia. In the case of 242. Administration professionals, all types of competences (behind the major competence groups) appear in equal numbers in Cyprus—except for language. For 331. Financial and mathematical associate professionals, Estonia is again the exception, where transversal skills and competences are dominant. For 334. Administrative and specialised secretaries, transversal skills are the dominant competence group in all countries.

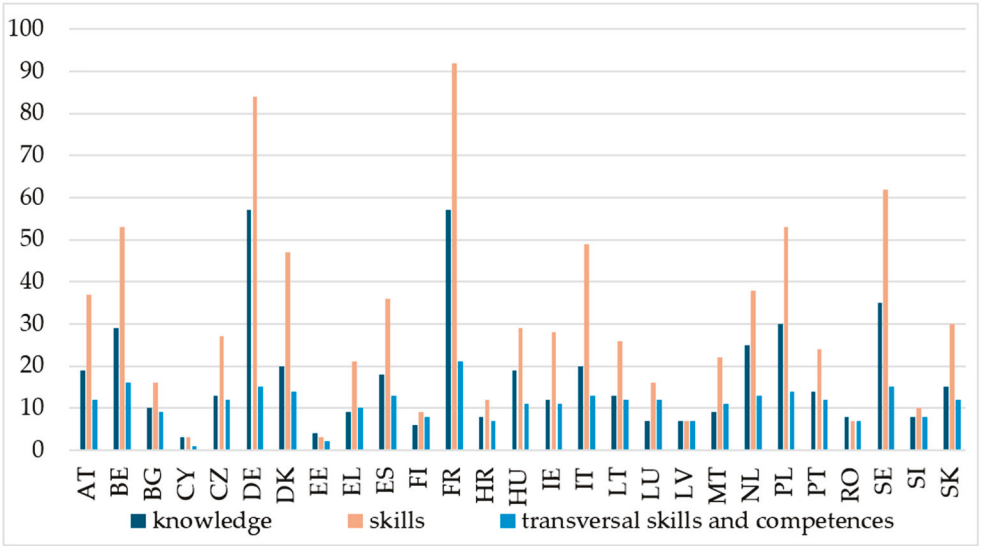

Figure 1. Number of competences in the OJA by competence group in the EU27 for the occupational group Business services and administration managers.

We conducted a cross-tabulation analysis for each occupational group. The results by occupational group are as follows:

121. Business services and administration managers—Cramer's V = 0.119, $p = 0.739$.
241. Finance professionals—Cramer's V = 0.097, $p = 0.998$.
242. Administration professionals—Cramer's V = 0.124, $p = 0.371$.
331. Financial and mathematical associate professionals—Cramer's V = 0.122, $p = 0.418$.
333. Business services agents—Cramer's V = 0.108, $p = 0.789$.
334. Administrative and specialised secretaries—Cramer's V = 0.129, $p = 0.137$.

Based on the cross-tabulation analysis, in all cases, there is a weak, non-significant relationship between the countries and the major competence groups. The conditions for a test of independence are not met in any of the cases.

As previously presented, for each occupational group, we selected the highest total value competences from each major competence group as cluster variables. The number of clusters and the countries that could not be assigned to any cluster are shown in Table 8.

Table 8. Number of clusters and countries not classified into any cluster by occupational group.

Code	OC121	OC241	OC242	OC331	OC333	OC334
Number of clusters	4	3	4	5	3	4
Countries not in the cluster	Cyprus Estonia	-	Cyprus Estonia	Estonia Ireland	Cyprus Estonia	Estonia

In all six cases, we examined the relationship between the variables and the clusters as qualitative characteristics (Figure 2). In five occupational groups, there is a significant and strong relationship between the clusters and the variables. The only exception is 333. Business services agents, where, for the language competence, the Eta (H) coefficient is 0.467 at a 6.7% significance level.

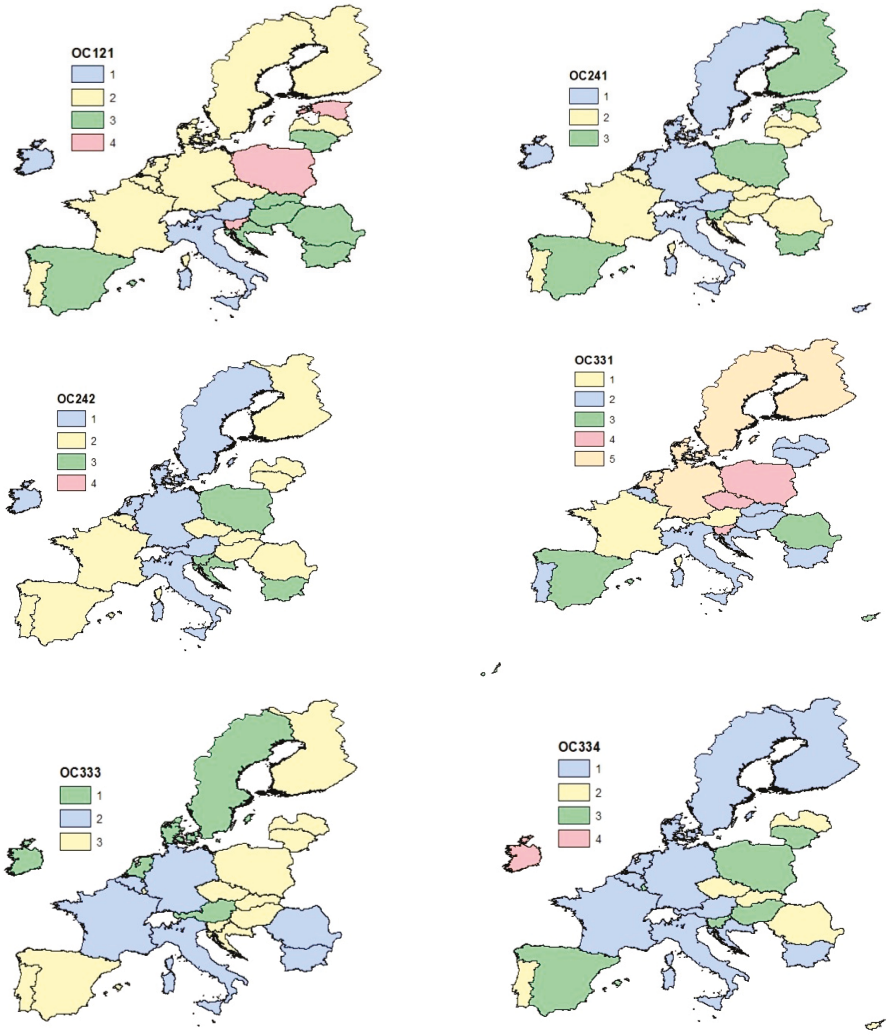

Figure 2. Results of the hierarchical cluster analysis.

For 121. Business services and administration managers, the countries in Cluster 1 are characterised by all competences being mentioned at above-average levels. Cluster 2

includes countries slightly above average, while Cluster 3 includes countries slightly below average. The countries in Cluster 4 fall at least 60% below the EU average. A similar pattern can be observed for OC241 and OC333: countries in Cluster 1 are above average, those in Cluster 2 are near average, and Cluster 3 contains countries that fall significantly below average (by at least 65% in OC241 and at least 33% in OC333). For 242. Administration professionals, the first three clusters behave similarly to those in the OC241 group. The exception is Cluster 4, which contains only one country—Luxembourg.

A somewhat different pattern emerges in groups OC331 and OC334. In 331. Financial and mathematical associate professionals, clusters similar to those seen in OC241 appear. Additionally, in Cluster 3, one competence—accounting and taxation—is mentioned more than 50% above average, while the frequency of the remaining competences is 15–40% below average. In Cluster 5, the countries are characterised by two competences—demonstrating willingness to learn and languages—being mentioned significantly more frequently than average (+56%, +31%), while the other two competences occur at around average levels (86%, 94%).

The most diverse pattern is observed in 334. Administrative and specialised secretaries. In Cluster 1, two competences—demonstrating willingness to learn and languages—are mentioned at least 25% more frequently than average, while accessing and analysing digital data and personal skills and development appear at around average levels. Cluster 2 presents the opposite: accessing and analysing digital data and personal skills and development are mentioned at least 25% above average, while the other two competences occur at average levels. Cluster 3 includes countries where the frequency of all competences falls at least 25% below average. In Cluster 4, which includes Ireland and Malta, the language competence is at 75% of the average value, while the other competences are mentioned more frequently than in any other cluster.

5. Conclusions

Leaders typically provide direction, coordinate activities, motivate others, make decisions, and assume responsibility. They are primarily expected to possess soft skills. In contrast, subordinates are tasked with the precise and reliable execution of assigned duties, where professional expertise plays a more central role. Thus, different expectations apply to leaders and subordinate employees. Different occupations and job categories are associated with distinct tasks and responsibilities. However, in terms of competencies, only minimal differences can be observed among the groups examined. The frequency of occurrence of specific competencies in online job advertisements (OJAs), both within main competency categories and across hierarchical job levels, shows no clear relationship. Based on the competency categories used in the advertisements, it is not possible to determine the hierarchical level of the position being advertised. Job level cannot be reliably identified based solely on OJAs, and even the occupational group is difficult to ascertain.

Based on our analysis, we find it important to draw the attention of human resource managers to the following implication: if the statement "a leader is not the same as a subordinate" is to be regarded as valid, then this distinction should be reflected in OJAs as well. This is particularly relevant in light of Eurostat and Cedefop surveys, which indicate that approximately 70–80% of job seekers search for employment online. In most EU countries, the vast majority of job advertisements—around 80–90%—are published online.

We were able to identify competences that are independent of occupational groups. These can be considered constant, "epic epithet-like" competences: management and administration; personal skills and development; languages; accessing and analysing digital data; collaborating in teams and networks; demonstrating willingness to learn.

The results of the cluster analysis by occupational group are summarised in Appendix A Table A1. We examined which countries fall into the same cluster at least five times across the six occupational groups.

Based on the classification, we were able to form seven groups. Belgium and France are characterised by consistently providing above-average numbers of competences in their OJAs. For all occupations, they show a slightly below-EU-average demand for demonstrating willingness to learn, while expectations related to computer use and accessing and analysing digital data appear at around or slightly above the EU average.

Czechia, Latvia, Portugal, Romania, and Slovakia show below-average demand for language skills and knowledge as well as for transversal skills and competences.

Greece, Hungary, Lithuania, and Luxembourg display below-average values across all examined cluster variables. The shortfall for language skills and knowledge, and transversal skills, and competences exceeds 30%. A common feature is that at Level 3—Technicians and associate professionals, the shortfall in collaborating in teams and networks and demonstrating willingness to learn exceeds 50%.

In Bulgaria, Finland, and Croatia, the number of competences listed per occupational group in the OJAs is between one-third and two-thirds of the EU average. The shortfall is around 40% for personal skills and development and accessing and analysing digital data. For computer use and collaborating in teams and networks, the shortfall reaches 60% compared to the EU average.

Germany, Denmark, the Netherlands, and Sweden perform at or above average across all variables. They place particular emphasis on personal skills and development and demonstrating willingness to learn, exceeding the EU27 average by 46% and 25%, respectively.

Ireland and Malta form a distinct group. For all frequently occurring competences—except one—they exceed the EU average by at least 25%. In the case of personal skills and development, the difference exceeds 100%. Unsurprisingly, the only competence where they score below average is language.

Poland and Slovenia represent the opposite of the previous group. For all frequently occurring competences, the frequency of mentions is only about 25–35% of the EU27 average.

Human Resource Management (HRM) is no longer merely an administrative function. It has evolved from basic payroll processing to a form of strategic partnership, supporting organisations in adapting rapidly to changing environments. HR professionals are now required to simultaneously address a variety of challenges: managing digital transformation, adapting to new forms of work, navigating intergenerational conflicts among the X, Y, and Z generations, and identifying and developing new competencies necessitated by automation and artificial intelligence. In this context, online job advertisements (OJAs) increasingly emphasise competencies that are difficult to develop but are essential for enabling workers to respond to rapid change and remain resilient during digital transitions. These competencies have gained a dominant presence in OJAs.

Despite global challenges, human resource issues must be addressed locally as the economic structure, level of development, and cultural context differ significantly across individual countries and country groups. For example, Western European education systems tend to be more practice-oriented and place greater emphasis on developing digital competencies than those of countries that joined the EU after 2004. These structural differences are reflected in the characteristics of local labour markets. HR professionals operating in specific regions cannot overlook the competencies already present in the local workforce, even amid overarching global trends. Although certain limitations of our research must be acknowledged—such as the reliance on the first three digits of ISCO codes, the differing ratios of OJAs to employed individuals across countries, and the

limited number of competencies analysed in four countries—a clear divergence among Member States can still be identified. Founding EU members and those that joined before 2004 typically emphasise transversal skills and competences in job advertisements. They also place high importance on personal skills and development as well as accessing and analysing digital data. In contrast, most of the countries that joined the EU after 2004 mention these competencies at significantly lower rates compared to the EU average. Thus, regional disparities are evident not only in economic and developmental terms but also in labour market competencies.

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Appendix A

Table A1. Clustering of EU27 countries by occupational group.

Country/Occupational Group	OC121	OC241	OC242	OC331	OC333	OC334
AT	1	1	1	1	1	1
BE	2	2	2	2	2	1
BG	3	3	3	2	2	1
CY		1		3		2
CZ	2	2	2	4	3	2
DE	2	1	1	5	2	1
DK	2	1	1	5	1	1
EE	4	3				
EL		2	3	3	3	2
ES	3	3	2	3	3	3
FI	2	3	2	5	3	1
FR	2	2	2	1	2	1
HR	3	2	3	2	3	1
HU	3	2	2	2	3	3
IE	1	1	1		1	4
IT	1	1	1	2	2	1
LT	3	2	2	2	3	3
LU	2	2	4	3	3	3
LV	2	2	2	2	3	2

Table A1. *Cont.*

Country/Occupational Group	OC121	OC241	OC242	OC331	OC333	OC334
MT	1	1	1	5	1	4
NL	2	1	1	5	1	1
PL	4	3	3	4	3	3
PT	2	2	2	2	3	2
RO	3	2	2	3	2	2
SE	2	1	1	5	1	1
SI	4	3	3	4	3	3
SK	3	2	2	2	3	2

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Article

Resilience During Crisis: COVID-19 and the New Age of Remote Work in Higher Education—A Systematic Literature Review

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Abstract: The outbreak of the COVID-19 pandemic took a sledgehammer to the education sector, shattering the established structured systems, norms and rituals of practices and procedures. To ensure continuity whilst adhering to the pandemic-induced containment measures, higher education institutions adopted a remote work model to address the needs of a dispersed workforce. Amidst the uncertainty and continuous changes posed by the pandemic, remote working arrangements gradually dominated the higher education workspace, thereby increasing demands on institutions and employees. Consequently, the notion of resilience as a crucial constituent of Crisis Management has never been more salient. Yet surprisingly, there has been a paucity of literature in this domain. Whilst research on resilience is gaining interest, there is a need for a comprehensive overview of what the concept means for academics during an emergency and its application in the Crisis Management framework. This article addresses this research gap using a systematic Literature Review method to unearth the current state of scientific research regarding resilience in Crisis Management in the context of remote work during COVID-19. The findings of the study provide a research agenda that centers on understanding how resilience in Crisis Management and its strategic use in remote work can advance the research streams.

Keywords: COVID-19; resilience; Crisis Management; remote work; higher education

1. Introduction and Background

The outbreak of the coronavirus pandemic (COVID-19) is considered one of the most significant and unpredictable global crises in recent times, leading to government shutdowns of various economic activities. Kniffin et al. (2021) note that the pandemic pushed millions of workers away from their traditional office spaces, leading to a de facto global experiment on remote working, a work arrangement that workers had no prior experience of, nor organizations prepared for (Wang et al., 2020). This accelerated the workplace experiment that had struggled to gain traction before the outbreak of COVID-19 (McKinsey & Company, 2020). The pandemic and its control measures caused the biggest shockwaves and set in motion waves of change in the education system. McNamara (2021) noted that the long-term impact of this change could likely echo through academic cycles, posing greater challenges for academics. Due to the complexity of the academic environment, the transition requires new processes of transformation to bring about the profound necessary changes. Fernandez and Shaw (2020) assert that the rapidity of the transition to remote learning was a response that came counter to the perception that changes in academia occur only at glacial speed. Academics had to embrace the model

of remote work and shift their pedagogical approach to suit the new market conditions. The transition demands changes in attitudes, values and beliefs and requires a complete turnaround from the traditional way of doing things (AbuJarour et al., 2021). Many academics grappled with the challenges of remote working with regard to teaching and learning, research, mentoring and other support activities.

These developments challenged the education system's full return to its state prior to the pandemic, becoming increasingly diaphanous. The dynamic nature of the human environment has made managing crises a common component, and resilience to ensure business continuity becomes optimal. The resilience of education systems is important for institutions to better cope in a crisis, thus making research in this space a prominent concept in the lexicon of Crisis Management. Extant studies have not paid much attention to the broad range of contexts in which the concept of resilience has developed and is being applied, making resilience research in management fragmented. A vast corpus of literature on resilience exists across disciplines addressing disasters, stress and trauma. Focusing on the Higher Education sector during the COVID-19 pandemic, most research studies failed to address resilience and remote work in tandem, given that the latter dominated the academic space. Little is known about the discussion of the links between the resilience of academics in remote work settings during the pandemic and its integration across a Crisis Management framework. In response to the paucity of research in this space, this article joins the discourse and contributes to this promising research area by attempting to address the following objectives:

i. To understand the resilience of academics in remote working arrangements during the COVID-19 pandemic; and
ii. To explore the application of resilience across the stages of a Crisis Management framework in addressing the challenges of remote working arrangements.

This article is organized as follows: the next section is a review of the literature on crisis, remote work and resilience. Thereafter, the authors describe the methodology; discuss the typology of the systematic literature review; detail the procedure adopted and the findings of the study. The last section concludes the article, proffers recommendations and highlights the limitations of the study.

2. Literature Review: Crisis, Remote Work and Resilience

'Crisis' is a term often used interchangeably to denote situations such as disasters, business interruptions, catastrophes and emergencies (Herbane, 2010). It is a progressive process that may not be restricted to one area within a common border and comprises three common elements, namely threat, surprise and short decision times (Mikušová & Horváthová, 2019). Crises are characterized as rare, significant, high impact, ambiguous, urgent, and involve high stakes (Simola, 2014). The concept also entails a period of discontinuity in which the system's core values are under threat, bringing about a destabilizing effect on the organization and requiring critical decision-making (Zamoum & Gorpe, 2018; Kayes et al., 2012). Reflecting on the key points above, the authors of this article adopted Hollier et al.'s (2020) definition of a "crisis" as a situation involving an urgent threat to core values and life-sustaining systems that requires an urgent response under conditions of significant uncertainty. This definition captures the true nature of the COVID-19 pandemic, with the World Health Organization declaring it a pandemic due to its rapid spread, posing a threat to human health, social and economic activities.

The pandemic exerted an abrupt and absolute impact on people's lives, forcing many organizations, including Higher Education Institutions, to resort to remote work. The concept entails a flexible working arrangement that allows tasks to be carried out outside of the traditional office space. The nature of such working arrangements has attracted

a mixed debate amongst scholars arguing for or against it. For some scholars, remote work enabled academics to adapt to the changes; reduce stress; remain productive; have a sense of autonomy; manage work; and control work schedules and life balance (Eaton, 2020; Ali et al., 2021), hence purporting that some academics worked efficiently remotely during the pandemic (Aczel et al., 2021). Contrarily, other studies found increased stress affecting academics (Dumulescu & Mutiu, 2021; Fernandez & Shaw, 2020); academic job requirements being not fully compatible with remote work (Avdiu & Nayyar, 2020); and non-availability or availability, with the sharing of lap-tops and internet provision (Hedding et al., 2020). Some studies found challenges in the digital divide, social inequalities, political issues, and the inappropriate administration of remote teaching facing academics (Jili et al., 2021; Czerniewicz, 2020). Furthermore, many institutions lacked the technological infrastructure needed to fully operate; and the necessary skills required for academics to work remotely (Whalen, 2020; Jili et al., 2021). Hence, resilience gained considerable attention given the uncertainties posed by the COVID-19 pandemic for HEIs.

Resilience, which is rooted in the field of Developmental Psychology, has become a prominent concept across various disciplines but is still relatively new in education (Alhawsawi et al., 2023). Ostensibly, resilience is a complex term defined from various standpoints and, depending on the nature of the research, could have different meanings. Although an umbrella term, Allen et al. (2021) defined resilience as the ability to adapt and recover from adversity. It emphasizes adaptability and the process of promoting recovery in an emergency. Aitken-Fox et al. (2023) noted that the focus is on identifying how individuals can be resilient; how organizations can develop the capabilities needed to be resilient; and what those capabilities are. The pandemic served as a phenomenal change event, a wake-up call to the education fraternity (Raghunathan et al., 2022), exposing the universal vulnerabilities of academic institutions and calling for a flexible and more resilient education system (Ali, 2020). The concept became very important, needing HEIs and academics to embrace it knowingly or unknowingly to ensure continuity. Hence, resilience in the context of COVID-19 remote work entails the ability of academics and institutions (environment and processes) to cope and prosper in the face of these changes.

3. Theoretical Expositions on Crisis and Resilience Management

The two critical features of the crisis lie in managing it (*Crisis Management*) by recognizing the adverse effect on institutions and developing adaptable models and practices to ensure continuity (*resilience*). Crisis Management (CM) entails "a process by which an organization deals with a disruptive and unexpected event that threatens to harm the organization, its stakeholders or the general public" (Bundy et al., 2017). Park (2021) added that Crisis Management encompasses the available processes in place at individual, organizational or country levels for addressing any unforeseen circumstances that may have adverse effects on operations and outcomes. Considerably, the COVID-19 pandemic tremendously and harmfully affected society at large. The institutional guidelines to prepare and respond to such unforeseen circumstances or catastrophes reflect a Crisis Management Plan (CMP).

A CMP mostly relies on the functions of planning, controlling and detailing the description of the roles and responsibilities of various functional levels (Izumi et al., 2021). Coombs (2012) notes that Crisis Management involves a process, and its effectiveness relies on its ability to handle the anticipated threats sequentially. Generally, a Crisis Management framework involves the phases of pre-crisis (mitigation and preparation), crisis response (actions activated to address the crisis) and post-crisis (recovery). Each of these phases comprises various steps and actions that need to be in place to assess and understand the factors contributing to the uncertain situation (Ozili, 2020; Venkatesh et al., 2019). Understanding the need for institutions to survive in such uncertain environments and to

foster future success, Duchek (2020) proposes a 3-stage Resilience Model, which includes anticipation (observation and identification—describes the preventative aspects relative to a crisis), coping (accepting the crisis, developing and implementing the necessary solutions) and adaptation (reflecting and learning from experience). This three-phase crisis and resilience framework plays out well in managing the COVID-19-induced remote work challenges for academics.

4. Materials and Methods

The study adopted a systematic literature review (SLR) methodology because of its high level of evidence as shown across disciplines. Fink (2019, p. 6) describes a systematic literature review as "a systematic, explicit [comprehensive] and reproducible method for identifying, evaluating and synthesizing the existing body of completed and recorded work produced by researchers, scholars and practitioners". Reviewing current literature allows for an understanding of the breadth of COVID-19 research conducted and published in relation to resilience and remote work in the HEI. In this context, SLR helps to map and assess the extant knowledge and gaps on specific issues (Mengist et al., 2019), as well as providing the current challenges and future directions. For Okoli (2015), SLR follows a methodological approach in which procedures for conducting the research are explained, whereby a comprehensive search is conducted within the scope, and it is reproducible by other researchers. A typical SLR consists of three broad phases of planning, conducting and reporting, which require the researcher to identify, select primary studies, extract, analyze and synthesize data from publications. Given no consensus on the number of steps in an SLR, this article adopts Barroso and Laborda's (2022) five-step methodological framework as shown in Figure 1.

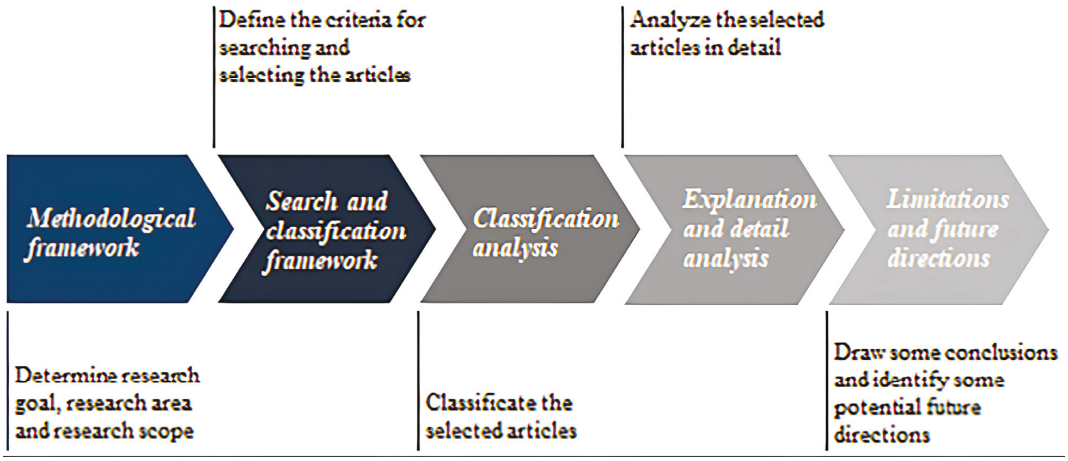

Figure 1. SLR methodological framework. Source: Barroso and Laborda (2022).

4.1. Methodological Protocol Phase 1—Planning: This Covers the Steps in Identifying and Selecting Primary Studies

Step 1: Identification of the research goal, area and scope

The researchers set the key direction of the analysis by identifying the goal, area and scope of the study. Hence, the goal of the research is to conceptualize resilience in the context of remote work within the Higher Education sector and understand how it can be applied across the phases of a Crisis Management framework in a pandemic situation. The research area focusses on academic literature covering resilience and remote work during the COVID-19 pandemic, specifically within a higher education context. This scope is set to ensure that the most relevant publications are selected and critically analyzed to capture the available information within the research space.

Step 2: Selection criteria and search

The second step entails identifying the relevant bibliographic databases and criteria for selecting academic papers addressing the research aim. The researchers considered documents indexed in four databases, namely Web of Science (WoS), SCOPUS, ScienceDirect and Google Scholar. The pilot search showed a dearth of literature in the research area, thus there was a need to use more databases for a wider search. In addition, these databases publish high-quality academic works and form a large source of research in the field of social sciences. Following protocols, the researchers applied an advanced search using all combinations of the keywords as set out in Table 1.

Table 1. Search terms and criteria.

Line 1 (Search Term)	"Resilience" and "Remote work"
Line 2 (Search Term)	"COVID-19" *or* "COVID-19 Pandemic" and "Higher Education"
Line 3 (Period)	"January 2020–April 2023"

Source: Authors concept.

4.2. Methodological Protocol Phase 2—Conducting

Step 3: Search and classification framework

This step allows researchers to filter, classify and select data. Using the keywords, (n = 256) articles were retrieved and extensively examined to ensure relevance to the objectives of the study, thereby limiting bias at the end of the analysis. With the help of EndNote version 20, duplicated items (n = 43) were carefully removed since databases often publish the same articles. Filtering and screening the titles and abstracts resulted in removing n = 179 records. Applying other inclusion and exclusion measures, the researchers considered only peer-reviewed journal articles published between 2020 and 2023. This is because journals validate recent knowledge in the field, and this timeframe saw a rise in remote work within HEIs. Also included in this study are full-text articles published in the English language across the field of social sciences but within the subject area. Excluded from the analysis are non-peer-reviewed publications (editorials, commentaries, dissertations, theses, book chapters, as well as articles without access to the full text). Hence, purified records of full-text articles meeting eligibility criteria resulted in n = 11 being singled out for analysis, as depicted in Figure 2 below.

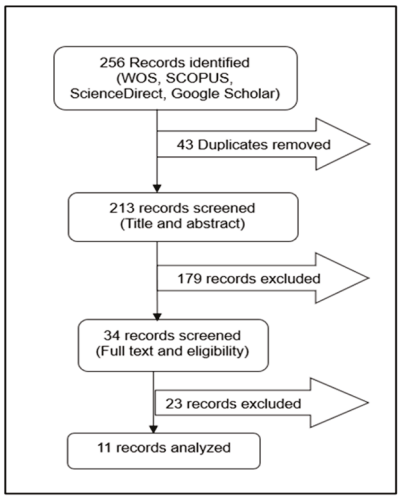

Figure 2. Flowchart for data selection. Authors concept: Literature search and study selection.

4.3. Methodological Protocol Phase 3—Reporting

The last phase of the SLR framework entails analysis and drawing limitations and future directions.

Step 4: Data Analysis and Discussion

Objective: Resilience of academics in remote working arrangements during COVID-19.

In Table 2 below, the researchers present a summary of academic papers analyzed. These academic papers were carefully selected, focusing on the entirety of the study and, most importantly, the methodology applied.

Table 2. Selected academic papers.

Authors (Year)	Title	Purpose	Keywords	Methodology	Findings (Themes)
Alhawsawi et al. (2023)	Understanding resilience and coping in a digitally transformed educational environment during COVID-19	Influence of contextual factors on teachers' resilience.	Academics, Resilience COVID-19	Mixed qualitative and qualitative case study	Individual resilience strategies helped teachers to cope with the COVID-19 associated challenges.
Bozkurt (2022)	Resilience, adaptability, and sustainability of higher education: A systematic mapping study on the impact of the coronavirus (COVID-19) pandemic and the transition to the new normal	Examination of COVID-19 from the perspective of higher education	HEI Resilience COVID-19	Systematic review and bibliometric analysis methods	Survival of higher education depends on the resilience, adaptability and sustainability skills of higher education institutions
Arranz et al. (2022)	Promoting lab culture to enhance academic resilience during crises.	Illustrates the essentials of promoting lab culture in transitioning from in-person to a remote lab environment.	Academics Remote work Resilience COVID-19	Qualitative	Proactive promotion of lab culture fosters academic resilience during crises.

Table 2. *Cont.*

Authors (Year)	Title	Purpose	Keywords	Methodology	Findings (Themes)
de los Reyes et al. (2022)	Resilience of higher education academics in the time of 21st century pandemics: A narrative review	Examines the resilience of academics in higher education.	HEI Academics Resilience	Narrative literature review	Academic resilience is a dynamic interaction between academics and their environments. Academics demonstrate their resilience through willingness to make changes, working in creative ways and achieving positive outcomes despite, at times, insufficient resources.
Procentese et al. (2022)	Teachers' efficacy in the face of emergency remote teaching during COVID-19 pandemic: The protective role of personal resilience and sense of responsible togetherness	Examines teachers' personal resilience and sense of responsible togetherness as factors supporting their work-related efficacy	Academics Remote work Resilience	Qualitative	Positive association between personal resilience and sense of responsible togetherness.
Shaya et al. (2022)	Organizational resilience of higher education institutions: An empirical study during COVID-19 pandemic.	Explores and expand a theoretical model on organizational capabilities that constitute organizational resilience.	HEI Resilience	Qualitative	Stages of organizational resilience are anticipation, coping and adaptation. Key antecedents for survival are knowledge, resources availability, social resources, power relationships and innovative culture. Two main moderators are crisis leadership traits and employee resilience.

Table 2. *Cont.*

Authors (Year)	Title	Purpose	Keywords	Methodology	Findings (Themes)
Bento et al. (2021)	Resilience in higher education: A complex perspective to lecturers' adaptive processes in response to the COVID-19 pandemic	Investigates the experience of lecturers in a university college in Brazil in the initial months of the COVID-19 pandemic	HEI Academics Resilience	Qualitative	Lecturers' adaptive processes during COVID-19 emanated from individual resilience elements. Open communication channel enhances the system-level resilience.
Delgado-Gallegos et al. (2021)	Teaching anxiety, stress and resilience during the COVID-19 pandemic: Evaluating the vulnerability of academic professionals in Mexico through the adapted COVID-19 stress scales.	Evaluates the vulnerability and adaptability of the academic professionals in Mexico	Academics Remote work COVID-19 Resilience	Quantitative	Academic professionals use of individual resilience during the process of transformation in education system and adapting and coping with stress during quarantine.
Mäkiniemi et al. (2021)	Loneliness and well-being during the COVID-19 pandemic: The moderating roles of personal, social and organizational resources on perceived stress and exhaustion among Finnish University employees.	Examines university employees' experiences of remote work during the COVID-19 pandemic.	HEI Remote work COVID-19 Resilience	Quantitative study	Personal resilience coping strategies and organizational support enhances well-being in organizations during the COVID-19 pandemic.
Ahn et al. (2021)	Academic caregivers on organizational and community resilience in academia (fuck individual resilience)	Explores institutional levels of support for academics during periods of crisis.	Quantitative	Systematic literature	Shifting away from individual approaches to resilience, building organizational and community resilience in academia will help withstand future crises and build sustainable academia.
Nandy et al. (2021)	Lessons from COVID-19 and a resilience model for higher education	Continuity of HEI activities in/post COVID-19.	HEI Resilience COVID-19	Systematic literature	Resilience model can be applied at both individual and institutional levels in rebuilding the system.

5. Results and Discussion

The discussion for this research objective concentrates on the final analysis of 11 papers addressing the study keywords. Data from Table 2 show that the resilience of academics in the context of remote work during COVID-19 emerged at individual and organizational levels. This finding resonates well with scholars' assertions on resilience being an attribute of an individual (Southwick et al., 2016; McAllister, 2013; Truffino, 2010). The idea is further stressed in Walker et al.'s (2017) definition of resilience as the mental reservoir of strength that helps people handle stress and hardship. This is based on the premise that resilient people draw on their mental strength to cope with and recover from traumatic challenges. Hence, individual resilience refers to one's ability to maintain a stable level of functioning following traumatic events (Bonanno, 2005), or the ability of individuals placed in adverse circumstances to "get by" and still lead a satisfactory life (Michaud, 1999). Kimhi (2016) added that one's level of resilience is vital in shielding the negative psychological consequences of a traumatic event. This involves individual behaviors, thoughts and actions that promote personal and mental wellbeing. In the case of the COVID-19 pandemic and its associated intense remote work, the ability of academics to navigate challenges became optimal. This explains the findings on why the use of individual resilience dominates across the reviewed papers in this article (Alhawsawi et al., 2023; de los Reyes et al., 2022; Procentese et al., 2022; Bento et al., 2021; Delgado-Gallegos et al., 2021).

A major resource for individual resilience is a sense of coherence (SOC), which comprises three elements, namely a sense of meaningfulness (i.e., the extent to which individuals perceive life as worthy of commitment and engagement); comprehensibility (i.e., the extent to which individuals perceive events as structured, consistent and clear); and manageability (i.e., the extent to which individuals believe that their external or internal resources are adequate to face stressful events) (Barni et al., 2020; Kimhi, 2016). As evidenced in various studies, Danioni et al. (2021) demonstrated in their study how the elements of SOC helped individuals cope with stressors during the COVID-19 pandemic lockdown. Another study by Zewude et al. (2023) found that SOC and resilience positively predict teachers' well-being and act as mediators between COVID-19 stress and teachers' well-being. Simply put, SOC as well as resilience helped to lower COVID-19 stress levels amongst the sampled teachers. Furthermore, de los Reyes et al. (2022) highlighted in their study how resilience reflects a dynamic interaction between academics and their environments; hence, academics demonstrated their resilience through their willingness to make changes, work in creative ways and achieve positive outcomes despite having insufficient resources at times. Mahat et al.'s (2022) study found that academics showed sustained engagement despite the need to overcome the continuing changes and uncertainties during the COVID-19 era and remote work. Hence, there is an indication that academics were able to assess and understand the situation (comprehensibility of COVID-19 and remote work) and manage scarce resources (manageability) and showed commitment and engagement to move in a health-promoting direction (meaningfulness).

The data also revealed that academic resilience during COVID-19 remote working arrangements emerged at an organizational level (Bozkurt, 2022; Ahn et al., 2021). Organizational resilience refers to the organization's capability to anticipate possible risks, successfully cope with unexpected events and learn and adapt to changing situations aimed at promoting organizational transformation (Duchek, 2020). This definition highlights the importance of capability, and Duchek (2020) stated that the capabilities of employees contribute to an organization's capability to be resilient. The ability to be resilient comes from the process, strategy, outcome and behavior that define the organization. Accordingly, resilience is conceptualized as a personal resource that encourages adequate adaptation

to significant traumatic events (Mäkiniemi et al., 2021; Smith et al., 2008, 2010). As a positive internal resource, individual resilience can be collectively and effectively managed to produce a positive personality that drives organizational outcomes. Hence, individual resilience is considered the main source of organizational resilience. In the context of this paper, resilient academics, fully supported by the institutions, could collectively and actively respond to and react positively to adversity, which in turn fosters survival. Ahn et al.'s (2021) study, which explores institutional levels of support for academics during COVID-19, highlighted the need to build organizational and community resilience in academia to help withstand future crises and build sustainable academia. Similar studies in this domain show how developing organizational resilience has helped institutions cope during the COVID-19 crisis and the associated remote work (Bartusevičienė et al., 2021; Brown et al., 2021). It is noteworthy that organizational resilience is an important factor capable of ensuring the effectiveness of the crisis response. This is because resilient organizations develop a broad and diverse knowledge base to cope with unexpected events (Duchek, 2020), thereby driving desirable performance in a turbulent environment.

The COVID-19 pandemic exposed HEIs and academics to abrupt unprecedented disruptions. These findings show the collective importance of individual and institutional resilience for an effective crisis response in a pandemic. In such situations, individuals become more innovative in exploring coping and survival strategies, and those with strong resilience are likely to overcome and manage the pandemic situation. Such individuals collectively can thrive, rebound and help the institution build capability to manage crises.

5.1. Resilience in the Crisis Management Life-Cycle

Duchek (2020) concurs that academic discussions about the dynamic nature of resilience in coping with crises is scant, hence the adoption of a narrative literature review procedure. In addition, research on academic resilience in the context of remote work is emerging, especially following the COVID-19 pandemic. Resilience is embedded in a dynamic process that is needed to sustain institutions during a crisis. It can be viewed from process and static theoretical perspectives (Jiang et al., 2021). These authors note that the process view of resilience enhances understanding of the dynamic and continuous monitoring of a crisis over time. Arguably, resilience gradually develops with different elements in a Crisis Management cycle, creating the ongoing and cyclical processes (McManus et al., 2008) needed to prepare for future crises and to ensure a continuous process. As noted earlier, a Crisis Management life cycle involves pre-crisis, crisis response and post-crisis stages, while resilience involves stages of anticipation, coping and adaptation. Hence, the current discussion is on aligning resilience to the different stages of a Crisis Management life cycle in the context of academic remote work during COVID-19.

5.1.1. Phase I: Pre-Crisis and Anticipation Stage

The pre-crisis stage consists of three sub-stages—signal detection, crisis prevention and crisis preparation. Pedersen et al. (2020) view the pre-crisis stage as three Ps, one that allows organizations to prevent (if possible), predict or prepare for a crisis. Depending on which sub-stage one prefers to adopt, Laugé et al. (2009) noted that while the signal detection sub-stage emphasizes warnings, information collection and analysis of the crisis, the prevention sub-stage works towards lessening the level of the risk, while preparedness points to having a Crisis Management plan, training, identifying vulnerabilities and effective communications (Laugé et al., 2009). Therefore, the main goal in the pre-crisis phase is to reduce any anticipated risks and be prepared strategically and tactically (Zamoum & Gorpe, 2018). In the COVID-19 setting, early detection in China allowed universities elsewhere in the world to apply threat detection strategies by assessing the environment

and the institution's present operating conditions. The institutions' CMPs at the pre-crisis stage provide the necessary resources for the continuation of operations of teaching and learning, research and other academic activities. The element of a resilience model at this stage focuses on observation and identification, which, according to Ortiz-de-Mandojana and Bansal (2016), allows institutions to recognize early signals of crisis and act quickly to avoid escalation. Important at this stage is training to help prepare and equip academics (Dhawan, 2020) and financial, logistics and health-related resources for addressing the anticipated remote work-related stressors (Karlsson & Offord, 2023; Sihag & Dhoopar, 2022; Gurukkal, 2020).

5.1.2. Phase II: Crisis Response and Coping Capabilities

The crisis response phase occurs when the crisis has hit the ground and is informed by two sub-stages—crisis recognition and crisis containment (Zamoum & Gorpe, 2018) or crisis acknowledgment and crisis response (Laugé et al., 2009). The corresponding resilience phase includes coping capabilities, which allow institutions to accept the crisis and develop and implement solutions. Thus, institutions acknowledge the crisis and respond by putting into action the CMP. The response and coping stages are tactical in nature, thus decision-making speed, action, behavior and communication (for both the internal and the external stakeholders or audiences) become vital elements in navigating the crisis. In the coronavirus pandemic and remote work setting, the stage seeks for management to recognize the pandemic and disseminate quick, accurate and consistent information to the stakeholders. The implementation of a CMP at this stage would be to lessen the immediate consequences and the associated side effects of the COVID-19 pandemic, e.g., resources to support academics working remotely, which may include working tools, ICT-based training, a workplace environment, productivity, health and work-life balance. Of importance is also the sound implementation of planned actions and continuous development of new policies and guidelines designed to assist academics working remotely (Karlsson & Offord, 2023; Sihag & Dhoopar, 2022; Gurukkal, 2020). Required by academics is the need to be flexible, digitally literate, organized, open-minded, creative thinkers and to possess the emotional capability to sail through the challenges imposed by remote working (Dohaney et al., 2020). In addition, Ge et al. (2022) pointed out the need to re-design work arrangements and conditions, workflow and training to suit remote work.

Many universities in South Africa, at the crisis response stage, provided consistent updates on information on their websites to keep abreast of COVID-19, sending weekly statements and detailing actions and procedures to follow to ensure continuity. Furthermore, Bundy et al. (2017) emphasize the importance of crisis leadership and stakeholders' perceptions and reactions to the crisis. In view of this, Dohaney et al. (2020) highlights leadership that provides incentives to encourage resilient initiatives, which in turn fosters the academic community's commitment towards establishing resilient systems. Yücel (2021) echoes the role of leaders in encouraging collaboration, promoting a sense of community and targeting the needs of the academic community to help reduce remote work anxiety.

5.1.3. Phase III: Post-Crisis and Adaptation

The focus at this stage is to assess the crisis recovery process, evaluate the Crisis Management strategy and better prepare for future crises. This stage allows institutions to evaluate the various actions taken in responding to the crisis. According to Laugé et al. (2009), the recovery process consists of corrective actions to solve the problems created by the crisis, while evaluation entails investigations into how and why the crisis occurred. This post-crisis stage fits well with the adaptation stage of resilience, which

entails the ability of institutions to adapt to critical situations, adjust following the crises and apply change for their own purposes towards advancement (Duchek, 2020; Limnios et al., 2014). In preparing for a future crisis, Pedersen et al. (2020) emphasized the need to measure the outcome of the crisis to ascertain how vulnerable, resilient or anti-fragile the system is after the crisis. The outcome after the crisis relates to how well-prepared the institution was in navigating the three phases of crisis (Pedersen & Ritter, 2020) and in providing opportunities for a learning experience (Bundy et al., 2017). Depending on the outcome, reputation repair and follow-up communication are still important at this stage, as institutions are required to provide updates on the recovery process and corrective actions. Institutions need to conduct an assessment of the aftermath impacts of the crisis and plan future development actions and strategies to mitigate future crises. Such actions would aim to assess the strengths and weaknesses of the alternative plans adopted during the crisis (Shaya et al., 2022), keeping the academic community engaged and enhancing its resilience (Sihag & Dhoopar, 2022). For example, the retention of the online learning experience can build academic resilience for future crises (Nandy et al., 2021; Karlsson & Offord, 2023). Financial, psychological and emotional support are also needed to ease the re-adaptation of academic activities (Bento et al., 2021; Sihag & Dhoopar, 2022; Shaya et al., 2022), and ongoing professional development, counseling and mentorship can facilitate academic staff recovery and strengthen their resilience.

Although the full impact of the COVID-19 remote work challenges for academics is yet to be completely understood, effective Crisis Management has become salient in the HEI environment. The post-crisis phase would therefore offer opportunities for social evaluations of academic staff perceptions of the effectiveness of the university's actions and procedures in managing the COVID-19 crisis. This is to ensure that possible changes are integrated to improve the existing institutional CMP to emerge stronger after the crisis and better prepared for future crises. The overall narrative review has shown resilience alignment across the Crisis Management framework emanating at individual and institutional levels applicable in the context of academic remote work. The authors hence propose an integrated framework of resilience in the Crisis Management cycle in the context of COVID-19 remote work, as shown in Figure 3.

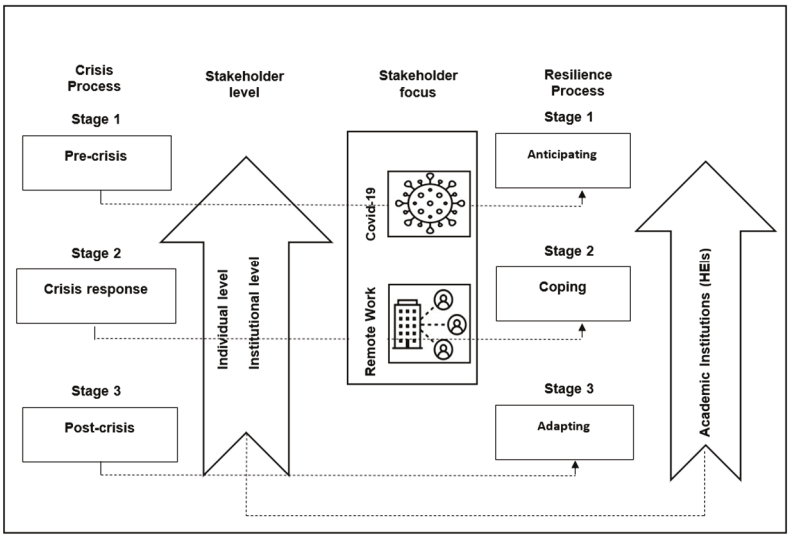

Figure 3. Conceptual framework: COVID-19 remote work context of resilience and Crisis Management. Source: Authors' concept.

The resilience theory argues that the most important thing in a crisis is not the crisis itself but how to deal with it. de Oliveira and Werther (2013) added that the ability to

detect critical developments both internally and externally to ensure proactive and adaptive processes becomes a key element for institutions. A resilient system should therefore have sufficient adaptive capacity to sustain the crisis; hence, the proposed framework in Figure 3 illustrates this. Overall, resilience can be developed across the stages of Crisis Management by establishing policies and procedures and continuity plans to respond to crises, developing strategies to manage the challenges associated with remote work, prioritizing the well-being of the academic community and acquiring technology to maintain business continuity.

5.2. Quality Assessment

Evaluating the validity of included studies is an integral component of a systematic literature review, and its findings depend on the methodological quality of those respective articles (Negarande & Beykmirza, 2020; Whiting et al., 2017). The researchers focused on reducing the levels of bias in the study by adopting a framework and following a protocol. The key content of the protocol followed includes setting the objectives, screening and search strategies, determining sources of data and eligibility criteria and data extraction and analysis. The researchers also used reputable databases, independently extracted, assessed all the articles, discussed any elements of ambiguity, set out inclusion and exclusion criteria, agreed on studies relevant in addressing the research objectives and reviewed the full-text articles of those studies. It is therefore believed that this procedure is reasonable and defendable and strengthens the quality of the study.

6. Conclusions, Limitations and Future Direction

The COVID-19 pandemic served as a phenomenal change event for HEIs by forcing institutions to re-design and implement flexible solutions to adapt to the new reality of remote work, which had hardly applied to academics before the pandemic. The transition to remote work witnessed changes to the culture, design and structure of HEIs, requiring management to make critical decisions to shape the future of the institutions. The ability to respond to new challenges and withstand and recover from such an unpredictable disruption is of utmost importance. In such a volatile environment, resilience becomes a critical skill and a core competence needed to navigate every step in remote work challenges. Through a systematic literature review and discussion of relevant literature, the objectives of the study were tested.

The first objective set out for this study was to understand the resilience of academics in remote working arrangements during the COVID-19 pandemic. The finding shows that academics' resilience for remote work during the COVID-19 pandemic emerged at both individual and institutional levels. At individual levels, academics applied various coping strategies, which entailed maintaining levels of mental flexibility and emotional regulation, among others. A major source of these coping strategies, as suggested in literature, stems from an individual's sense of coherence (SOC), which consists of a sense of meaningfulness, comprehensibility and manageability. The ability to apply these components of SOC strengthens an individual's resiliency. At institutional levels, resiliency is strengthened through the process, strategy, outcome and behavior that define the organization. These are reflected in the institution's living values, goals and culture. Hence, a combination of individual and institutional coping strategies helped to explain the academics' resiliency with remote work during COVID-19 pandemic era.

The second objective of the study explored the application of resilience across the stages of the Crisis Management framework in addressing the challenges of remote working arrangements. The findings indicated that the resilience framework could be applied across a Crisis Management framework, thus leading to the development of Figure 3. The

framework shows a comprehensive understanding of how elements of resilience can be integrated into a Crisis Management cycle.

This research, therefore, makes theoretical contributions to the literature on crisis and resilience in the context of academic remote work in higher education. It is important to note that this study is not without limitations. Recalling that the COVID-19 pandemic caused a major shift in the norms and culture of academic work, at the time of conducting this study, a paucity of literature existed in the research area. Hence, the analysis is of only 11 academic peer-reviewed papers. However, the researchers attempted to strengthen the line of argument by citing studies within the concept but outside of academia, for example, Danioni et al. (2021). Although the study population was not indicated, it is believed that the Italian adult population includes academics, and the study was conducted by researchers working in a university environment. Furthermore, due to the scarcity of studies, the authors recommend that more research be conducted in the areas of resilience and Crisis Management given the unpreparedness of HEIs to cope during the outbreak of COVID-19 pandemic, after which many are still struggling with the ripple effect. Future studies are needed to test the developed framework for Crisis Management.

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Article

The Impact of Ergonomic Rationalisation on the Efficiency and Productivity of the Production Process

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Abstract: This paper is aimed at understanding the possibility of applying ergonomics in the reorganisation of the work environment with the aim to improve working conditions and to increase the productivity of the examined workplace in an industrial company. Due to constant changes in markets, industrial companies are forced to seek new methods and paradigms for planning and managing innovations in order to ensure their competitiveness. An essential part of this process is the emphasis on improving production processes, where various methods with different focuses can be used. These methods not only optimise work processes, but also allow companies to minimise the resources needed for production and increase overall productivity. Another useful tool for industrial enterprises can be ergonomic rationalisation. The importance of ergonomics in improving employee working conditions and production process efficiency has been the subject of studies promoting various concepts. This study focuses in particular on examining the possibility of extending the outputs obtained by the REFA method to outputs obtained through ergonomic analysis. To achieve the objectives of the paper, the case study method was chosen, given that it was necessary to apply the REFA method in combination with ergonomic rationalisation in the specific conditions of the industrial company for the possibility of identifying bottlenecks in the production process from the point of view of its productivity, efficiency, and workforce involvement. Based on the results, it was possible to propose measures to increase the efficiency of the production process while respecting the principles of ergonomics. As part of the solution, the author team concluded that the findings obtained by combining both methods do not show significant differences, but rather complement each other and provide a broader view of the issue under study. At the same time, it can be stated that the solution cannot be considered definitive due to possible dynamic changes in the industrial environment (changes in the composition of the workforce and the scale of production and evolving technology, e.g., AI). The subject of future research will be to adapt the applied combination of methods so that it is universally applicable to any industrial sector, with minimal required adjustments to meet the specifics of individual industries.

Keywords: rationalisation; ergonomics; productivity; employees

1. Introduction

Industrial enterprises are constantly seeking new methods and paradigms for planning and managing innovation to effectively serve new and existing markets with new and/or changed products and services. Part of this process is an emphasis on improving the production processes that form the basis of efficient business operations. Given the need

to keep pace with the current challenges of the times, it is essential to purposefully seek out bottlenecks and waste within the production process and, ideally, eliminate them. This can be achieved by implementing modern manufacturing technologies such as automation (Ajiga et al., 2024; Karumban et al., 2023), digitalisation (Lee et al., 2021; Pihir et al., 2018), and lean manufacturing principles (Varela et al., 2019; Lai et al., 2019). These methods not only optimise work processes, but also allow companies to minimise the resources needed for production and increase overall productivity. Rationalisation can also be another useful tool for industrial enterprises.

Rationalisation of production has its justification in the development of the company, and thus, improves its competitiveness in the market. These interventions in production offer the possibility of using new technologies which are beneficial both in terms of improving working conditions and in economic terms (Dostal & Sadilek, 2021).

Rationalisation can take different forms, depending on its focus and objective. In general, rationalisation can be defined as a set of state-of-the-art knowledge, methods, techniques, and organisation that are designed to ensure minimal wastage of effort (human effort) or material (cost reduction) in order to increase benefits (Rolander et al., 2013; Szombathyová & Krauszová, 2008).

The aim of the paper is to understand the potential of the comprehensive application of ergonomics in the reorganisation of the work environment. The purpose is to improve working conditions and to increase the productivity of the studied workplace in an industrial enterprise.

The research question guiding this study is as follows:

Question 1: Will the application of another method enrich the results obtained by applying the REFA method?

When formulating the research question, we assumed that by applying a combination of methods, more robust and comprehensive data could be obtained to influence the efficiency and productivity of the production process using ergonomic rationalisation.

2. Theoretical Background—Production Processes and Possibilities for Their Rationalisation to Increase Efficiency and Productivity

The classification of individual types of production processes according to several criteria allowed us to reveal some of their characteristics that can be generalised to other types of production processes. Starting from a rather general definition of a product, we will refer to these generalised manufacturing systems as production systems. Irrespective of the substantive nature of the product, it is always a complex of purposeful activities of organised groups of people, which is divided into operations and sub-processes. It is a given complex of operations (examinations at specialised workplaces) to be carried out in a certain order (Součková, 2017).

The manufacturing process represents the activities associated with the actual design of the product, the technology of its manufacture, the production process, assembly, testing, packaging, and shipping. In order to ensure that the entire production process is carried out correctly in a manufacturing enterprise, the entire production stage must be taken care of in a timely manner. This is where the technological changes to the starting materials are made. This is also where the components and the whole product are given the shape or composition specified by the designer in the technical documentation in order to achieve the desired level of quality and utility at the minimum production cost. From the point of view of business economics, the aim is to realise economically optimal production (Součková, 2017).

The connection between production processes and ergonomic rationalisation is key to optimising production efficiency, improving working conditions, and increasing employee

productivity (based on Brito et al., 2018). This approach combines the technical aspects of production with ergonomic design principles, ensuring that production processes are efficient, safe, and adapted to human abilities and constraints. Achieving greater efficiency through ergonomic rationalisation requires linking the scientific knowledge of human performance, job design, and work organisation.

In this case, rationalisation can be defined as the process of streamlining and improving the productivity and efficiency of activities in an organisation through the use of process adjustments, improved outputs, better planning and coordination, more efficient use of resources, the introduction of new technologies, and improved management and organisation of work (Vaara et al., 2006).

If the work activity is the subject, rationalisation may involve altered requirements for how leadership is exercised and rearrangements of work practices and work tasks, often at the cost of intensifying work through altered time exposure factors (Rolander et al., 2013).

The aim of rationalisation can be to create a better and more efficient working environment for employees and to improve the performance of the organisation as a whole.

When we need to make the involvement of the workforce more efficient, we can define rationalisation as the improvement of human activity, increasing its efficiency and economy, i.e., the totality of measures for the most efficient use of manpower and technology on the basis of the use of modern knowledge of science and new technologies. It is in this process that ergonomics can be used, and its application is changing with the growth of research and knowledge about ergonomics but also in the light of new human problems arising around the world (Koirala & Nepal, 2022).

The objectives and benefits that can be achieved through rationalisation are illustrated in Figure 1.

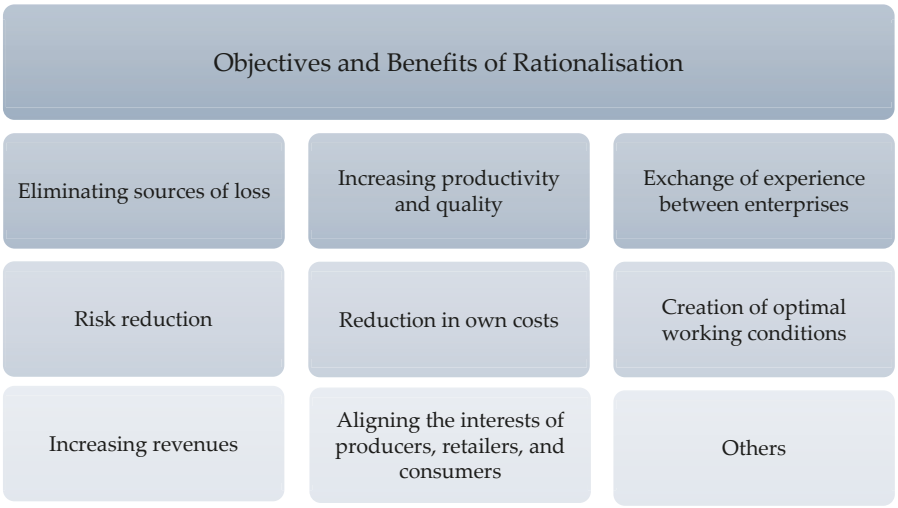

Figure 1. Objectives and benefits of rationalisation (own processing by Szombathyová & Krauszová, 2008).

Ergonomics in its focus can cover a wide range of topics related to the workforce. It studies the relationship between workers and jobs, which affects every part of the workplace. The subject of ergonomics can be the design of the workplace itself, the equipment of the product, the environment, and personnel policies, taking into account the biomechanical, physical, and psychological needs of employees. When all aspects are taken into account, it is possible to improve the efficiency and productivity of the work system while ensuring worker health, safety, and satisfaction (Koirala & Nepal, 2022; Onofrejová & Šebo, 2020).

Like ergonomics itself, perspectives on the working environment have evolved over time. In the work environment, the focus is not only on its functionality but also on its aesthetic appeal, as a good-looking space can motivate, inspire, and ultimately increase a person's work efficiency (Peteri, 2017).

However, for many companies, ergonomics can be seen as an external factor that is not part of their strategy, planning, and control cycles (Koirala & Nepal, 2022). The role of ergonomics is to create a comfortable working environment for the worker. On the other hand, with the advancement of technology, progressive technologies such as simulations, virtual reality, and augmented reality are offered in Industry 4.0. The advantage is the ability to create a virtual environment of any work process. Therefore, integrating Industry 4.0 technologies with ergonomics can increase workplace efficiency. Ergonomists can use these simulations to identify risks or sources of discomfort that may affect the actual worker (Mostafa, 2023).

The environment in which employees work has a huge impact on work efficiency as well as on comfort and safety. If the work environment is not designed correctly, the employees compensate for the deteriorated conditions, which in turn affects their health and comfort, and ultimately, affects their overall productivity and efficiency. In such a context, the workspace can also be seen as a place used to continuously look for room for improvement. There are a number of approaches that address the underlying determinants of the work environment. Villarouco et al. state ergonomics as supporting the following (Villarouco et al., 2012):

- Natural comfort—warmth, light, or suitable acoustics;
- The dimensions of the working environment in relation to the type of work to be performed;
- The materials used;
- Equipment and furniture and their distribution within the space;
- Safety;
- Sustainability.

Rationalisation of work is expected to increase efficiency, competitiveness, and sustainability in a dynamic business environment. Work rationalisation can be achieved through individual predetermined methods and procedures to be followed. For maximum efficiency in production, rationalisation measures such as improvement in the spatial layout, work organisation, work processes, work products, etc. are used. This is mostly based on the suggestions or objections of workers, preliminary economic calculations, etc. (Herman, 2012).

Within ergonomics, there are many tools and methods that are used to assess the work environment and ensure the safety and comfort of employees. A number of modern technologies (Table 1) in the form of simulation software with the ability to monitor a larger number of parameters can be used to collect the data needed to evaluate the interrelationships between the employee, the work environment, and the work tools. Although the perspective of the worker is extremely important, the use of these technologies objectifies the overly subjective nature of the assessment. Importantly, it is desirable to combine several of the above technologies for objective data collection and subsequent evaluation. From the collected data, a digital working environment can be modelled. We can incorporate a digital employee with specific physiological characteristics into this environment. A number of tests and simulations can then be performed, and the ergonomic suitability of the working environment can be monitored. The advantage is that there is no need to visit real work areas, and there is the possibility to simulate different work tasks (Berlin & Adams, 2017; Horváthová et al., 2018).

Table 1. Tabular representation of technology types used for data collection in ergonomic assessment (Horváthová et al., 2018; Middlesworth, 2024).

Technology Type	Functionality	Basic Evaluated Parameters									Impact on the Work Activity Being Monitored * None * Partial	Methods and Ways of Evaluation
		Position of the Upper Limbs	Position of the Lower Limbs	Torso Position	Head and Neck Position	Use of Force	Frequency of Movements	Energy Expenditure	Subjective Assessment of the Burden	Workplace Layout		
Wearable sensor systems	Sensors for measuring physiological functions					*	*	*			* Discomfort caused by wearing sensors	Legislative, the Ruffler method, Index method
Motion capture	Sensing human position and movement	*	*	*	*		*				* Sensing without markers * Sensing with markers	Legislative, OWAS, RULA, REBA
CERRA	Augmented reality workplace screening	*		*	*		*			*	* Observer presence at the workplace	Legislative, OWAS
Simulation software	Modelling and simulation of work activities and the workplace	*	*	*	*	*	*			*	*	Legislative, OWAS, RULA, REBA, NIOSH
Mobility applications	Questionnaires and checklists								*	*	*	Legislative, Nordic questionnaire

Efficient production development is a key aspect of a successful business. Rationalisation, as a tool for optimising production, involves rational decision making, the promotion of worker initiative, and professional rationalisation activities. Rational action consists of the optimal use and creation of the individual parts of the system that is subject to rationalisation. It is crucial for successful development that the objectives of rationalisation and change are properly understood and that the conditions for their realisation are created. The economic essence of rationalisation efforts consists of achieving higher performance and efficiency through the knowledge and application of modern systems, concepts, and working methods.

3. Materials and Methods

To increase the efficiency of the production process, emphasis is now being placed on optimising and rationalising production schedules. In addition to time analysis, it is also necessary to take into account the human factor, which can be limiting in terms of the success of the solution. In practice, several methods can be used to analyse production processes to make processes more efficient, reduce waste or improve quality, or ensure the smooth operation of the company. Time and motion study (TMS), Value Stream Mapping (VSM), Six Sigma Analysis, DMAIC, Work Sampling, Failure Mode and Effects Analysis (FMEA), Statistical Process Control (SPC), the REFA method, lean manufacturing, and Bottleneck Analysis are the most commonly used methods for the analysis of manufacturing processes, and their results are mainly translated into indicators such as Overall Equipment Effectiveness (OEE), Process Capability Analysis (Cp/Cpk), and others.

The selection of the appropriate method for analysing the production process depends on the desired objectives and the industry in which it will be used. Often, it is necessary to use a combination of several methods to take a holistic view of the process and ensure continuous improvement.

Due to the nature of manufacturing and the industry in which the case study was addressed, the REFA method, which is based on detailed time measurement and includes analysis to identify inefficient movements or steps, was used for the analysis. It focuses on structuring work tasks to increase productivity.

The REFA method (Reichsausschuß für Arbeitszeitermittlung) (Bures & Pivodova, 2015; Vlčeková, 2024) is a method of direct measurement of work with the ability to assess with what intensity and efficiency the work is performed. It is applicable to both cyclical and non-cyclical work. The REFA method (REFA, 2003) details the steps involved in conducting time studies. It is widely used within industrial engineering to improve the efficiency of manufacturing processes (based on Čolović et al., 2024). It is part of the broader field of time and motion studies and involves systematic analysis to optimise work flows, reduce waste, and increase productivity. The method relies heavily on the detailed recording and observation of work processes and is useful for designing better work environments and organising tasks more efficiently. In particular, it includes an unambiguous system of nomenclature and division of time, performance rating, and special recording forms.

We have therefore used the REFA method to analyse work processes in detail and identify areas where efficiency and productivity can be improved. Comparison of the outputs with legislation will ensure compliance with standards and regulations relating to workers' working conditions, complementing the results from the CERAA application.

For the purpose of the analysis, the work of all work activities at each workstation within production lines A and B of the production plant was measured in the months from July to September in 2023. The parent company of the company examined in the study is located in Germany, where the REFA method is standardly used to study work activities. The company thus has a database of time snapshots of the production lines,

which made it possible to choose a quantitative approach. Measurements for the needs of the case study were carried out in the branch company under study. The following methodological procedure was applied when implementing the REFA method. As part of the preparation of the analysis, its goal was chosen, in this case, reducing working time. Work activities within the production process were selected for the needs of the analysis. Subsequently, all relevant data on the process (time, costs, tools, and methods) were collected. As part of the work process analysis, the process was mapped to obtain a complete overview of all its steps. In order to identify tasks and operations, the process was divided into smaller tasks and operations performed by the worker. Then, the times of individual operations were measured using stopwatches. Data collection was carried out using a Casio stopwatch HS-80TW-IEF (Casio Computer Company, Limited, Sibuji, Tokio, Japan) and a pre-prepared REFA time frame in the company's production hall during the relevant production operations on the line. Individual activities on the production line were measured between 25 and 30 times, depending on the type of activity measured. As long as an operation performed on one piece was measured, it was measured 30 times, and as long as different activities within one operation were measured on several modules at the same time, the measurement was repeated 25 times. The analysis of working conditions was processed using the REFA form, where information about the work task, work time, and worker were recorded (with respect for GDPR); the work process was also summarised, the influences acting during the measurement were recorded, and notes with the form coding were made for traceability. The form included a time snapshot intended for serial production with regular repetition, where the sections of the process were identified, numbered, and defined, and measurement points were determined. It was also necessary to determine the relative quantity (number of modules on the carrier, 1 piece when welding) and, finally, the level of required performance and times. For the purpose of analysis, all 24 workers working at each position on the production line were imaged. The age range of the female workers was 35–55 years, laterality was right-handed in all of them, and work exposure ranged from 0 to 12 years. Furthermore, 66% of the female workers performed work sitting, and 34% of the female workers stood while working. None of the female workers were trained in the occupation, but 23 female workers had been properly trained for the job. Thus, it was assumed that they are well aware of the production processes and have sufficient experience of them as a result of their occupational exposure. One female worker was part of the training programme for one week, and her knowledge and skills required to work on the imaging operation were assessed at 85%; thus, she did not perform all the operations to full capacity. Her work performance was slightly limited, the duration of individual operations was longer, and the cost required to perform them was higher. Adjusting time and cost estimates in light of the worker's actual performance will help to obtain a realistic picture of processes and costs. For a comprehensive view of worker performance, measurements were taken at different times of the day (at the beginning of the shift, before and after the lunch break, and at the end of the shift). By averaging the performance curve from the collected data, it was possible to refine the measurement results with respect to the whole working day. The next step was to improve the work process by identifying inefficient and redundant movements and actions. The production process was subsequently modified by redesigning the work process by introducing new technologies and changing working conditions. In the phase of determining the standard time, it was calculated for the individual operations under study based on measurement and analysis, taking into account productivity standards. As part of the implementation of the improvements, employees were retrained in new work procedures and new technologies. Control and verification of the correctness of the solution were carried out by simulation using the Witness software (v.12).

In addition to the measurement of work activities, an analysis of the risk factors of the working conditions and their projection to individual body parts was carried out at the workplace using data collection through the Nordic Questionnaire (Kuorinka et al., 1987). All (100%) of the female workers participated in the analysis. The findings were supported by screening of the ergonomic conditions at the analysed workplaces through the use of the CERAA application. In this way, the spatial design of the production line workplaces was analysed; specifically, the reach distances were measured. The analysis was carried out on all four operations, assessing the spatial conditions for female workers, including an assessment of the work area when working both sitting and standing.

4. Results

The following part of the paper includes the results of the analysis of the production process by the REFA method, through which time was measured in detail and inefficient movements or steps were identified. Based on this, it was possible to structure work tasks to increase productivity. To comprehensively improve working conditions and increase overall productivity on the production line, the findings were complemented by a detailed ergonomic analysis of the production line operation with emphasis on identifying areas for improvement. Consequently, it was possible to propose measures to increase the efficiency of the production process while respecting the principles of ergonomics.

4.1. Results of the REFA Manufacturing Process Assessment

The next section of the paper covers the outputs of the analysis using the REFA method. The aim was to identify bottlenecks on sections of the line in terms of differences in times between operations and to rationalise an inefficient process within the production cycle in the form of multiple carrier handling that does not add value to the final product.

The reason for using the REFA method to improve the efficiency of the production process and productivity in the company is its standard use in the parent company in Germany. Within the company database, there is a database of REFA time frames for production lines; therefore, a quantitative approach using the method was chosen. For the outputs within the case study, the measurements were performed in the present. The data collection was carried out using a stopwatch equipped with a precision measuring mechanism, which enables accurate time recording, in a pre-prepared REFA time frame in the production hall of the company during the production operations in question on the line.

The work measurements were taken on production lines 1 and 2 for all the activities taking place at the workstations. The flow of material starts on the right at the assembly area, where three workers (or more as needed) sit and assemble the torso. The torsion chassis are then moved along gravity conveyor 1 to the furnace workstation. The furnace workstation is not the subject of the analysis as the soldering furnace program cannot be shortened or influenced. The soldering furnaces are operated by a single worker, and the programme takes 60 min, after which the worker pulls out and puts the module stack on gravity conveyor 2. From there, a worker (green colour in Figure 2) takes the spool and removes the semi-finished product from the process and assembly torsion—line section B. The semi-finished products are transferred on a carrier to two workers on line section C (yellow), who place each piece near the workstation on line section D (orange). During production on line 2, a worker carrying out activities for line section C (yellow) carries the semi-finished products in a carrier to the worker at the ultrasonic welder (orange, worker on the left).

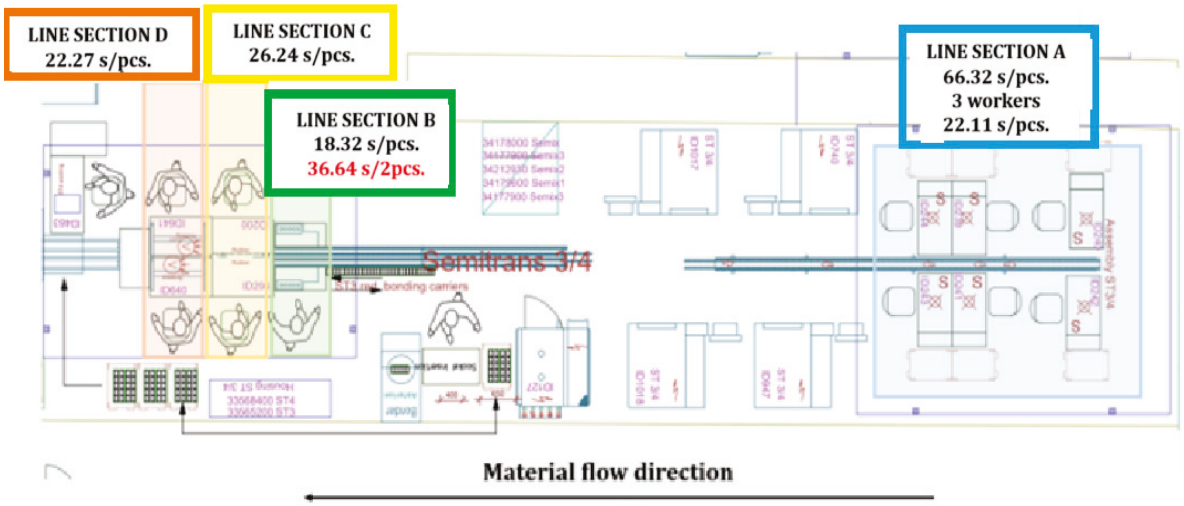

Figure 2. Time snapshot results for ST3 in the workplace layout (own processing, 2023).

From the individual measurements, using a stopwatch, the individual time t_i in a predetermined number was detected, from which the advancement time F was subsequently calculated. It is an internal company rule that the value of ε must be less than or equal to 2.5% when processing the time frames. This rule was followed during data collection.

After filling the form with the baseline and measured data, the evaluation is calculated in the right part of the spreadsheet according to the progression section in the time frame sheets.

The first step represents the sums of the assessed performance level L at the progression segment, where L = 100 (percent of worker performance) and n represents the number of measurements.

$$\sum L_n = 100 + 100 + 100 + \cdots = 100 * 25 = 2500. \quad (1)$$

In the case of a worker with 85% performance, L = 85. This also applies to the other calculations. Similarly, the sum of the actual individual times t_i of the progression sections must be calculated, where the individual measured times are summed, as shown in the example from time frame ST3-R-2 for the operation "Taking the splint off the belt".

$$\sum t_{in} = 4.28 + 4.58 + 7.52 + 6.94 + 3.93 + 6.56 + 3.42 + 4.96 + 6.92 + 7.26 + 10.3 + 9.35 + 6.84 + 3.82 + 5.75 + 5.98 + 5.77 + 4.99 + 12.49 + 6.36 + 5.08 + 4.31 + 5.97 + 6.81 + 6.77 = 156.94, \quad (2)$$

The second step is the determination of the mean power level L according to the corresponding calculation, where ∑L represents the sum of the considered power level at the advancing section and n in the calculation represents the number of the considered power level. In all time frames, the same calculation procedure was used, shown for the line section B on production line 1, registration number ST3-R-2:

$$\overline{L} = \frac{\sum L}{n}; \ \overline{L} = \frac{2500}{25}100 \quad (3)$$

The mean value of the actual individual time $\overline{t_i}$, where $\sum \overline{t_i}$ represents the sum of the actual individual times of the progression legs, and n in the calculation represents the number of summed actual individual times, was then determined. In all time frames,

the same calculation procedure was used, shown for line section A on production line 1, registration number ST3-R-2:

$$\overline{t_i} = \frac{\sum t_i}{n};\ \overline{t_i} = \frac{156.94}{25} = 6.3 \tag{4}$$

The required time t, which was given in seconds in the time slide sheets, was calculated using the mean power level and the mean value of the actual individual time $\overline{L}\overline{at_i}$ according to the following formula:

$$t = \frac{\overline{L}}{100} * \overline{t_i} \tag{5}$$

For the ST3-R-2 time frame, the calculation of the required time t was adjusted due to the fact that there were 5 modules on the shield, and the calculations were recalculated on a per-piece basis:

$$t = \frac{\overline{L}}{100} * \frac{\overline{t_i}}{5} = \frac{100 * 6.8}{100 * 5} = 1.4 \tag{6}$$

Twenty-four measured time snapshots were evaluated in the same manner as for the ST3-R-2 snapshot, and the resulting average times of the monitored workers are recorded in Table 2.

Table 2. Resulting average times from time snapshots (own processing, 2023).

Operation	Registration No.	Time (s)	Average (s)	Registration No.	Time (s)	Average (s)
Line section A	ST3-M-1 ST3-M-2 ST3-M-3	63.14 67.57 68.26	66.32	ST4-M-1 ST4-M-2 ST4-M-3	75.32 78.26 75.37	76.32
Line section B	ST3-R-1 ST3-R-2 ST3-R-3	18.00 17.45 19.50	18.32	ST4-R-1 ST4-R-2 ST4-R-3	16.92 18.09 20.28	18.43
Line section C	ST3-I-1 ST3-I-2 ST3-I-3	24.95 27.18 27.24	26.46	ST4-I-1 ST4-I-2 ST4-I-3	26.06 23.68 24.87	24.87
Line section D	ST3-Z-1 ST3-Z-2 ST3-Z-3	21.61 23.95 21.25	22.27	ST4-Z-1 ST4-Z-2 ST4-Z-3	25.19 24.92 24.92	25.01

The times are charted on the line layout for the production of ST3 modules in Figure 2 and for the production of ST4 modules in Figure 3. The bottleneck, disassembly on line section B, is marked in the aforementioned figures, and this is because one worker disassembles and delivers semi-finished products for two lines of other operations, and hence, the doubled operation time is the longest compared with the others. Therefore, it may happen that the workers performing the operation on the line section C sometimes have to wait, which is considered wastage. Although the operation on line section A takes the longest time, it is supported by three workers, which means that one piece comes out from them every 22.11 s.

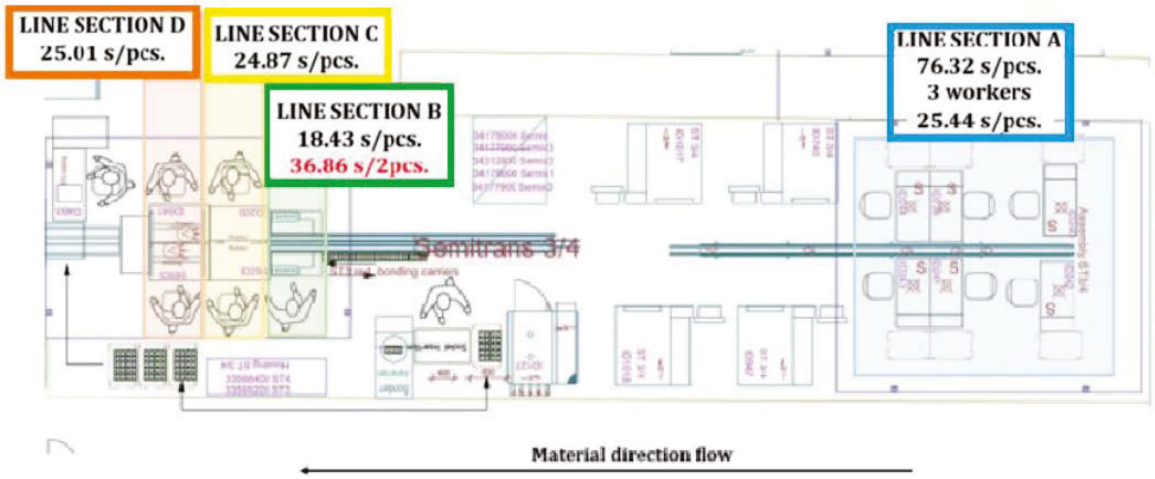

Figure 3. Time snapshot results for ST4 in workplace layout (own processing, 2023).

The bottleneck represents line section B. By evaluating the time frames, it was found that it takes a worker up to 3.26 s per piece to reload a carrier. The given time was calculated as the sum of the average times per piece obtained from the time snapshots from all the workers on the operation on line section C, specifically from the following activities:

- Taking the carrier off the table: (0.8 + 1.1 + 1.4 + 1.2 + (1.3 * 0.85))/6 workers = 1.1 s/pc,
- Unloading pieces for the next operation + carrier return: (2.2 + 1.9 + 2.4 + 2.2 + 2.1 + (2.55 * 0.85))/6 workers =2.16 s/pc.

Carrier reloading activity has potential for improvement. In one eight-hour shift, workers produce 1473 ST3s and 1465 ST4s, which means that in a three-shift operation, up to 4419 ST3s and 4395 ST4s are produced in one day. In a day, the workers of section C handle the carrier in a cumulative time of 4 h, i.e., 80.03 min in one shift for the production of ST3 and 79.60 min in one shift for the production of ST4.

In the case study, the aim was to rationalise an inefficient process within the production cycle not only in terms of time, but also in terms of workforce participation and comfort. If only the REFA method had been used to achieve the rationalisation objective, the inefficient process would have been addressed solely in terms of technical parameters and without taking into account the needs and constraints of the workforce. The rationalisation could be less efficient precisely because of the failure to take into account the workplace constraints on the workforce that limit the solution. This can be avoided by supplementing the analysis with an ergonomic assessment of the conditions on production lines A and B.

4.2. Ergonomic Assessment of the Production Line

For a comprehensive assessment of the working environment with the aim of improving working conditions and increasing overall productivity on the production line, an ergonomic analysis was also performed using multiple methods.

When assessing workplace comfort from the perspective of spatial design and the impact of the risk factors in the work environment from the subjective perspective of the female workers, it was found that the highest incidence of body-related problems is in the neck and upper back (Figure 4), where 24% of the female workers were forced to see a doctor due to the aforementioned difficulties, which indicates their intensity.

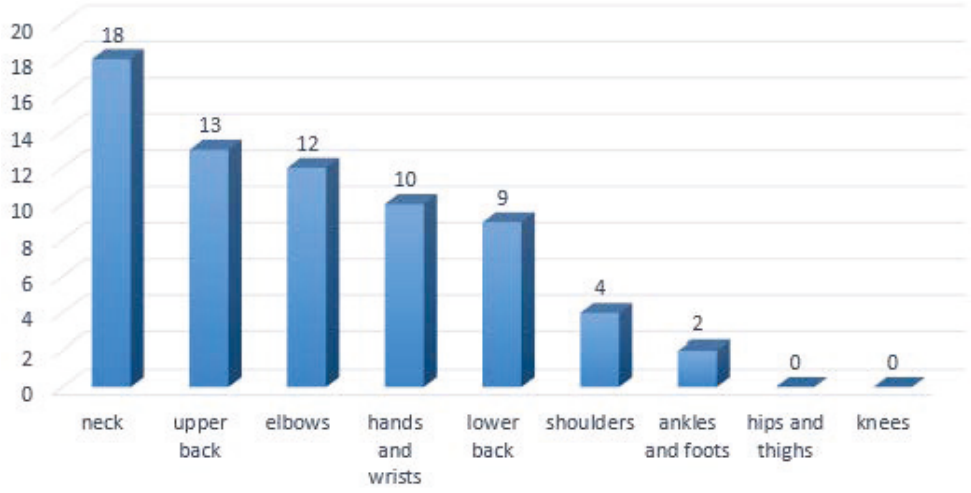

Figure 4. NQ—The pain and tingling in a specific part of the body (own processing, 2024).

To identify potential risks in the work environment, the female workers themselves subjectively assessed the work environment factors. The assessment score was in the range of 0–10, where factors rated above 9 points were considered bothersome. The results show that the greatest strain is caused by 3 factors, namely, a fixed working position without the possibility of individual adjustment, the frequency of performing the work operation, and the handling of small objects.

The objectification of the identified shortcomings in workplaces and of the working environment conditions was ensured by screening using the CERAA application and confrontation with legislative documents. The non-compliance of the workplace solution with the legislation is shown in Table 3. The workplace screening itself supports the findings from the questionnaire survey, because as a result of the identified spatial deficiencies, discomfort is projected onto the above-mentioned body parts of the female workers.

Table 3. Evaluation of measurements of the sitting workstation dimensions (own processing, 2024).

Working Plane Dimension—Sitting	CERAA (mm)		Line Section A (mm)	Line Section B (mm)	Line Section C (mm)	Line Section D (mm)
	Optimal	Maximal				
Height	590	750	730	750	750	750
Width	685	1100	1000	760	1000	1000
Depth	315	500	480	**530**	**540**	**510**

At the workplace on line section B, it is possible to perform work while standing also; therefore, the corresponding dimensions of the workplace were measured for standing work as well. The results are given in Table 4.

Table 4. Evaluation of measurements of the dimensions of the workplace on line section B in a standing position (own processing, 2024).

Working Plane Dimension—Standing	Non-Adjustable Working Height		Space for Legs			
			Height		Depth	
	CERAA (mm)	Real Size (mm)	CERAA (mm)	Real Size (mm)	CERAA (mm)	Real Size (mm)
Height	900	970	226	250	181	226

By evaluating the data obtained from employees using the Nordic Questionnaire, the risk factors in the workplace appear to be the monotony of the work with long-term, excessive unilateral strain on muscle groups in the same working positions. The result is an

increase in discomfort and pain, especially in the neck, upper back, and elbows. The cause was identified, also using the CERAA application, in the form of an unsuitable working plane height and unsuitable reach distances. Other dimensions of the workplaces are in accordance with legislative requirements. Nevertheless, the shortcomings in the area of reach distances signal the need to adjust working conditions to improve the ergonomics and worker safety. They also complement the findings that were identified through the application of the REFA method. It found:

- Existing differences in times between individual operations indicate a bottleneck on line section B. Because the time of a given operation is on a selected line section, the female worker takes the preparation for two branches of section C and section D, which can cause delays in the aforementioned operations, leading to a waste of time.
- An inefficient process within the production cycle exists; specifically, the multiple manipulations of the carriers by female workers translate to a cumulative time of 4 h per day, not including the manipulation of products associated with the use of the carriers, while the given activity does not add value to the resulting product.

Based on the above-mentioned outputs from the implemented analyses, it can be stated that the ergonomic analysis (implemented by combining the subjective views of the workers, objectified by applying the CERAA application) in combination with the REFA method made it possible to obtain more comprehensive data to influence the efficiency of the production process. The assumption set out in the research question was confirmed by the application of the above-mentioned methods.

The findings revealed were also confirmed through a simulation of one work shift in the Witness Horizon simulation system. The identified outputs were also confirmed by observation and comparison with the applicable legislation in the area in question. Based on these data, it is possible to design a more efficient production process and rationalise the production line, not only from the perspective of its productivity but also the comfort of the human workforce, specifically:

- A conveyor system and electric conveyor would make it easier for female workers to handle modules, or even eliminate the handling completely in some steps, which will result in a reduction in the time per piece in operations on line sections B and C (Figure 5). We can eliminate the waste identified by the REFA method.

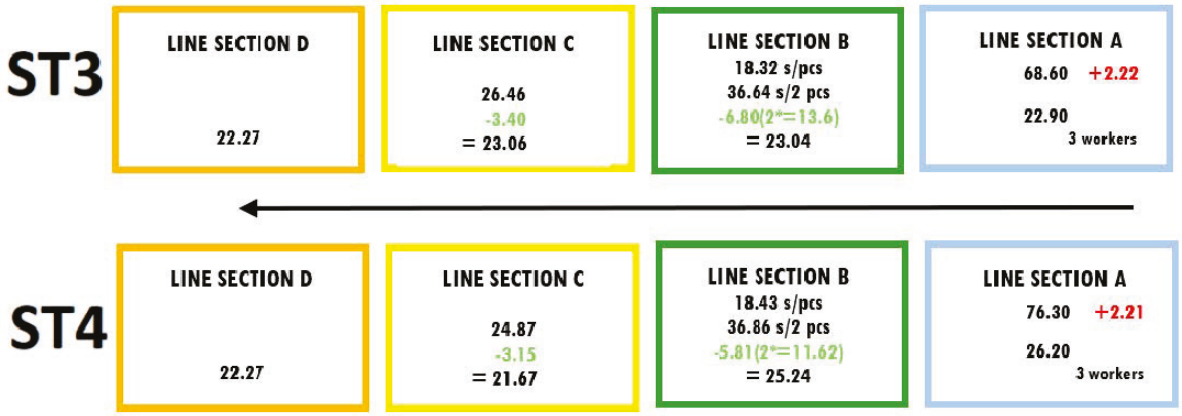

Figure 5. The conveyor system design summary (own processing, 2023).

By implementing the proposals, due to the bottleneck, 870 more pieces of product ST3 and 674 more pieces of product ST4 could be produced on the work line during one shift (Table 5).

Table 5. The comparison of the manufactured pieces on the line after modifications based on the results of the REFA method (own processing, 2024).

	Product ST3		Product ST4	
	Current State	**After Adjustment**	**Current State**	**After Adjustment**
Shift time without break (s)	27,000	27,000	27,000	27,000
Bottleneck (s)	18.32	11.52	18.43	12.62
Number of pieces produced per shift (pcs)	1473	2343	1465	2139

- Ergonomic workplace equipment—proposals are aimed at improving the working environment and conditions for employees in the form of adjusting the design of the work desk (cutouts in the desk to reduce the depth of the working plane, elbow pads), adding local lighting and anti-fatigue ESD mats, and introducing rotation of the workers at exposed workplaces. The impact of an ergonomic solution on financial indicators may be indirect, but the impact on the overall efficiency and long-term sustainability of the company is significant. Ergonomic adjustments can increase the well-being and health of employees, which can have a positive impact on their work performance and satisfaction, thereby contributing to a comprehensive assessment of the work environment.

In the industrial company where the analysis was performed, it was decided to eliminate the identified bottleneck on line section B, which is caused by excessive walking when handling the semi-finished product, and also to divide the production batch into two branches of the operation. The bottleneck affected other operations on the production line. The waste in the form of redundant processes was found in the use of carriers that are used only between operations on the B and C line sections. The carriers took up space in the workplace, piled up on it, and handling them increased the ergonomic risks. To eliminate the identified shortcomings, an automatic conveyor system was designed to ensure transport between individual sections of the production line. Another proposal that will help rationalise the workplace and complement the conveyor system is the design of an electric conveyor that serves to move modules from line section A to line section B. The bottleneck identified on line section B, where it took the female worker up to 3.26 s per piece to remove and return a rail to the conveyor because it was far away from her, caused waste due to unnecessary processes, namely transfers and errors that occur when rails collide with each other. By combining it with the first proposal, a suitable workplace can be created for the worker on line section B, where she will have a rail with modules ready within reach as well as a place to return the rail.

5. Discussion

Published outputs declare numerous examples of the use of individual analytical methods, which are aimed at rationalising the production process either as a whole or in its parts. The very importance of rationalising production processes based on time analysis and ergonomics in improving the efficiency of the production process has been the subject of the various studies. When rationalising production processes, authors focus on automation of the production process (Ajiga et al., 2024), digitalisation (Lee et al., 2021), or lean production (Varela et al., 2019) in order to analyse the work process in detail and identify areas where efficiency and productivity can be improved. Ergonomic rationalisation deals with improving the work environment (e.g., lighting—Dupláková et al., 2019, 2022) and work processes (Novek & Bandurová, 2001) with the aim of increasing the efficiency, comfort, and safety of workers (Colim et al., 2021).

From the specific outputs within the case study, by applying the selected methods and implementing the proposed changes, the times between individual operations were shortened, the inefficient production process was rationalised, and the productivity of the work on the production line was increased while simultaneously adjusting the workplaces to eliminate the identified shortcomings in terms of ergonomics.

Bottlenecks identified in REFA can be evaluated very quickly through short-term indicators such as Cycle Time, which measures the time it takes to complete one unit of a product or process; Overall Equipment Effectiveness, which combines availability, performance, and quality to measure the efficiency of production equipment; Downtime Rate, which assesses the amount of time equipment is out of service; Scrap Rate, which tracks the number of non-conforming products; Throughput, the number of products produced in a given time; and Capacity Utilisation, which assesses the extent to which available resources (machinery, labour) are being utilised. The use of these indicators makes it possible to quickly identify problem areas and subsequently propose measures to eliminate them, thus improving the fluidity and efficiency of the production process.

The evaluation of the effectiveness of the proposed measures from the perspective of the benefit to the workforce cannot be assessed based on short-term indicators, because the effect will become apparent only after a certain period of time. We usually use a one-year evaluation period, when we can see whether the solution has brought positive impacts. For this reason, it seems appropriate to evaluate the social efficiency of an investment that emphasises the human capital of a company. From a company perspective, social efficiency can be understood not as profit maximisation, but as creating added social value and social inclusion of the employees and reinvesting profits in the development of the main social goals of the company. The social responsibility encompasses an effective and responsible approach to the components of investments made for society, employee relations, creativity, and workplaces' sustainability. However, the effectiveness of investments in the field of ergonomics cannot be directly quantified using the classic arsenal of investment evaluation methods for several reasons:

- The effect of the investment does not appear immediately after the investment is made,
- The effect may manifest itself differently in each operation,
- The effect is almost always indirect, manifesting itself in areas such as reducing costs from illness (absence from work), reducing losses from accidents, reducing losses from employee turnover, and improving the work environment and work culture.

The assessment of the social efficiency of the expenditure of investment funds with respect to the useful result in a certain period of time (Michník, 1995) can be defined from the basic relationship:

$$E_{SOC} = u \cdot e$$

where:

u—social effect of the investment,

e—effect per unit of the investment effect.

The social impact of an investment is usually defined as the area within which the measures taken are to be reflected in the form of an improvement in the identified/measured condition. Determining the unit of effect is no longer so clear-cut; it can be a specific (single) work position or a work cell to which the improvement is applied. Given that all of the above areas that fall into the area of social efficiency are quantified ex post on a quarterly, semi-annual, or annual basis, the effect can be measured only after they have been quantified, i.e., efficiency can be measured and quantified only after the final quantification of morbidity, injury, and fluctuation indicators. In addition to the fact that all indicators reduce the costs associated with production, it can be assumed that when "work does not

hurt a person", i.e., does not cause any harm, the effect will also occur in the form of a reduced defective products rate and in the form of higher labour productivity.

6. Conclusions

Effective production development currently forms the basis of successful business. Rationalisation, as one of the tools for making production more efficient, means rational action, using workers' initiative and professionally performed rationalisation activities. Rational action is based on the optimal use and creation of individual components of the system that is the object of rationalisation. For its development, it is crucial that rationalisation plans and changes are correctly understood and that conditions and prerequisites for their implementation are created. The economic essence of the rationalisation efforts therefore lies in achieving higher performance and higher efficiency and presupposes the knowledge and application of newer and more modern systems, concepts, and methods of work (Szombathyová & Krauszová, 2008).

Compared with new technological trends such as Industry 4.0, the REFA method still has a relevant role in maintaining proportionality between human effort and benefit. It also suggests that, given the ever-evolving technology, the REFA method will remain relevant in the future and can be an effective tool for improving efficiency and optimising production processes in current industry, but it will likely require further development to adequately respond to new technological challenges (Ahrens, 2018). Between the two major development lines in industry in recent decades, automation and the development of the methods to improve production efficiency, the REFA method falls into the latter group, as it focuses on improving production efficiency and optimising costs (Ahrens, 2018).

The current work reality reflects the growing use of artificial intelligence in the design of hybrid work systems. The REFA method and the periodic AI system form the basis for the analysis and optimisation of production processes, with an emphasis on supporting, not replacing, the human workforce. AI parts acquire diverse data, such as assembly information in the work environment, which they then use to generate information, situations, or states, such as selecting a workflow based on the acquired component data. They later react to the acquired and evaluated data, such as by visualising the next work steps. The combination of the REFA method and artificial intelligence allows for a structured view of the use of AI in work systems, highlighting its benefits in ergonomics and digital assistance systems. This synergy strengthens efficiency and innovation in the work processes (Pietschmann et al., 2022). The REFA method identified bottlenecks in the production process, which were also confirmed from the employees' perspective by performing an ergonomic analysis, which will allow for a more comprehensive solution that takes into account the needs and limitations of employees, thus avoiding tunnel vision when solving the problem. In future research, it will be possible to consider incorporating artificial intelligence into the evaluation of collected data for the purposes of applying the REFA method; however, in the part dealing with the ergonomic rationalisation of the working environment, research will be needed that would eliminate errors from excessive use of AI to assess the participation of human labour in the production process, given that we believe that AI is not yet at a level that could guarantee the relevance of the data.

Within the research limitations, our research may have been influenced by the gender imbalance of the sample of respondents as well as its individual variability. It is important to note that the gender imbalance of the sample may affect the generalisation of the findings to the wider working population. Regarding data analysis, everything was carried out in accordance with the requirements for this type of data collection and evaluation. We do not assume the occurrence of any errors in the analysis and processing of data. The above solution cannot be considered definitive due to the possible changing composition of the

workforce, the scope of production, and evolving technology. Therefore, it is necessary to monitor development trends and correct the solution through future research. The subject of the research following the above case study is to adapt the applied combination of methods so that it is universally applicable to any industry with minimal required adjustments to meet the specifics of individual industries.

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Article

Incorporation of Controlling into the Organizational Structures of Industrial Enterprises

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Abstract: Enterprises, especially those operating in a dynamic environment of industrial production, need a management concept capable of responding to changes. For prompt and accurate reactions, it is crucial for managers to have a feedback system that allows monitoring the achievement of defined goals, the utilization of the enterprise's potential, and the identification of its weaknesses. Controlling is an effective tool that enables monitoring and reporting the necessary areas, ensuring the efficient functioning of business processes through the early identification of deviations. It provides the enterprise's management with vital information about goal achievement, the enterprise's real potential, warnings about shortcomings, and a relevant feedback system. This research is aimed at examination of the role of controlling within the organizational structures of industrial enterprises in Slovakia and evaluation of the degree to which the current integration of controlling requires adjustments in companies' organizational structures. For the research purpose, a questionnaire survey was conducted, including 61 respondents, all specialists from financial or controlling departments. The most significant findings include the organizational integration of the controlling department within the surveyed enterprises and the necessity to reconsider how the controlling department is incorporated into the company's organizational structure. The findings suggest that companies with a functional organizational structure may need changes to enhance decision-making authority within the controlling department, while those with a line organizational structure already grant sufficient decision-making power to controllers.

Keywords: controlling; industrial enterprises; management; organizational structure; performance

1. Introduction

In a rapidly evolving market, industrial companies face significant challenges. To succeed, it is essential for them to adapt to these changes and respond swiftly to technological and economic advancements. Embracing digitalization and implementing Industry 4.0 principles are critical for enhancing efficiency (Strachotová et al. 2019; Yaqub and Alsabban 2023). The dynamic changes resulting from Industry 4.0 have the greatest impact on industrial enterprises. Industry, especially the automotive industry, is the key economic sector in Slovakia, so Slovakia is most affected by this transformation among comparable countries.

Effective business management without controlling is impossible. Management requires comprehensive information and systems to effectively identify risks and opportunities. Management decisions in today's businesses must be data-driven to remain competitive and constantly adapt to, or even shape, the environment (Cristofaro et al. 2025). Traditional accounting, encompassing both financial and managerial accounting, is thus enhanced by controlling, which focuses on data analysis and processing (IGC 2010). Controlling primarily involves planning, control, and management, which together constitute the 'control circuit.' Planning sets the company's strategic direction for the upcoming year, while reporting facilitates the monitoring and analysis of any deviations

and their underlying causes. Management ensures the implementation of the plan by overseeing its execution and making necessary adjustments to align with strategic objectives (Rasoloniaina et al. 2014; Vollmuth 2004). Controlling supports corporate management through a complex information and organizational connection. By providing adequate cost information, it facilitates timely decision-making for management in all phases of the process. Management has the primary responsibility to address economic and business challenges. Additionally, having indicators and information about business processes is essential for optimal decision-making. Effective monitoring relies on the availability of accurate and objective data to compare with planned data, underscoring the necessity of introducing controlling (Weber and Schäffer 2008; Mehović and Softić 2014).

Controlling is a modern approach that helps management adapt to new circumstances, creating dynamic and resilient organizations capable of tackling challenges. With controllers acting as experts, it provides proactive and impartial support for real-time decision-making (Chodasová et al. 2013; Osmanagić Bedenik 2015). Its implementation is essential for enhancing the performance and market value of enterprises (Sedliačiková et al. 2021b). As the trend toward Industry 4.0 continues, digitalization is increasingly impacting production and controlling processes (Pfeifer 2021). Industry 4.0 technologies facilitate continuous control loops, making management control systems dynamic to align with organizational strategy and environmental factors (Yeheskel and Globerson 2020). These technologies provide access to big data from the internet of things and other sources, enabling machine learning and artificial intelligence to enhance decision-making and predict future outcomes (Javaid et al. 2022; Rahman et al. 2023). Many industrial enterprises have adopted lean management, yet their finance and controlling departments still use early 20th century methods, such as classical standard costing. Modern controlling must align with Industry 4.0 standards and guide companies toward flexible organizational structures (Pavlák and Písař 2020). Industry 4.0 is transforming accounting systems and controlling through technologies such as big data, AI, blockchain, and automation, which improves financial data analysis and cost optimization (Onyshchenko et al. 2022). The integration of Industry 4.0 into accounting information systems and processes will benefit companies, employers, employees, and clients through improving productivity, efficiency, and controlling functions (Chur and Yap 2024; Stacho et al. 2024). The implementation of artificial intelligence can improve efficiency, accuracy, and decision-making capabilities in controlling, leading to better management and optimization of business processes (Abdullah and Almaqtari 2024). In summary, controlling supports the adaptation of businesses in the Industry 4.0 era and improves real-time decision-making. Technologies such as big data, AI, and automation are transforming controlling, optimizing processes while enabling more flexible organizational structures. Industrial enterprises face challenges in adapting controlling to the requirements of Industry 4.0, particularly in its integration into the organizational structure. Functional structures often limit the decision-making authority of controllers, whereas line structures provide better conditions for effective decision-making. These challenges highlight the need to optimize processes to support strategic management and enhance competitiveness.

A robust control system is essential for companies operating in a rapidly evolving industrial landscape. It enables management to make informed decisions based on real-time data, facilitating a more agile response to market changes. Quality control also enhances cost efficiency and helps identify potential risks, allowing the company to better allocate resources, plan investments, and maintain competitiveness in an environment marked by rapid technological and market advancements. Knowledge of new possibilities, structures, and systems in industrial enterprises must adapt to changing requirements and challenges in production management. It is crucial to consider whether controlling is ready for these challenges and to provide accurate data for management and control systems. Traditional controlling focuses on retrospective data, spending excessive time analyzing past results. Future-oriented controlling must assess whether internal processes still meet current demands. The first step is to analyze the actual situation objectively and identify

urgent requirements. This assessment forms the basis for developing and implementing optimal solutions. For the controlling department to effectively address the challenges of supporting management in making critical decisions, it is essential to integrate it properly into the company's structure. The research presented in this article focuses on the current position of controlling departments and their role within the organizational structures of industrial companies in Slovakia. It also aims to evaluate the need and potential benefits of redefining the position of controlling based on its current level of integration. Despite the growing importance of controlling for effective management and strategic decision-making, there is a lack of research that systematically examines its specific position and organization in industrial enterprises in Slovakia. This study focuses on practical challenges related to the level of controlling integration and the unclear definition of its competencies within the organization. A deeper investigation into these issues is needed, particularly concerning the controlling department, which plays a key role in business decision-making processes. The goal is to evaluate the need and potential benefits of redefining the position of controlling based on its current level of integration, creating opportunities to enhance organizational efficiency and support operational and strategic decision-making. The article addresses the challenges of Industry 4.0, requiring more effective integration of controlling into organizational structures and proposes a redefinition of controlling's role to help companies better utilize modern technologies and increase competitiveness. It also highlights the fact that different organizational structures may achieve varying levels of controlling effectiveness, with lower effectiveness potentially indicating the need for transformation.

The main theoretical contribution of this article is the expansion of knowledge regarding the position of the controlling department within a company's organizational structure. The practical contribution is a new perspective for managers on how the integration of controlling can support strategic decision-making and increase business efficiency in a rapidly changing technological and market environment driven by Industry 4.0.

2. Literature Review

Controlling originated from the corporate role of the controller in the USA around the turn of the 19th and 20th centuries, with early functions emerging in rapidly growing companies, notably around 1880 with the Atchison, Topeka, and Santa Fe Railway System. Initially, tasks focused on financial issues related to bonds, shares, and securities. During this period, financial and cost accounting were distinct, with cost accounting primarily concentrating on production. As cost accounting evolved, so did controlling. The Controller's Institute of America was established in 1931, followed by the Controllership Foundation in 1944, which expanded the understanding of controllers' responsibilities beyond just accounting (Šiška 2013; Perović and Vujičić 2015). As American firms expanded into Europe, controlling became established in Central Europe, particularly in Germany, France, and Austria. Today, large corporations typically have dedicated controlling staff, while many small- and medium-sized enterprises have established separate controller roles. In Slovakia and neighboring countries such as the Czech Republic, Hungary, and Poland, controlling practices began to be implemented in 1991 (Foltínová 2011). In the professional and scientific literature, controlling is defined in various ways, but all definitions share similarities and aim to capture the essential features of controlling.

Controlling encompasses a range of tasks, including preparing financial reports, monitoring performance, and providing management advice (Goretzki and Strauss 2017).

The fundamental tasks of controlling involve planning, control, and management, collectively known as the "regulatory circuit". The planning process sets the main direction for the company for the next business year. Accurate control is facilitated by the company's reporting, and cause analyses address any deviations. The management process ensures adherence to the planned direction (Mann and Mayer 2000; Vollmuth 2004). Controlling encompasses numerous tasks across various business areas, culminating in reporting.

Thus, the identification of key performance indicators within controlling and reporting frameworks is essential.

The development of enterprise systems has provided management accountants with access to larger data stores and enhanced computing power. These systems enable accountants to use data analysis techniques for questions like what happened (descriptive analysis), what is likely to happen (predictive analysis), and what is the optimal solution (prescriptive analysis) (Appelbaum et al. 2017). Industry 4.0 is currently having a profound impact on the field of controlling by introducing advanced technologies and processes. The integration of the Internet of Things (IoT), artificial intelligence, and big data analytics has revolutionized traditional methods, enabled real-time data analysis, and facilitated proactive decision-making (Folgado et al. 2024). The application of artificial intelligence and real-time data collection enables controlling systems to respond more flexibly to changes and enhance cost efficiency by optimizing resource utilization. Industry 4.0 not only increases operational efficiency but also redefines the role of controlling functions in supporting strategic decision-making within industrial enterprises (IBM 2021). Technological innovations enable more efficient real-time data analysis, allowing for more flexible responses to changes and optimization of resource usage, which in turn increases cost-effectiveness. In the organizational structures of industrial enterprises, controlling has become a key tool for supporting operational and strategic decision-making and improving operational efficiency, thus significantly contributing to successfully adapting to the challenges of the modern industrial environment.

In many companies, the distinction between controlling and managing is unclear, creating confusion over the roles of controllers and managers. Controlling is essential for financial planning, liquidity management, and accounting oversight. Controllers are often confused with managers or financial directors due to their extensive responsibilities (Bragg 2012). A common issue is the overstaffing of administrative roles, with management often taking control and reducing delegation, despite acknowledging its inefficiency (Bagautdinova and Validova 2014). The integration of controllers within the organizational structure is crucial, as is clearly defining their job content, authority, and responsibilities. Thus, the organizational form of controlling is a key issue (Kobulnický and Kádárová 2013; Tamulevičienė 2019).

An organization comprises elements, relationships, and a structure that forms a cohesive unit. This structure, defining the essence of organizational activity, includes hard and soft elements. The hard dimension consists of material components such as groups and hierarchical units, while the relationships between these units represent the soft elements (Ahmady et al. 2016). Integrating controlling into a company's structure offers various alternatives: the controller may serve in an advisory role without decision-making authority, hold a line position with decision-making power, or adopt a cross-functional role that combines consulting and coordination with decision-making authority. This integration is vital for addressing serious deviations that threaten the company (Kobulnický and Kádárová 2013). Investigating the controlling department's position within industrial companies helps assess the need for repositioning to enhance efficiency. If internal quality is lacking, companies may outsource external controlling services. Discussions about offshoring controlling processes arise due to evolving cost structures from advancements in data usage. The digitalization of the business environment continually creates new opportunities for accounting information providers (Bhimani and Willcocks 2014). Problems with traditional integrations of the controller primarily arise from the existence of hierarchical structures, which can lead to issues with the flow of information, monitoring, and reporting of necessary data. These issues often result in difficulties in ensuring that data are provided with the required quality, structure, and timeliness for necessary expert analysis.

Problems with hierarchical structures have prompted companies worldwide to adapt by streamlining operations, reducing layers, downsizing, and laying off employees. Some managers are inclined toward a management revolution, altering their approach to organizational thinking. They are increasingly engaging with their organizations in fundamen-

tally different ways, viewing them not as a static hierarchy but as a portfolio of dynamic processes (Ghoshal and Bartlett 1995; Matošková et al. 2023).

To address the lack of integration of controlling in traditional management structures and avoid outsourcing, companies can utilize specific responsibility centers. Defining the type of responsibility center (RC) for the controlling department is essential for the effective functioning of the management control system, as it centralizes budgeting, evaluation, accounting, and performance stimulation (Huang 2019).

For business entities, transitioning to a new corporate architecture is a fundamental decision, particularly when creating a progressive, innovative organizational and management framework focused on digitalization. The rapid pace of development has led to new organizational structures and the abandonment of traditional line and line functional structures. The rise of unstructured production forms, advancements in information technology, and the development of the Internet have increased the potential for dynamic decision-making processes and expanded the number of alternatives to consider. New organizational structures should reflect these changes, enabling companies to innovate and enhance their flexibility (Váchal and Talíř 2020).

A study on the controlling system's impact on organizational structure reveals a reciprocal relationship between controlling and structure. Controlling influences organizational form across four dimensions: configuration, specialization, centralization, and formalization. Implementing a controlling system typically results in a simpler and clearer organizational structure, allowing for better definition of duties, powers, and responsibilities through budgeting, reporting, and coordination. Controlling establishes order within the organization (Lichtarski 2005). Additionally, managing business risks requires mutual, unofficial cooperation among departments (Hudáková and Lusková 2017). Another study highlights the importance of interactions between individuals, both formal and informal; the absence of a central controller; and the coexistence of formal and emerging roles in organizational structures. These challenges arise during organizational development. The rapid pace of environmental changes requires structures that enhance agility in processing information, transforming it into decisions in a flexible and adaptive manner (Vesga et al. 2018).

Organizations implementing controlling should focus on the quality of this management support method. Simple implementation of control is insufficient; proper execution is essential. It is crucial to develop functional, organizational, and instrumental control solutions tailored to the organization's characteristics and its operating environment (Bieńkowska 2020).

Based on the presented theoretical framework and findings from previous research, a gap in existing knowledge was identified. Consequently, the research was aimed to analyze the role of control within the organizational structures of industrial enterprises in Slovakia and to assess the extent to which the current integration of controlling necessitates organizational structural changes within companies.

3. Materials and Methods

The aim of the presented research was to determine the status of controlling within the organizational structures of management in industrial enterprises in Slovakia and to assess whether a change is needed in the current inclusion of controlling within the existing management structures.

The research methodology was based on similar studies focused on the transformation of controlling, where the positive effects of lean management are well-documented. These studies primarily highlight their impact on improving process efficiency, reducing costs, and increasing productivity. The results of Camelot's survey revealed how well companies understand lean management and the extent to which effective control mechanisms have been developed and are possibly already being used to optimize the achievement of corporate goals. Almost 40% of respondents have not yet explored the philosophy and methods of lean management. Around 15% have begun to explore lean management

and have implemented its initial methods. However, more than 45% of respondents are already actively engaged in lean management. Despite this, lean management is still more commonly applied in production areas than in administrative functions (Spieler and Roth 2023). The findings suggest that lean management in controlling still holds significant potential. Most planned lean initiatives within companies fail during implementation. According to the AME (Association for Manufacturing Excellence), up to 90% of all lean initiatives fail in practice (Spieler and Roth 2023). The transformation of controlling requires the company to reevaluate its organizational structure, hierarchy, and responsibilities. Identifying waste is essential not only when designing the processes within the framework of the new organizational structure but also in all other activities. Changes in organizational structure and communication motivate employees to overcome resistance and train senior managers, staff, and internal customers on the benefits of lean management (Eliferov and Repin 2019). Therefore, we decided to conduct quantitative research to identify the potential for the transformation of controlling in relation to its integration into the company's organizational structure. We also aimed to examine whether there is a relationship between the current integration of controlling into the company's organizational structure and the need for its transformation.

Figure 1 contains the sequence of steps we took to achieve the main aim of this research.

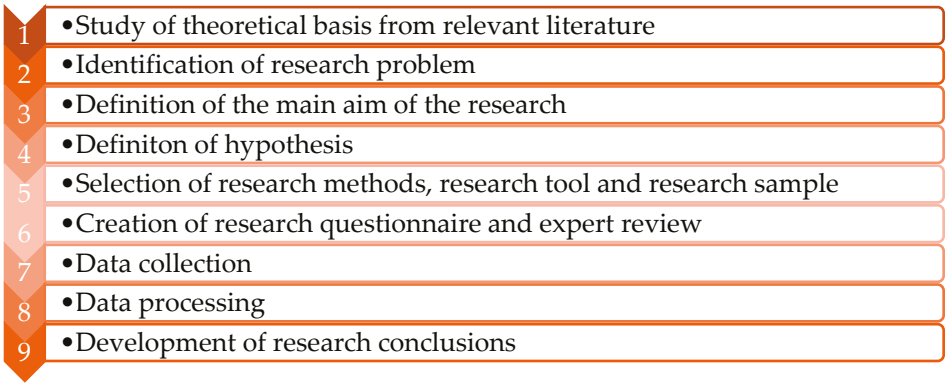

Figure 1. The overview of research phases (own elaboration 2024).

Quantitative research was conducted to understand the use of controlling, its extent of application within industrial enterprises, and the need for transforming controlling practices. A questionnaire was created for data collection and distributed in 2022 and 2023 by directly addressing financial or controlling departments. The questionnaire was distributed online. Respondents were contacted via email with a request to complete the questionnaire, and they indicated their consent to participate by clicking the "submit questionnaire" button. We selected medium and large enterprises as our research sample. Based on previous research and theoretical background, we assume that small enterprises typically do not have a dedicated controlling department, and the role of the controller is usually carried out by a member of the company's management. To be classified as medium or large enterprises according to the European Union categorization, at least two out of three criteria must be met: number of employees > 50, annual turnover > EUR 10 million, and total annual balance sheet amount > EUR 10 million. Subsequently, we used stratified sampling to proportionally select samples that represent companies from each region in Slovakia. The sample selection strategy ensured representativeness across various industrial sectors in Slovakia by focusing on a balanced selection of respondents from diverse sectors, each with different needs and approaches to controlling. This approach guaranteed that the research results are relevant to industrial enterprises across multiple sectors.

As a result, the research sample consisted of 150 medium and large industrial enterprises. To ensure an adequate sample size, we utilized a survey sample size calculator,

which, at a 95% confidence level and a 10% margin of error, determined a minimum required sample of 59. In total, 61 questionnaires were evaluated as correctly completed.

The questionnaire consisted of two parts. The first part was focused on the identification of the company (size of the company—large/medium; industry sector—automotive/mechanical engineering/electrotechnical/chemical/metallurgical/other; ownership—Slovak/foreign). The second part of the questionnaire contained questions aimed at answering the research hypothesis. The specific text of the questions and answers is as follows:

1. Does your company have a separate controlling department whose job is not only financial controlling, but also technical/cost controlling? (Yes/No).
2. How many employees does the controlling department in your company consist of? (1/2–4/More than 5).
3. What is the organizational integration of the controlling department in your company? (Line/Functional/Dotted line/External controller).
4. Do you consider that the organizational structure of the company requires change regarding the inclusion of controlling? (Yes/No).
5. What centers of responsibility does the controlling department use in your company? (Shared Services Centre/Centre of expertise/Outsourced services/None).
6. If you belong to a consolidated entity, do you have standardized reporting within the controlling departments (If you do not belong to a consolidated unit, skip the question)? (Yes/No).
7. What key performance indicators of production processes are the most important for you from the point of view of reporting (list at least 5)? (Available as promised/Number of quality notices with technical reasons/Improving technical systems/Timely delivery/Sickness rate in percentage/Number of complaints sent to suppliers/Control costs in the production process/Number of turnovers of average warehouse stocks/Change in purchase price/Productivity tied to material costs/Productivity tied to value-added cost types/Relative change in production costs/Average inventory turnover rate/Production efficiency/Material scrapping/Stocks/Production output in EUR/Production result of the company).

Respondents selected one answer for each question, except for question 7, where multiple answers were allowed.

The questionnaire underwent content validity testing, a critical step in ensuring its relevance and accuracy during the preparation process. Experts in finance and controlling conducted the content validation, assessing whether all key areas were adequately covered and whether the questions aligned with the primary challenges and topics in the field. This process was essential to ensure the questionnaire would gather relevant information and provide valid data for testing the hypothesis. The experts evaluated the clarity and phrasing of the questions to ensure that the respondents could easily understand and interpret them. It was vital that the questions were not only relevant but also expressed in a clear and comprehensible language, enabling respondents to provide precise and unambiguous answers. Content validity testing is a standard practice in studies and research where obtaining accurate and reflective responses is crucial. This step allowed us to identify and address potential ambiguities in the questions or the provided answer options, minimizing the risk of bias caused by unclear or incomplete responses.

The experts were selected based on their previous collaboration and their expertise in finance and controlling, while their work experience ensured the relevance of their assessments. Each expert independently validated the research questionnaire and provided feedback, which was then incorporated into the questionnaire. The process continued until no further comments or suggestions for adjustments were provided by the experts.

Data collection was conducted electronically, and the gathered data were subsequently processed and analyzed statistically.

To present the results, tables and graphs were constructed, showing absolute, relative, and cumulative frequencies. Statistical testing of the hypothesis was conducted using regression analysis and the chi-square test.

To fulfil the research aim, we set two research hypotheses (RHs).

RH1: *There is a statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the established reporting standardization within the controlling function.*

RH2: *There is a statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the need to change the organizational structure of the company regarding the inclusion of controlling.*

4. Results

In Slovakia, medium and large companies statistically use controlling significantly more than small companies (Sedliačiková et al. 2021a). These larger firms are also more resistant to perceived obstacles that could hinder controlling's practical implementation (Potkány et al. 2024). Small- and medium-sized companies often struggle with uncertainty and lack familiarity with controlling. For effective implementation, it is crucial for owners of small and medium enterprises to hire individuals proficient in controlling (Soósová 2011). Considering the background, we focused on medium and large companies in this research. The research sample consisted of 61 industrial companies based in Slovakia. The structure of respondents is shown in Table 1.

Table 1. Structure of research sample (own elaboration 2024).

Structure of Respondents	Absolute Values		Relative Values	
	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)	Cumulative Frequency (%)
Large company (over 250 employees)	45	45	73.77	73.77
Medium company (50–249 employees)	16	61	26.23	100.00
Automotive industry	21	21	34.43	34.43
Mechanical engineering industry	17	38	27.87	62.30
Electrotechnical industry	15	53	24.59	86.89
Chemical industry	1	54	1.64	88.53
Metallurgical industry	1	55	1.64	90.17
Other industry	6	61	9.83	100
Slovak company	58	58	95.08	95.08
Foreign company based in Slovakia	3	61	4.92	100.00

Based on Table 1, large companies participated in the research to a higher extent. Likewise, the most represented companies from the point of view of the company sector include the automotive industry, the mechanical engineering industry, and the electrical engineering industry. This fact corresponds to the distribution of industrial sectors within enterprises in Slovakia. In terms of ownership, most businesses are owned by Slovak owners.

Table 2 shows the distribution of companies, according to whether they have an autonomous controlling department.

Table 2. Companies from the point of view of an autonomous controlling department (own elaboration 2024).

Separate Controlling Department	Absolute Values		Relative Values	
	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)	Cumulative Frequency (%)
Yes	56	56	91.80	91.80
No	5	61	8.20	100.00

Based on Table 2, a significant majority (91.8%) of companies have an autonomous controlling department, whereas 8.2% do not have a separate controlling department.

Table 3 shows the respondents in terms of the number of employees who are engaged in controlling or work in the controlling department.

Table 3. Companies in terms of the number of employees involved in controlling or working in the controlling department (own elaboration 2024).

Number of Employees	Absolute Values		Relative Values	
	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)	Cumulative Frequency (%)
1	7	7	11.48	11.48
2–5	41	48	67.21	78.69
more than 5	13	61	21.31	100.00

As shown in Table 3, enterprises with two to five employees that are involved in controlling processes or work at the controlling department are the most represented. Only 11.5% of companies have controlling provided by a single employee. It can be concluded that a controlling function performed by just one employee is typically found in some medium-sized enterprises with fewer employees, where the role of the controller is taken on by a member of the management team. In such cases, the controller is often limited to conducting ad hoc analyses that may not provide substantial added value from a business management perspective. The organizational integration of the controlling department within the company is illustrated in Figure 2.

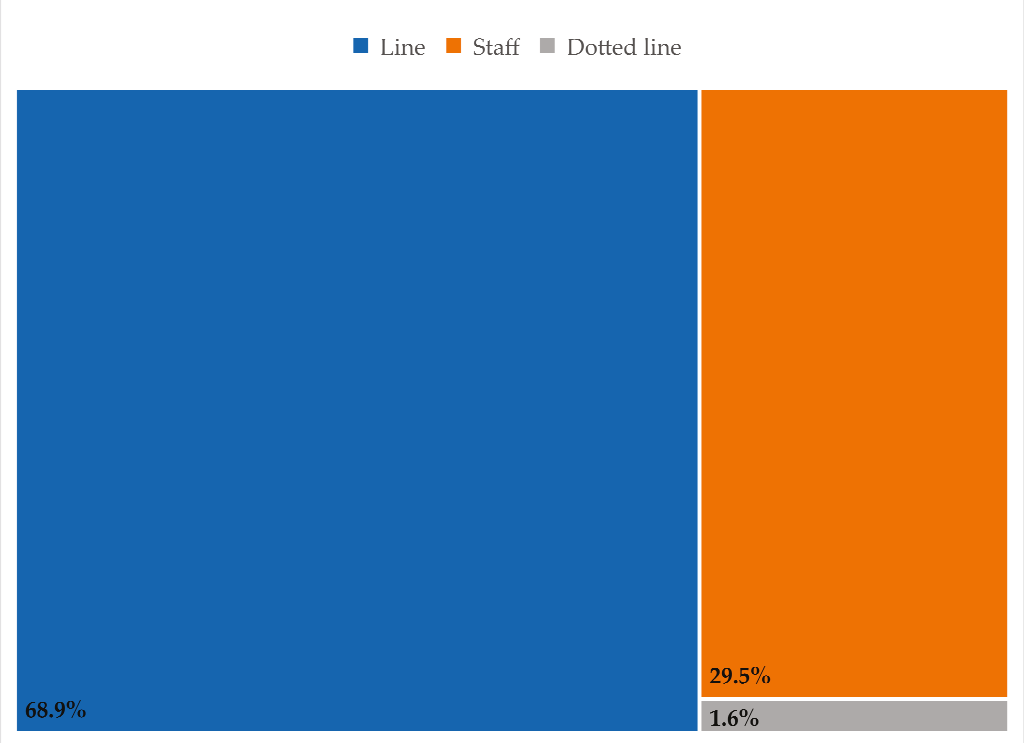

Figure 2. Responses for organizational integration of the controlling department in the company (own elaboration 2023).

Regarding the organizational integration of the controlling department, 68.9% of companies have line organizational integration, followed by staff organizational integration with 29.5%. Percentage of companies with controlling in the form of a dotted line within the

organizational structure is 1.6%. A leader in a dotted line is a person to whom employees report on specific projects or as a secondary superior (Kim 2023). We conclude that since 73.8% of the respondents are part of large companies, the largest companies have a line organizational integration of controlling. The controller is therefore on the same level as other members of management. The controller has decision-making authority as the head of production or the head of the economic department. Subsequently, we proceeded to investigate the representation of the respondents in terms of the use of support centers, as shown in Figure 3.

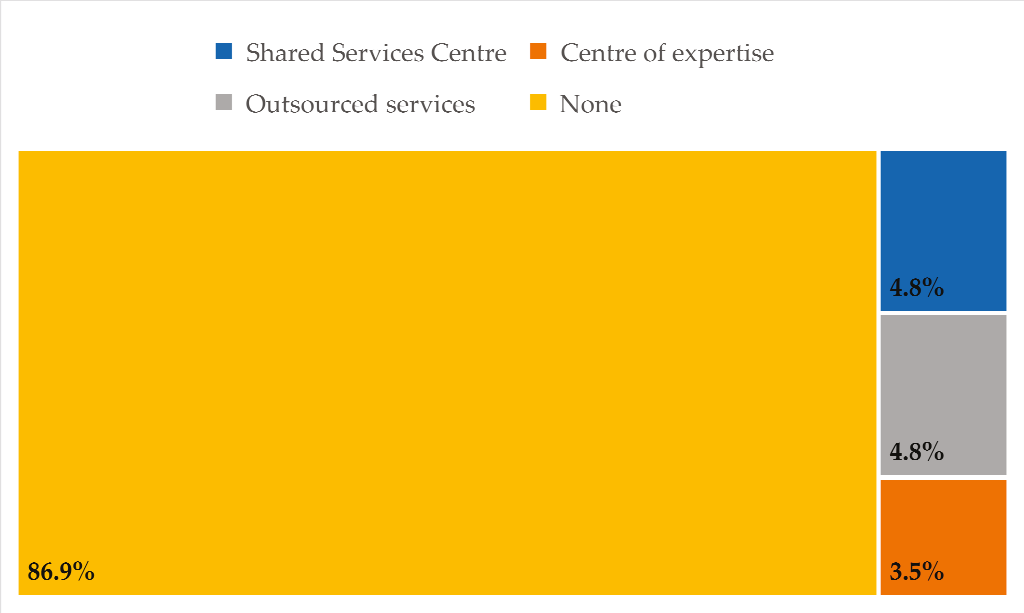

Figure 3. Enterprises in terms of using other internal or external departments to support controlling (own elaboration 2023).

The results shown in Figure 3 indicate that most companies have not implemented responsibility centers as part of their organizational structure, suggesting a lower level of formal specialization in controlling. Out of the 56 companies with dedicated controlling departments, only two utilize expert centers, which could indicate that controlling is not structured into specialized units with clearly defined competencies and responsibilities. The even lower occurrence of shared service centers (three companies) and outsourcing of controlling services (also three companies) suggests that firms are not widely relying on these modern organizational models. This may be due to several factors, such as a lack of resources for implementation, limited knowledge of the benefits of these approaches, or simply a preference for more traditional organizational models.

Based on the theoretical background and expertise of the authors' experiences, we proceeded to test the established hypotheses.

We established a null hypothesis for RH1:

RH01: *There is no statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the established reporting standardization within the controlling function.*

We then formulated an alternative hypothesis for the null hypothesis:

RH1: *There is a statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the established reporting standardization within the controlling function.*

Table 4 captures the structure of respondents belonging to the consolidated entity in terms of whether it has established reporting standardization within the controlling function.

Table 4. Respondents from the point of view of the standardization of reporting (own elaboration 2024).

Standardizing Reporting	Absolute Values		Relative Values	
	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)	Cumulative Frequency (%)
No	6	6	9.84	9.84
Yes	55	61	90.16	100.00

It can be seen from Table 4 that the respondents answered that reporting is not standardized in all companies. Despite that, the results that standardization of reporting is established in most companies, indicate a strong focus on efficiency, consistency, and improving the quality of decision-making. This approach enables companies to better respond to regulatory requirements and enhance confidence in the accuracy and comparability of data. The implementation of standardization also suggests advanced digitalization and the use of modern technologies to support management processes. The number of companies according to the current incorporation of controlling in the organizational structure and the standardization of reporting is shown in Table 5.

Table 5. The number of companies according to the current integration of controlling in the organizational structure and the standardization of reporting (own elaboration 2023).

Integration to the Organizational Structure	Standardization of Reporting		
	Yes	No	Sum
Line organizational structure	41	1	42
Functional organizational structure	13	5	18
Dotted-line organizational structure	1	0	1
Sum	55	6	61

As can be seen in Table 5, if the controlling department is integrated into organizational structure of company as line department, the standardization of reporting is implemented to the highest degree.

To test the null hypothesis, we chose regression analysis. Table 6 describes the regression model.

Table 6. Regression model summary (own elaboration 2024).

Model Summary				
Model	R	R Square	Adjusted R-Squared	Std. Error of the Estimate
1	0.401	0.161	0.147	0.277

As presented in Table 6, the correlation coefficient R is 0.401. This indicates a moderate dependence between the standardization of reporting and the method of incorporating the controlling department into the organizational structure of the company.

The coefficient of determination R-squared explains that 16.1% of the variability in reporting standardization is influenced by the incorporation of the controlling department into the organizational structure of the company. The analysis of variance, which indicates how well the regression model describes the data, is shown in Table 7.

The statistical indicator F, with a value of 11.323, represents the ratio between the explained variability of the model (regression) and the unexplained variability (residual)

and reflects the strength of the regression model. The significance value $p = 0.001$ is much lower than the standard accepted level of statistical significance $p < 0.05$, indicating that the model is statistically significant. The regression, representing the variability explained by the model, is 0.871, while the residual value is 4.539. The mean square for regression is 0.871, and it is 0.077 for residual.

Table 7. Analysis of variance (own elaboration 2024).

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	0.871	1	0.871	11.323	0.001
	Residual	4.539	59	0.077		
	Total	5.410	60			

The coefficients of the regression equation are presented in Table 8.

Table 8. Model coefficients (own elaboration 2024).

Coefficients [a]					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
1 (Constant)	0.801	0.095		8.402	0.000
What is the organizational integration of the controlling department in your enterprise?	0.221	0.066	0.401	3.365	0.001

[a] Dependent Variable: If your enterprise is part of a consolidated group, do you have standardized reporting implemented within the controlling departments?

The unstandardized coefficient has a value of 0.801, and the unstandardized coefficient b1 has a value of 0.221 The coefficient b1 means that if the level of integration of controlling increases by one unit, the value of implementing standardized reporting will increase by 0.221 units, assuming all other factors remain unchanged. The standardized coefficient beta is 0.401 at a significance level of $p = 0.001$, which is lower than the standard accepted level of statistical significance for accepting hypothesis H1, set at $p < 0.05$. The value of 0.401 indicates the relative strength of the independent variable's influence on the dependent variable. Due to standardization, this coefficient can be compared across different models. The beta coefficient shows a medium-strength positive impact of the integration of the controlling department on the implementation of standardized reporting. Since we have only one independent variable, the integration of the controlling department into the organizational structure of the company, the standardized coefficient beta is identical to the correlation coefficient R in Table 5. The results confirm that the organizational integration of the controlling department into the company's structure has a significant impact on the implementation of standardized reporting in the controlling department. Based on these results, we reject hypothesis H01 and accept hypothesis H1. The integration of the controlling department into the organizational structure significantly supports the implementation of standardized reporting, which can lead to more efficient management, better transparency, and more accurate decision-making.

Subsequently, we proceeded to test the second hypothesis. We established a null hypothesis for RH:

RH02: *There is no statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the need to change the organizational structure of the company regarding the inclusion of controlling.*

We then formulated an alternative hypothesis for the null hypothesis:

RH2: *There is a statistically significant relationship between the current inclusion of the controlling department in the organizational structure of the company and the need to change the organizational structure of the company regarding the inclusion of controlling.*

Responses of the respondents, regarding the need to change the inclusion of the controlling department within the organizational structure of the company, are in the Table 9.

Table 9. The need to change the inclusion of the controlling department within the organizational structure of the company (own elaboration 2024).

Need to Change	Absolute Values		Relative Values	
	Absolute Frequency	Cumulative Frequency	Relative Frequency (%)	Cumulative Frequency (%)
No	46	46	75.41	75.41
Yes	15	61	24.59	100.00

Table 9 shows that up to 75.4% of respondents do not need to change the organizational structure of the company. We conclude that the companies that answered in the previous question that their organizational integration of the controlling department is linear, that is, the controller is integrated at the same level as other members of the management, do not need to change the organizational structure. We note that in the remaining 24.6% of companies where the controller subordinates directly to the management and has no decision-making or executive authority, the management is not satisfied with this organizational structure. These results indicate that line integration of the controlling department is more effective in terms of management satisfaction compared to other forms of organizational structures. They also highlight that companies with insufficient decision-making autonomy for controllers could benefit from reorganization to better support strategic management and enhance the efficiency of controlling.

The number of companies according to the current incorporation of controlling in the organizational structure and need for change is shown in Table 10.

Table 10. The number of companies according to the current integration of controlling in the organizational structure and the importance of changing the organizational structure of the company, with regards to the integration of controlling (own elaboration 2023).

Integration Into the Organizational Structure	Need for Change		Sum
	Yes	No	
Line organizational structure	4	38	42
Functional organizational structure	11	7	18
Dotted-line organizational structure	0	1	1
Sum	15	46	61

As can be seen from Table 10, for a linear organizational structure, the option that no change in the organizational structure is needed was the most frequently indicated.

Subsequently, we tested the null hypothesis with the Chi-square test of independence, the results of which are shown in Table 11.

As we can see in Table 11, the *p*-value of the test of 0.0001 is less than the significance level of 0.05; we reject the null hypothesis. Thus, there is a dependency between the current organizational structure of the company and the perception of the need for change in the organizational structure. Based on the data and information from the respondents shown in Table 10, there is a need for change in companies that have a functional organizational

structure. One reason may be the need for greater decision-making competences within the controlling department, as controlling included in the functional organizational structure has only an advisory role, which can result in low efficiency. In a line structure, controlling has direct responsibility and authority within individual departments, which assumes that decisions are directly integrated into day-to-day management. Line integration of the controlling department also enables better communication between departments, as controlling is part of operational management and is in direct contact with other business functions. This integration also ensures quicker adaptation to changes, as it is directly involved in management processes and can respond flexibly to dynamic situations, unlike a staff or functional model, where there may be a delay between identifying the need for change and its implementation. From a cost-reduction perspective, when controlling is part of a line structure, it directly influences decision-making, contributing to cost optimization and more efficient resource utilization. We note that companies that have a line organizational structure do not need to change the organizational structure. Since the head of the controlling department is on the same level as the head of production or the head of the accounting department, the controller has decision-making authority.

Table 11. Chi-square for hypothesis H02 (own elaboration 2023).

Summary					
Count	Rows	Cols	df		
61	3	2	2		
Chi-square					
	Chi-sq	*p*-value	x-crit	sig	Cramer V
Pearson's	18.41437	**0.0001**	5.991465	yes	0.549431
Max likelih	17.57581	0.000153	5.991465	yes	0.536776
	Chi-sq	*p*-value	x-crit	sig	Cramer V
Pearson's	18.41437	**0.0001**	5.991465	yes	0.549431
Max likelih	17.57581	0.000153	5.991465	yes	0.536776

5. Discussion

The integration of controlling into a company's organizational structure affects not only the authority of the controlling personnel but also access to essential data for monitoring and reporting. Based on the results characterized in the previous subsection, in companies where the controlling department is integrated within a line structure, there is no perceived need for a transformation of controlling. One potential reason for this may be the fact that the line organizational structure has a clear hierarchy and management, which supports simple decision-making and effective management. Communication between managers and employees is also simplified, reducing the likelihood of misinterpretations or delays in the transmission of information (Gabriel and Chika 2020). Additionally, the line structure is effective in coordinating people and activities, allowing for better management of daily operations. Due to the vertical authority and the absence of a complex approval process, decision-making is faster compared to functional organizational structures (Nizma et al. 2024). Companies with functional organizational structures may require a greater need for change because these structures are less flexible in response to a rapidly changing environment, hinder communication, and slow down decision-making (Skripak et al. 2016). Increasing the efficiency of controlling in these companies could involve transitioning to a line organizational structure, which would simplify decision-making processes and support a clear hierarchy of responsibilities. At the same time, improving coordination through decentralization could enable more efficient use of controlling processes in support of strategic goals. Management should aim to eliminate losses from internal complaints, poor production quality, and customer dissatisfaction. Establishing an effective feedback system is vital for promptly signaling deficiencies and providing relevant information to address current issues. This highlights the importance of controlling as a critical management tool (Šatanová et al. 2015). Controlling intersects many company areas, and its perception varies

among individuals, ranging from monitoring cost consumption to complex consulting and future-oriented management. Research shows a focus on cost monitoring, calculations, and budget management (Potkány et al. 2022). Ultimately, controlling's primary task is to support management by generating reports essential for informed decision-making (Bestvinová 2022).

Many companies are currently influenced by new technologies and the growing volume of associated information (Gonos et al. 2016). New technologies are fundamentally changing strategic management in companies through digitalization, automation, and innovation. Companies face the pressure of rapidly adapting to technological changes that affect their ability to compete and improve efficiency (Kitsios and Kamariotou 2021; Dodgson 2021). Effective use of controlling provides significant benefits, contributing to competitive advantages, financial health, performance, and sustainability (Poláková et al. 2023). Control and controlling are also key tools of strategic management, supporting organizations in achieving their goals through planning, monitoring, and adjusting strategies. It includes both financial and non-financial indicators, enabling managers to make data-driven decisions and effectively adapt strategies to changing conditions (Martins et al. 2024). Thus, integrating controlling within organizational structures is crucial, as it defines the powers and responsibilities of the controlling department. The controlling function is evolving (Delaere and Ballon 2007), and despite new procedures from accounting, it remains a vital managerial task to prevent losses or chaos. Globally, there are two main approaches to controlling: the Western approach values individual responsibility and autonomy, while the Eastern approach emphasizes discipline and strict adherence to rules (Mišún 2018). Ultimately, controlling manages production quality through relevant information to meet goals and identify weaknesses in processes (Šatanová et al. 2015).

The controller plays a vital role in providing essential information for management, making integration within the company's management structure crucial. However, significant obstacles to implementing controlling tools include satisfaction with current performance measurements, high costs, and limited personnel and time resources (Teplická et al. 2019). It is essential to decide whether controlling will be managed by someone with other responsibilities or a dedicated employee. In large companies, evaluating the controlling department's position and integration is crucial. Existing departments must monitor effectiveness, and if issues arise, transformation options should be considered. It is incorrect to assume uniformity among companies within a single concern; each targets different markets and is influenced by local legislation and culture. Häll et al. (2023) state that national cultural influences shape organizational structures and management cultures, resulting in unique processes for each company.

The integration of companies into global concerns varies; some have a long history, while others are newly established, acquired, or still integrating operational programs. This research offers insights for companies on incorporating or transforming controlling within their organizational structure. Transforming controlling requires reassessing the company's structure, hierarchy, and responsibilities (Shafiee Kristensen and Shafiee 2019). A key finding is that successful implementation of new management concepts depends on employee support. Motivated employees who understand the need for controlling transformation can enhance its chances of success (Buhusayen et al. 2021). Monitoring and comparing changes enable organizations to leverage strengths and initiate development interventions (Ledimo and Nico 2014). One of the most critical factors in the transformation process is the top–down commitment of senior management. Their active involvement influences the entire project, including restructuring and cultural changes in employee attitudes toward quality. Education and training in lean management are essential for successful transformation. Changes in organizational structure and communication motivate employees to overcome resistance and educate internal customers—senior managers, teams, and departments—on the benefits of lean management (Alnadi and McLaughlin 2021).

To achieve better performance, processes must be controlled. Managing activities around these processes enhances the company's controllability, encourages controllers

to consider both internal and external customer perspectives, and helps align resources effectively (Nowosielski 2014; Tamulevičienė 2016).

6. Conclusions

Based on the evaluation of the research hypothesis, we confirm a dependency between the current organizational structure of the company and the perceived need for change, particularly in companies with a functional organizational structure in industrial enterprises in Slovakia. It can be concluded that companies in Slovakia need a transformation of controlling. Slovakia, the Czech Republic, Poland, and Hungary began implementing controlling around the same time (Foltínová 2011) and share a similar history, having transformed in the 1990s and entered the EU together in 2004. While cooperation continues within the EU framework (Kowalska et al. 2018), further research is needed to confirm if the situations in these countries are indeed similar by expanding the sample to include others. The biggest shortcoming for large companies is the low level of standardization in controlling processes, particularly affecting those with divisions in different geographical locations. Standardizing business processes aims to achieve consistency among core organizational processes, enhance service delivery efficiency, and optimize costs (Goel et al. 2023). Any form of standardization improves company functioning. This is crucial because controlling focuses on cost optimization, making standardization essential. It also involves implementing prescribed procedures that eliminate various forms of waste. Different types of standards include regulations, quality standards, technical standards, and process manuals.

Quality and productivity are closely related to workplace standards. While most companies have standards in place, employees often lack awareness or fail to adhere to them. Effective leadership is crucial for maintaining a quality management system, yet many organizations do not recognize its importance, leading to behaviors that deviate from effective leadership expectations (Riwayadi 2024). Standardizing work operations is necessary to ensure quality, safety, and efficient use of resources. Data standardization is essential for transforming controlling processes, although striving for perfect data integrity can be wasteful (Hikmawatty et al. 2024). Given the importance of monitoring and reporting for decision-making, it is essential to consider controlling as a fundamental support function within every organization. If controlling processes are ineffective, assessing the necessity and methods for transforming them is crucial.

From the perspective of research recommendations derived from the findings, it is advisable to re-evaluate the use of the functional organizational structure within the controlling department and consider its reorganization to more clearly define decision-making competencies. Another recommendation is to introduce decision-making authority within the controlling function, allowing the controlling department to directly intervene in processes and more effectively support management and performance optimization. Following the implementation of these changes, companies should regularly monitor and analyze the extent to which the transformation of controlling has delivered the expected benefits, such as improved decision-making processes and streamlined operating costs.

The main theoretical contribution of this study is the expansion of knowledge regarding the position of the controlling department within a company's organizational structure. The study highlights the need to adapt controlling in different organizational structures, thereby developing the theory on the relationship between organizational structure and the need for controlling transformation. It also provides a new perspective on how the integration of controlling can support strategic decision-making and increase business efficiency in the context of a rapidly changing technological and market environment. In terms of practical implications for managers, it points out that for companies with non-line organizational structures, controlling needs to be adjusted to support collaboration between departments and provide managers with an integrated view of performance. Considering various decision-making lines can lead to increased efficiency and strategic planning. Within a line structure, controlling effectively supports decision-making due to the clear

hierarchy and direct communication. It is also important to emphasize the role of new technologies. Managers should implement new digitalization technologies, such as artificial intelligence or big data, to gain a competitive advantage and respond more flexibly to a dynamic environment. To improve the integration of controlling, managers should adapt controlling processes in non-line organizational structures to foster collaboration between departments and create an integrated view of the company's performance. Additionally, they should simplify decision-making lines in line-based structures, enabling more efficient planning and supporting faster decision-making.

Among the limitations of the research, the size of the research sample can be noted, which would benefit from being supplemented with additional companies to enhance the sample's representativeness. The number of respondents may limit the ability to generalize the results, and the findings could be skewed, not fully reflecting the broader reality of different companies and organizational structures. For more robust conclusions, a larger and more diverse sample would be needed. However, due to the difficulty of obtaining relevant respondents, such research would require a much longer timeframe. Another research limitation is the fact that a larger number of experts for questionnaire validation could have increased the reliability and applicability of the questionnaire. The experts were exclusively from the fields of finance and controlling, and a broader perspective from experts in organizational structures or strategic management could have expanded the results.

The generalization of research results to similar cases or situations is possible based on the sharing of the same characteristics and patterns (industry-oriented enterprises, large- and medium-sized enterprises, and geographical location).

Future research directions should focus on the reporting, including a more detailed examination of report contents and ways to improve the efficiency of controlling reports. It would also be valuable to explore the integration of controlling in other sectors, such as services or public organizations, to identify specific needs. These sectors face different challenges and needs in controlling, which could reveal new approaches and strategies. Research focused on these areas would provide valuable insights for companies outside of traditional industry sectors and would also help expand theoretical frameworks to encompass various types of organizations. Additionally, further research could focus on identifying regional differences, studying the application of controlling in companies from different countries while considering cultural, economic, and legislative specifics. Such research could uncover how economic and cultural contexts influence the way businesses implement and manage controlling. Comparative studies between industries and regional contexts would contribute to a better understanding of flexible approaches to integrating controlling across different enterprises and cultures. Another area of future research is undoubtedly examining companies that have undergone specific forms of transformations in their controlling departments and identifying the associated benefits or limitations. Further research could focus on creating a model to analyze various levels of decision-making authority within controlling and their impact on business performance. This model could simulate the effects of different degrees of autonomy in controlling on decision-making efficiency across different areas of the enterprise. In terms of transforming the controlling department, quantitative methods such as regression models or efficiency analysis could be applied to identify the specific benefits of reorganizing controlling. Another direction is focused on incorporating quantitative approaches to explore the potential application of emerging technologies in controlling. This includes investigating how tools like big data analytics, artificial intelligence, and automation can be effectively integrated into controlling practices, and analyzing their impact on decision-making, efficiency, and cost optimization in companies.

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The Impact of E-HRM Tools on Employee Engagement

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Abstract: The examination of the impact of digital innovations on employee motivation and engagement is crucial given the rapid technological advancements. This study focused on digital HRM practices, such as digital interaction platforms. The results indicated that respondents generally had positive to neutral views on these practices, with big data analytics receiving the highest rating for its potential to enhance organizational performance and employee engagement. The study revealed a moderately strong positive correlation between the use of digital platforms and big data analytics, suggesting a holistic approach to digital transformation in HRM. However, a weak correlation between digital innovations and engagement suggests that the direct impact of digital tools on employee engagement is limited by other factors. Larger companies tend to implement advanced digital HRM practices more due to their greater resources. The study's limitations include a restricted sample from the Central and Eastern European region and reliance on self-assessed data. Future studies should include more diverse regions and long-term studies, combining quantitative data with qualitative insights. Digital innovations in HRM offer promises for process improvement and data-driven decision-making, but their impact on employee engagement is complex and requires an integrated approach of technological and managerial practices.

Keywords: digital innovations; employee motivation; engagement; managerial practices

1. Introduction

The topic of the impact of digitalization in human resource management (HRM) on employee motivation is not new, with the concept existing since the early 20th century. However, recent advances in data availability, computational tools, and interdisciplinary innovations have significantly increased its impact. Research shows that digital HRM practices, such as big data analytics and the resulting digital training or digital performance evaluation, have a significant impact on employee motivation and consequently on their job performance (Huselid 2018; Burnett and Lisk 2021).

The use of digital platforms for interaction between employees and management is another critical factor influencing employee motivation. Al-kharabsheh et al. (2022) emphasize that these practices can lead to increased employee engagement, which directly impacts their performance. Furthermore, e-HRM practices focusing on the development of employee skills and motivation can lead to the creation of sustainable e-HRM systems. These systems subsequently improve the overall performance of the company, as evidenced by studies from Bag et al. (2022) and Stareček et al. (2021).

Digital HRM practices are thus not merely technological enhancements but strategic tools that can significantly contribute to organizational success. Implementing advanced digital solutions in HRM, such as big data analytics, digital training, digital performance evaluation, and digital interaction platforms, can substantially increase employee motivation and overall company performance (Urbancová and Vnoučková 2015; Vetráková and Smerek 2019; Wojčák et al. 2018). However, the implementation of these solutions

requires a holistic approach that encompasses not only technology but also managerial and organizational changes to fully realize their potential.

This article critically analyzes the impact of digital innovations on employee motivation and engagement, addressing the growing need for research that examines the practical applications and consequences of digital tools within human resource management (HRM). Specifically, the study responds to calls for deeper exploration of how technologies such as big data analytics and digital interaction platforms shape employee experiences, engagement, and overall motivation (Huselid 2018; Al-kharabsheh et al. 2022). By leveraging organizational theory, this article provides a detailed evaluation of how these innovations transform traditional HR processes, offering a novel perspective on their strategic value.

The originality of this research lies in its focus on the relationship between digitalization and employee engagement, a topic that has been insufficiently examined in the existing literature (Burnett and Lisk 2021). While many studies have explored the technological benefits of digital HRM tools, few have comprehensively investigated how these tools affect human aspects, such as motivation and engagement. The central puzzle addressed by this research is whether digital innovations, often designed to improve efficiency and productivity, enhance or detract from employee engagement, particularly in the context of Central and Eastern Europe (Bolli and Pusterla 2022). This research aims to fill this gap by addressing the question: How do digital HRM practices influence employee motivation and engagement, and what specific conditions enhance or limit these effects?

The theoretical framework of this study is rooted in organizational theory, focusing on how digital technologies transform internal communication, decision-making, and the delegation of autonomy to employees. The study aims to illustrate the multifaceted nature of digital HRM practices by examining both technological and managerial aspects (Stofberg et al. 2021). The methodology employed combines quantitative survey data with qualitative insights from in-depth interviews. This dual approach enables a more comprehensive understanding of how digital innovations are integrated into HRM strategies and their impact on employees.

This article offers several significant contributions to the field of HRM. First, it addresses a gap in the literature by exploring the dual impact of digital innovations on both organizational performance and employee engagement. Second, the study's findings reveal that while digital tools such as big data analytics and digital interaction platforms can enhance organizational efficiency, their effect on employee motivation is complex and mediated by factors such as management style, organizational culture, and the extent of digitalization (Chan et al. 2021). These insights provide valuable guidance for organizations seeking to balance technological advancements with human-centered management practices.

In the following sections, the article will progressively explore the key aspects of this research. Initially, we provide an overview of the current literature on digital innovations in HRM, with a focus on their influence on employee motivation and engagement. Subsequently, the research methodology is presented, including a comprehensive explanation of the research design, data collection processes, and analytical techniques. This is followed by an in-depth analysis of the results, which are drawn from data collected from companies in Central and Eastern Europe. The discussion then elaborates on the implications of these findings, both from a theoretical and practical perspective. In conclusion, the paper synthesizes the main insights, addresses the study's limitations, and offers suggestions for future research directions.

2. Literature Review

Academic literature is increasingly focusing on the study of employee engagement, examining a wide range of factors that influence this concept. The study by Susanto et al. (2023) highlights the importance of motivation, job satisfaction, and leadership as key elements that enhance employee engagement, which subsequently leads to improved performance and productivity within organizations. This research emphasizes the interconnection between these factors and their impact on work performance. Additionally,

Pincus (2022) proposes a more sophisticated model of engagement that integrates employees' psychological needs, such as autonomy and recognition. This model demonstrates that engagement is linked to fundamental human motives and that its sustainability depends on the organization's ability to support these needs. González-González and García-Almeida (2021) further develop the idea that engaged employees are more proactive in generating innovations, which, in turn, enhances the organization's adaptability to changing conditions. Moreover, according to Eliyana et al. (2019), organizational culture and the work environment play a decisive role in employee engagement. Their study shows that a positive work atmosphere and effective leadership style directly promote job satisfaction and contribute to increased employee performance. Collectively, these studies highlight that employee engagement is not simply the result of individual factors but a complex process in which motivation, organizational structure, and leadership intersect, with all of these aspects being critical for the long-term success of an organization.

Generally, it is often expected that the digitalization of the work environment contributes to increased engagement due to higher productivity, simplified interactions with colleagues and supervisors, greater worker autonomy, and flexible forms of work (Stofberg et al. 2021; Okkonen et al. 2019). A study focused on Generation Y employees in Malaysia published on SpringerLink confirms that younger employees are more engaged and satisfied when they have access to digital tools that facilitate communication and collaboration. This factor is crucial for retaining talent and reducing turnover, as younger employees seek a modern work environment that allows for flexibility and efficiency (Shahruddin and Daud 2018).

The results of a study by Bolli and Pusterla suggest that digitalization has a rather negative impact on employee job satisfaction. The increased time pressure caused by digitalization has a slight negative impact on job satisfaction, and the deteriorating work-life balance negatively affects job satisfaction. Analyses also show that this negative impact is more pronounced among men, employees over 35 years old, and those in executive positions. Conversely, the positive impact of digitalization on job satisfaction due to increased autonomy is seen in women and younger employees. In terms of productivity, digitalization is more beneficial for women, older workers, and non-executive employees. The positive impact on job satisfaction through simplified interaction with colleagues and supervisors is greater among non-executive employees than among executives (Bolli and Pusterla 2022).

Stofberg's research examines the impact of digitalization on employee engagement and creative teams. It shows that workplace digitalization and an innovative culture significantly influence employee engagement. Employees' digital literacy moderates the relationship between workplace digitalization and employee engagement (Stofberg et al. 2021). Similarly, the results of the study by Chan et al. indicate that employees' digital skills significantly increase their engagement in a digitally innovative workplace (Chan et al. 2021). This highlights the need to improve employees' digital literacy to increase their engagement. Providing training and skill development ensures that employees are better prepared for technological changes, leading to higher satisfaction, motivation (Cetindamar et al. 2021; Nikou et al. 2022), and engagement (Cetindamar Kozanoglu and Abedin 2021).

In the context of workplace digitalization, it is also important to focus on a managerial orientation towards employees. Studies by McKinsey & Company show that a people-centered approach helps improve collaboration and innovation, leading to better employee engagement and overall company performance (Bachmann et al. 2021). When implementing productivity and efficiency initiatives, employees' highly specialized knowledge offers potential for local adjustments and improvements. Moreover, employees who feel part of the change process and that their opinions and needs are considered are more motivated and engaged. Such bottom-up contributions typically require employees to "buy into" top management initiatives (Schneider and Sting 2020). Managers who actively communicate with employees and explain the reasons, consequences, and roles of employees in digital-

ization processes alleviate their concerns and resistance to change, ultimately increasing their engagement and motivation towards the initiative (Blštáková et al. 2020).

An important aspect is also the analysis of how digital platforms can improve communication and collaboration among employees, directly affecting their engagement and motivation (Copuš et al. 2019; Fajčíková and Urbancová 2019; Lorincová et al. 2019; Heim and Gierlich-Joas 2022; Aliyev 2024). Additionally, increased autonomy and flexible working conditions brought by these technologies can be key to retaining talent and reducing turnover. Although digitalization has the potential to improve the work environment, it is also necessary to pay attention to possible negative aspects, such as increased time pressure and the disruption of work-life balance.

In recent years, the importance of digital interaction platforms has significantly increased. Many organizations have transitioned to remote or hybrid work models, increasing the need for effective communication tools (Pal and Vanijja 2020; Howlett 2022). These platforms allow employees to communicate, collaborate, and share information electronically and in real time, which is crucial for the modern work environment. Platforms such as Yammer, Workplace by Meta, Asana, Trello, Zoom, Microsoft Teams, and Google Meet enhance collaboration and communication among employees regardless of their geographic location, which is essential for maintaining productivity and an innovative environment within organizations (Zhang et al. 2022; Tudose et al. 2023). Effective communication tools can significantly increase productivity by reducing the time needed to exchange information, discuss projects, and resolve emerging issues, leading to higher team efficiency (Zhang et al. 2022). Digital platforms also support innovation by creating a favorable environment for the emergence of new ideas and solutions (Tudose et al. 2023). With the capabilities these platforms bring in data analysis and feedback, managers can make better decisions, respond more quickly to changes, and optimize processes in real time (Kunath and Winkler 2018).

In recent years, the significance of digital platforms for interaction within HR has greatly increased, particularly in their role in supporting complex human resource management processes. Platforms such as Microsoft Teams, Slack, and Trello significantly contribute to real-time feedback management (Lechermeier et al. 2020). Building on this, Chalutz Ben-Gal (2019) in her study "Strategic HR Analytics: Shaping the Future of Human Resources" explores the impact of reports generated through digital analytical tools on HR decision-making processes. Furthermore, digital tools for training and development, such as Zoom and Google Meet, enable managers and trainers to efficiently train employees remotely, providing flexibility and real-time access to training materials (Hongsuchon et al. 2022). Additionally, digital onboarding tools using interactive platforms significantly improve the social adaptation of new employees and accelerate their integration into the organizational culture (Petrilli et al. 2022; Sani et al. 2023). Successful implementation of digital interaction platforms can thus provide companies with a significant competitive advantage.

The emerging field of workforce analytics promises significant improvements in organizational performance and career management of employees (Huselid 2018). Organizations have never had so many opportunities to measure and evaluate workforce effectiveness. While not all companies have adopted the available tools and technologies, leading ones have already utilized new technologies to track productivity, sales, customer satisfaction, workflows, quality, and workplace interactions frequently, sometimes in real time (Burnett and Lisk 2021; Skorupińska et al. 2024; Jankelová et al. 2020; Papula et al. 2019). Big data analytics enables the examination of large and diverse data sets (Mateen et al. 2024; Vassakis et al. 2018). This process involves using advanced analytical techniques, algorithms, and tools to extract hidden patterns, correlations, trends, and other useful information. Additionally, the tools for synthesizing and analyzing this data have rapidly advanced in recent years, with more common availability of statistical modeling, machine learning technology, and artificial intelligence applications (Raschka et al. 2020). Big data analysis using statistical analyses, machine learning, or text analysis through platforms like R and Python allows for trend identification (Bruce et al. 2020). Properly applied analytics help optimize processes and identify at-risk employees, taking mea-

sures to retain them (Luchtenberg and Migliorini 2022; Stephan et al. 2016). Tools such as SAP, SuccessFactors, and Workday provide comprehensive talent management solutions (De and Baroi 2022). The analysis results are then presented through various visualization tools such as charts, dashboards, and interactive maps via platforms like Tableau and Power BI, enabling managers and HR specialists to quickly understand findings and make informed decisions (Carlisle 2018). However, when it comes to measuring and tracking employee engagement, most companies still evaluate engagement on an annual or longer basis using traditional survey techniques (Burnett and Lisk 2021). Big data analytics in HR, particularly when incorporating analog and biometric data, provides organizations with the ability to gain deeper insights into the multifaceted factors that influence employee engagement and motivation. This analytical framework aids in identifying the underlying causes of low engagement, predicting potential risks to employee performance, and optimizing the effectiveness of interventions targeted at fostering employee engagement and motivation. By leveraging such data-driven insights, HR professionals can implement more strategic and impactful workforce management practices, ultimately enhancing overall organizational performance.

Current trends in enhancing organizational performance focus on two main areas. The first involves improving performance through the implementation of digital platforms used for direct performance analysis (Štaffenová and Kucharčíková 2023; Nedeliaková et al. 2019; Stareček et al. 2023), trend forecasting, and supporting employee interactivity. The second area focuses on increasing employee engagement (Tej et al. 2021) and motivation in a constantly changing environment influenced by the implementation of digital innovations.

Previous research on the digitalization of the work environment has predominantly focused on issues related to the use of new technologies and their application in supporting and stimulating employee engagement (Stofberg et al. 2021; Heim and Gierlich-Joas 2022). Additionally, the impact of implementing digital technologies on shaping and transforming organizational culture has been analyzed (Aliyev 2024). However, a research gap exists in examining whether the use of big data analysis on employees and digital communication tools for transmitting personnel and work-related information within HRM leads to adjustments in personnel policies in such a way that employee engagement ultimately increases. Given that HRM establishes personnel policies aimed at enhancing motivation and engagement, the proper use of big data analysis and digital tools can contribute to optimizing these policies, which, in turn, may foster greater employee engagement and well-being.

3. Materials and Methods

To gather existing theoretical and empirical knowledge relevant to the research questions, electronic scientific databases such as EBSCO HOST Research Databases, SCOPUS, Web of Knowledge, and Web of Science were used. The process involved defining search terms based on the research questions, conducting the searches, sorting the results by relevance, critically evaluating the selected literature to identify key findings and gaps, and summarizing these findings to create a theoretical foundation for the study.

These findings served as the foundation for formulating hypotheses aimed at examining the relationships between employee engagement, digital interaction platforms, and the use of big data analytics in the context of human resource management (HRM).

Hypothesis 1 (H1). *Employee engagement has a positive correlation with digital interaction platforms. This is based on the premise that digitized communication platforms, such as Microsoft Teams, Slack, or Trello, could potentially enhance employee engagement. While the literature suggests that these tools improve collaboration and communication (Al-kharabsheh et al. 2022), it has not yet been conclusively demonstrated that they have a direct and measurable impact on employee engagement. Thus, H1 is focused on verifying whether these platforms indeed lead to increased employee engagement.*

Hypothesis 2 (H2). *Digital interaction platforms and big data analytics are positively correlated. This explores whether companies utilizing digital interaction platforms are also effectively implementing big data analytics within HRM. This hypothesis does not assume that these two elements are automatically linked but seeks to determine whether their combined use occurs in practice. The literature does not yet provide clear support for this connection, so the goal is to assess whether these technologies function together or are implemented independently.*

Hypothesis 3 (H3). *Employee engagement has a positive correlation with big data analytics suggests that big data analytics could help optimize personnel policies, which in turn could increase employee engagement. Although theory supports the importance of employee engagement for organizational success, it has not been conclusively proven that the use of big data in HRM directly leads to increased engagement. Therefore, empirical testing is needed to verify whether big data analytics contributes to the optimization of these policies and, subsequently, to higher employee engagement.*

The aim of the questionnaire design and data collection was to assess the current level of implementation and future expectations of digital innovations in human resource management and the concept of supporting employee engagement and motivation. Google Forms were used for the distribution and collection of data. The questionnaire was designed to comprehensively map the extent of the application of modern tools and concepts in human resource management, the perceived importance of these tools and concepts for the future of the company. For the purposes of this study, we focused on questions related to digital innovations and their role in employee engagement and motivation strategies. Specifically, the following three questions were utilized:

- To what extent do you consider employees in your organization to be engaged in their work and contributing to the achievement of organizational goals?
    - Very low—Employees are minimally engaged in their work and contribute only to a basic extent toward organizational goals.
    - Low—Employees show limited engagement and rarely contribute beyond their core responsibilities.
    - Moderate—Employees are moderately engaged and regularly contribute to the organization's goals.
    - High—Employees are actively engaged and frequently contribute beyond their core responsibilities.
    - Very high—Employees are fully engaged, continuously contributing, and identify with the organization's goals.
- To what extent do you implement big data analytics of analog and/or biometric data to evaluate employee well-being and engagement levels in your organization?
    - Not implemented
    - Not yet implemented, but planned in the near future
    - Unable to assess the level of implementation
    - Partially implemented
    - Fully implemented
- To what extent do you use digital platforms for interaction and HR management in your organization?
    - Not used
    - Not yet used, but planned in the near future
    - Unable to assess the level of usage
    - Partially used

The distribution of the questionnaire took place from January to September 2020 and from March to December 2021, targeting managers responsible for human resource management in companies from Central and Eastern Europe. The composition of respondents was

determined considering the size of the enterprise by the number of employees to achieve a double-digit number of representatives in various size categories.

The authors of this article are members of an international research consortium consisting of 55 researchers from Europe. As part of the research conducted by this research network, more than 3000 managers from the private sector operating in Central and Eastern Europe, responsible for managing and developing human resources in their companies, were contacted. The selection of respondents in each country was random. In the context of the study conducted by the authors of this article, several surveys were conducted on a cumulative sample of more than 1550 managers (in the years 2020 and 2021) representing entities in the private sector. Out of the total number of 1552 companies contacted in 2020, 1112 questionnaires were fully completed, representing a participation rate of 72%. Similarly, in 2021, out of the total number of 1558 companies contacted, 1109 questionnaires were carefully completed, representing a participation rate of 71%. Specific demographic data of respondents, categorized by workforce size and business sector are provided in the Table 1.

Table 1. Workforce size, business sector structure.

Number of companies by size (number of employees):	**2020**	**2021**
1–9	324	326
10–49	242	244
50–249	243	243
250 and more	303	296
Number of companies by industry sector:	**2020**	**2021**
Industry	363	362
Services	493	500
Other	256	247

Source: own processing from survey data.

The authors used basic descriptive statistics for the initial processing of the collected data. The aim was to provide an overview of the distribution of values and their variability for the individual studied areas. They used indicators such as mean values, medians, modes, standard deviations, and variances, which allowed them to gain a basic understanding of the values of the variables of engagement, digital interaction platforms, and big data analytics.

To gain a deeper understanding of the relationships between the variables, the authors utilized Spearman's correlation analysis. This method allowed them to determine the strength and direction of relationships between individual variables, thus verifying the stated hypotheses. The correlation matrix showed which variables are positively correlated, allowing the authors to identify key relationships between the studied factors.

To verify the independence between pairs of variables, the authors applied the Chi-squared test. This test enabled them to assess whether there is a statistically significant dependency between the individual variables. Using this method, they identified which variables are dependent on each other, thus confirming or refuting their hypotheses about the relationships between the variables.

To determine whether the size of the enterprises affects the results, the authors used the Kruskal–Wallis test. This non-parametric test was chosen because their data are ordinal and the groups have different sizes. The Kruskal–Wallis test allowed them to compare multiple groups and determine whether there are statistically significant differences between them, providing a deeper insight into the impact of enterprise size on the evaluated areas.

4. Results

The authors of the paper initially processed the collected data using basic descriptive statistics. These statistical indicators provide an overview of the distribution of values and their variability for the individual areas studied. The following Table 2 presents the

mean values, medians, modes, standard deviations, and variances for the variables of engagement, digital interaction platforms, and big data analytics.

Table 2. Basic Descriptive Statistics for the Variables of Engagement, Digital Interaction Platforms, and Big Data Analytics.

Variable	Engagement	Digital Interaction Platforms	Big Data Analytics
Mean	1.940789	2.368421	2.911184
Median	2	2	3
Mode	2	2	2
Standard Deviation STDEV.S	0.944828	1.340949	1.428818
Variance	4	4	4

Source: own processing from survey data.

The data presented in Table 3. indicates that the majority of respondents rated the examined areas positively. Average values on a five-point scale for different aspects are as follows: employee engagement achieves an average score of 1.94, suggesting that employees in organizations are somewhat engaged in their work, although there is still room for improvement. Digital interaction platforms used in HRM are rated with an average score of 2.37, indicating a limited level of use. The highest average score was recorded in the area of big data analytics in HRM, with an average of 2.91, suggesting that the companies in the sample still utilize these tools relatively infrequently for employee assessment.

Table 3. Spearman Correlation Matrix.

Variable	Engagement	Digital Interaction Platforms	Big Data Analytics
Engagement	1.000		
Digital Interaction Platforms	0.161	1.000	
Big Data Analytics	0.169	0.609	1.000

Source: own processing from survey data.

The average values, which are close to the midpoint of the scale, reflect slightly positive opinions from respondents on these areas, but highlight the necessity for improvement in certain aspects. Other statistical indicators, such as the median and mode, which mostly score at 2, confirm the overall tendency toward slightly positive responses. The variability in responses is most pronounced in the evaluation of big data analytics, which may indicate differing levels of adoption of these technologies in the analyzed organizations.

To gain a deeper understanding of the relationships and to verify the stated hypotheses, the authors conducted a Spearman correlation matrix. This matrix shows the strength and direction of the relationships between all variables.

The overall results indicate varying levels of positive correlations between the variables. The strongest moderately strong positive correlation, with a coefficient of 0.609, is between digital interaction platforms and big data analytics. Conversely, engagement shows only very weak positive correlations with the other variables: 0.169 with big data analytics and 0.161 with digital interaction platforms.

Hypothesis 1 (H1). *Engagement has a positive correlation with digital interaction platforms—was not supported. The Spearman correlation coefficient between engagement and digital interaction platforms is 0.161, indicating a very weak positive correlation. This result shows that respondents' engagement has only a very weak relationship with the use of digital interaction platforms.*

Hypothesis 2 (H2). *Digital interaction platforms and big data analytics are positively correlated—was supported. The Spearman correlation coefficient between digital interaction platforms and big*

data analytics is 0.609, indicating a moderately strong positive correlation. This means that higher use of digital interaction platforms is associated with higher use of big data analytics.

Hypothesis 3 (H3). *Engagement has a positive correlation with big data analytics—was not supported. The Spearman correlation coefficient between engagement and big data analytics is 0.169, indicating a very weak positive correlation. This result shows that respondents' engagement has only a very weak relationship with the use of big data analytics.*

Based on the findings, we conducted a Chi-squared test for each pair of variables to test the independence between them. The test results are presented in the following Table 4.

Table 4. Chi-squared test.

Variable 1	Variable 2	Chi2	*p*-Value	Degrees of Freedom
Engagement	Digital Interaction Platforms	58.82	8.25×10^{-7}	16
Engagement	Big Data Analytics	53.37	6.57×10^{-6}	16
Digital Interaction Platforms	Big Data Analytics	567.06	2.19×10^{-110}	16

Source: own processing from survey data.

The Chi-squared test results confirm that there is a statistically significant dependency between all examined pairs of variables. The very low *p*-values (much less than 0.05) indicate that the dependencies between the variables are statistically significant and cannot be attributed to chance. The strongest dependency was found between digital interaction platforms and big data analytics (Chi2 = 567.06, $p = 2.19 \times 10^{-110}$), consistent with our previous findings from the Spearman correlation analysis. These conclusions support the claim that companies simultaneously invest in the development of digital innovations and increasing employee engagement, with the greatest emphasis on the connection between digital interaction platforms and big data analytics.

The authors were also interested in whether the results could vary depending on the size of the enterprise. Therefore, they decided to use the Kruskal–Wallis test to determine if the size of the enterprises plays a role in the results. This test was chosen because the data are ordinal, the independent groups have different sizes, and the assumptions for parametric tests like ANOVA were not met. The Kruskal–Wallis test allows comparing multiple groups and determining if there are statistically significant differences between them, providing a deeper insight into the possible impacts of enterprise size on the evaluated areas. The results of the test for the variables engagement, digital interaction platforms, and big data analytics based on the size of the enterprise are shown in the following Table 5.

Table 5. Kruskal–Wallis test.

Column	Kruskal–Wallis Stat	*p*-Value
Engagement	4.32	0.229
Digital Interaction Platforms	8.67	0.034
Big Data Analytics	6.11	0.107

Source: own processing from survey data.

As Table 6. indicates, for the variable engagement, the *p*-value of 0.229 suggests that the differences between the groups (based on enterprise size) are not statistically significant at the 0.05 significance level. Similarly, for the variable big data analytics, the *p*-value of 0.107 indicates that the differences between the groups are not statistically significant at the 0.05 significance level. Only the variable digital interaction platforms has a *p*-value of 0.034, suggesting that the differences between the groups are statistically significant at the 0.05 significance level.

Table 6. Median Usage Values of Digital Interaction Platforms by Enterprise Size.

Number of Employees	Median Value
1–9	1.5
10–49	2.0
50–249	3.0
250 and more	4.0

Source: own processing from survey data.

Based on these findings, we were interested in which enterprises exhibit higher values of digital interaction platform usage.

These results indicate that smaller enterprises are likely to use digital interaction platforms less compared to larger enterprises.

5. Discussion

Digitalization in human resource management (HRM) represents a revolutionary step. This study focuses on analyzing the impact of utilizing digital tools in HRM on employee engagement. The results of the presented research indicate that respondents generally hold neutral to positive views regarding the evaluated areas of digitalization in HRM, with big data analytics receiving the highest average rating (2.91 on a five-point scale). This suggests that companies in the sample still use these tools for employee evaluation relatively infrequently. Basic descriptive statistics suggest that the values for engagement, digital interaction platforms, and big data analytics are close to the middle of the scale, indicating slightly positive outcomes of the application of these variables in the organizations' practice. This aligns with the expected trend and is consistent with the study by Bhatti et al. (2022), which confirms that organizations in CEE are positively oriented towards adopting current trends to maintain competitiveness. A study published by McKinsey & Company further states that companies in Central and Eastern Europe, referred to as "digital challengers", are undergoing digital transformation and using digital technologies to increase productivity and innovation. These companies are successfully integrating digital platforms and big data analytics into their business processes, enabling them to better respond to rapidly changing conditions and employee needs.

Despite the general assumption that the implementation of innovations in HRM will not only contribute to the efficiency of performing individual tasks but also to the more successful achievement of strategic goals—among which increasing employee engagement certainly belongs—the results of our study suggest that there is no particularly strong relationship between these variables. The results of the Spearman correlation matrix indicate that employee engagement has only a very weak positive correlation with digital interaction platforms used in HR administration at a level of (0.161), and therefore, the proposed hypothesis H1 was not supported. This suggests that focusing on enhancing employee engagement is not directly linked to the use of digital interactive platforms in HRM. Similarly, hypothesis H3, stating that employee engagement is significantly correlated with the use of big data analytics in HRM, was also not supported, as the analysis again showed only a very weak positive correlation at a level of (0.169). This essentially aligns with the findings of Bolli and Pusterla (2022), which suggest that digitalization can have both positive and negative effects on employee engagement. However, it is important to note that the positive focus on engagement in organizational practice indicates that this trend is of interest to organizations.

On the other hand, the Spearman correlation matrix shows a moderate (0.609) correlation between the use of digital interaction platforms in HRM and the application of big data analytics in HRM, indicating that higher use of digital platforms is associated with higher utilization of big data analytics. Hypothesis H2, that digital interaction platforms and big data analytics are positively correlated, was supported (0.609). In practice, this suggests that companies implementing digital platforms for interaction tend to also use big data analytics and vice versa. This relationship may be due to the fact that both approaches

are part of a broader strategy of digitalization and modernization of HR processes, which includes improving communication, collaboration, and decision-making processes through technology. These results are consistent with studies by Bhatti et al. (2022) and Ajah and Nweke (2019), which indicate that companies investing in digital innovations, such as communication platforms, often also seek other technologies, such as big data analytics, to maximize efficiency and gain a competitive advantage. This is also confirmed by the Chi-squared test results, which showed a statistically significant dependence between all variables, with the strongest dependence being between digital interaction platforms and big data analytics.

According to research by Dahlbom et al. (2020), larger companies are more inclined to implement advanced technologies in HRM, including big data analytics. These companies have better resources to invest in the technologies and infrastructure needed for effective use of big data. Larger organizations also more often possess the technical and analytical capacities needed to implement and manage complex human resource management systems (HRM). Our Kruskal–Wallis test results supported this assertion, showing that the size of the company affects the use of digital interaction platforms, with larger companies using them more than smaller ones.

6. Conclusions

Examining the impact of digital innovations on employee motivation and engagement is an important area of research, especially given the rapid technological progress and its extensive impact on modern workplaces. The objective of this research was to fill a gap in the existing literature by examining how digital human resource management practices, such as the use of digital platforms for employee interaction and big data analytics, impact employee engagement. The results of our study suggest that the implementation of digital innovations in HRM does not directly contribute to increasing employee engagement.

Respondents generally held neutral to positive views on the practices of digital human resource management. The study revealed a moderately strong positive correlation between the use of digital interaction platforms and big data analytics, suggesting that companies investing in one form of digital innovation tend to adopt the other as well. This indicates a holistic approach to digital transformation in HRM. However, the weak correlation of digital innovations with engagement suggests that while digital tools can improve certain HRM functions, their direct impact on employee engagement may be limited or influenced by other factors. Finally, larger companies are more inclined to implement advanced digital HRM practices compared to smaller companies, due to their greater resources and capacity to invest in and manage complex technologies.

This study successfully addressed a gap in understanding the dual focus on digital HRM innovations and employee engagement. It provided empirical evidence that while digital tools are adopted by organizations for efficiency and data-driven decision-making, their impact on employee motivation and engagement is complex and may require supportive cultural and managerial practices to be fully realized.

The authors recognize the limitations of the study in the research sample, which was limited to organizations operating in Central and Eastern Europe, and may not fully represent global trends. Additionally, reliance on self-assessed data and the use of a five-point scale may have partially limited the depth of the insights gained. Another limitation could be the relatively short data collection period, which might have overlooked long-term trends and effects of digital HRM practices. There is also a wide range of other digital tools applicable in HRM that were not evaluated by the authors. Additionally, these trends are relatively new, and therefore, the actual impact of their use may only become evident after a certain period of time.

Future studies should include more diverse regions to capture global trends in the adoption of digital HRM innovations. Longitudinal studies would be appropriate to understand the long-term impact of digital innovations on employee engagement. Quanti-

tative data could be supplemented with qualitative insights from in-depth interviews or case studies.

In conclusion, while digital innovations in HRM offer significant promises for improving organizational processes and data-driven decision-making, their direct impact on employee satisfaction and engagement is complex and influenced by many factors. Organizations must adopt a balanced approach that integrates technological advancements with supportive managerial practices to fully realize the potential benefits for employee engagement and overall performance.

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Preferences of Generations of Customers in Slovakia in the Field of Marketing Communication and Their Impact on Consumer Behaviour

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Abstract: This paper deals with the analysis of the preferences of different customer generations in Slovakia in the field of marketing communication and its influence on consumer behaviour. Currently, marketing communication is an integral part of company strategies and has a key influence on how customers choose products or services. With the increasing importance of the generational segmentation of customers, understanding their individual preferences and tendencies in communication becomes an essential prerequisite for success. In this paper, we explore how preferences differ between Baby Boomers, Generation X, Generation Y, and Generation Z, and how these preferences influence their consumer behaviour. Based on the analysis of primary and secondary data, the main trends and preferences of generations in the field of marketing communication were identified. This paper provides useful information that can be used by companies in the creation and implementation of marketing strategies. At the same time, the paper enables a better understanding of the dynamics of consumer behaviour in the context of generational preferences and will help identify opportunities for improving marketing activities and more effective communication with target groups.

Keywords: marketing communication; generations of customers; consumer behaviour

1. Introduction

In today's economic environment, a company's success is greatly influenced by its ability to communicate effectively with different customer segments. One of the key factors influencing the effectiveness of marketing communications is understanding and taking into account the individual preferences and tendencies of different customer generations. In Slovakia, as in many other countries, there is a spectrum of generations with different values, preferences and ways of interacting with marketing tools. This paper deals with the study of preferences of customer generations in Slovakia in the field of marketing communication and their influence on consumer behaviour. In today's dynamic and technologically advanced environment, marketing managers must constantly adapt marketing strategies to effectively reach target groups. Understanding the preferences and reactions of different generations is key to successfully targeting and reaching customers through different channels, tools and forms of communication. This paper introduces the issue of marketing communication and its importance in today's competitive environment. We examine the impact of different marketing communication tools and their influence on the consumer behaviour of different generations. The aim is to contribute to the understanding of the consumer behaviour of different generations of customers in terms of the use of marketing communication tools.

2. Literature Review

Generation is one of the most important areas of study in marketing today. Proper identification and targeting are key to successful product launches. The discussion of

generations is the concept on which authors such as Bergh and Behrer (2010) began their research in the early part of this millennium. The concept of generation was first mentioned by R. Ingelhart (1977), who used generation as a way of segmenting a population.

In classifying the time periods of each generation, there is a huge amount of data that are partly different and partly identical. The greatest agreement can be found with older generations such as Baby Boomers and Generation X, where the definition of these generations is heavily influenced by historical events such as the World War, which had a global impact on generations around the world. The vast majority of authors agree that Baby Boomers are people born between 1946 and 1964 (Egerová et al. 2021). However, for younger generations, such a consensus in classification is not as pronounced. Although these generations are referred to as "global generations" due to the rapid development of information technology, there is not much consensus among authors. One reason for this may be the fact that since the end of World War II, there has been no cultural or historical event that has affected the entire world in the same way. As noted earlier, authors disagree on the precise classifications of generations. The most notable differences concern the naming of each generation and the time intervals in which they have been active in the marketplace. Therefore, we provide some examples of the breakdown of generations from both perspectives in Table 1.

Table 1. Classifications of generations (Čvirik 2018; Smolka 2019; Bejtkovský 2016; Lissitsa and Laor 2021).

Autor	Name of Generation	Time Range
Lissitsa Laor	Baby Boomers	1946–1965
	Generation Y	1966–1980
	Generation Z	1981–1994
	Generation Z	1994–present
J. Bejtkovský	Baby Boomers	1946–1964
	Generation X	1965–1976
	Generation Y	1977–1995
	Generation Z	1996–present
S. Smolka	Generation X	1966–1976
	Generation Y	1977–1995
	Generation Z	1996–2012
M. Čvirik	Greatest Generation	1901–1924
	Silent Generation	1925–1945
	Baby Boomers	1946–1964
	Generation X	1965–1979
	Generation Y	1980–1994
	Generation Z	1995–2009
	Generation Alfa	2010–present

The duration of one generation lasts approximately 20 to 25 years, but this period may vary depending on how long children take to mature. Different generations tend to share similar ideas, values, attitudes, and beliefs (Pattuglia and Amoroso 2023). Table 2 shows the classification, which is one of many. However, it is important to understand that there is diversity in how generations are classified and defined. These generations were chosen because of their current presence in the Slovak market and their purchasing power.

Table 2. Generations of customers (own elaboration, 2024).

Generational Cohort	Time Range
Baby Boomers	1946–1960
Generation X	1961–1980
Generation Y	1981–1995
Generation Z	1996–2010

Baby Boomers are currently the oldest generation with some purchasing power on the Slovak market (Smolka 2019). Their age and experience tend to create loyal customers who seek valuable products and services that meet their needs and preferences (Hamdani et al. 2020). The preferences of this generation lean towards traditional brick-and-mortar stores, where they have long experience in buying selected products (Lissitsa and Laor 2021). They also prefer quality and durable products and are willing to pay a higher price for them (Seberíni 2021). This generation focuses on value and quality rather than price and is loyal to brands and stores they trust (Reidl 2012). Generation X is the first generation that has grown up and witnessed the development of new technologies that have influenced their consumer behaviour (Lissitsa and Laor 2021). This generation is open to both traditional and modern marketing communication tools (Pekovic and Rolland 2020). The arrival of the internet has made Generation X the first generation to engage massively in online shopping. In terms of brands, Generation X prefers brands that have a good reputation and are associated with responsible companies and sustainability (Seemiler and Grace 2018). In general, Generation X tends to shop thoughtfully, considering the balance between price and quality. They criticise advertisements and prefer quality and functionality over luxury (Smolka 2019). Generation Y differs from their predecessors in that they prefer a wider range of media, not just the internet. They also watch television, read newspapers, and listen to the radio (Frye et al. 2020). These characteristics have created the conditions for Generation Y not to be limited to one medium, as was the case with the previous generation (Lissitsa and Laor 2021). A very strong point of this generation is online shopping. The internet has become a part of their daily lives, and they use it to find information as well as to purchase goods and services (Seemiler and Grace 2018). This generation tends to use reviews and recommendations from other consumers in their purchasing behaviour. They are very active on social media and like to share their experiences and opinions on different products and brands (Twenge 2023). The youngest generation on the Slovak market is Generation Z, which is significantly different from previous Generations X and Y. This generation is considered to be the most technologically advanced (Smolka 2019). Its members are closely connected with modern technologies (Seemiler and Grace 2018). One of the desires of this generation is originality and therefore prefers personalised products and services. For Generation Z, environmental sustainability is very important, and they often prefer products from brands that are active in this area and produce sustainable products (Munsch 2021). The tendency of this generation is to expect immediate satisfaction of their needs and prefers fast delivery and easy return of products (Lissitsa and Laor 2021). Generation Z emphasises quality over quantity and is willing to pay a higher price for a higher-quality product that meets their needs and will have a longer shelf life (Roth-Cohen 2022).

Generational theory examines how historical, cultural, political and economic events shape the collective consciousness and behaviour of people born in the same time period. This theory argues that each generation has unique values, lifestyles, work habits, and technological skills. Authors such as Roth-Cohen (2022), Čvirik (2018), Egerová et al. (2021), and others support this approach and emphasise that generational differences are the result of shared experiences during individuals' formative years. However, some scholars, including Bobby Duffy (2021), Costanza et al. (2012), Jean Twenge (2018), and Jennie Bristow (2019), criticise this theory. They argue that differences between people within a generation may be greater than between generations, and that social and technological changes often play a larger role than generational differences alone. These critics point to the need for a more comprehensive approach that takes into account individual and contextual factors. We understand that there are flaws in generational theory, but in our view, the positives outweigh the negatives. Although generational theory has its critics who point out its shortcomings and the need for a broader consideration of individual and contextual factors, it still remains a valuable tool for understanding the behaviour of different age groups. Indeed, each generation is influenced by specific historical, cultural and technological events that shape their values, preferences and purchasing behaviour.

Marketing communication and consumer behaviour are closely linked areas of marketing that together contribute to the success of companies in a competitive marketplace. With increasing competition, it is necessary for companies to use marketing communication effectively to gain an advantageous position in the market (Kotler and Armstrong 2019). Marketing communication includes various tools that companies use to inform, persuade and remind customers of the existence of the benefits of their products and services (Alakkas et al. 2022). These tools play a key role not only in providing information about the quality, value and benefits of products, but also in listening to and satisfying customers' needs (Kotler and Keller 2019). Marketing communication is based on a core marketing philosophy that focuses on understanding the market, identifying customer needs, and providing optimal solutions that satisfy those needs and convey value. This approach evolved from the sales approach, which focuses on influencing consumer demand for products they do not normally buy (Kotler and Armstrong 2019). From this perspective, marketing communication has gradually transformed into a marketing concept where the achievement of goals depends on the identification of consumer needs and wants. In today's business environment, where the range of companies is wide, the active use of communication strategies is the key to success in the marketplace (Hanuláková 2021). According to Bergh and Behrer (2010), marketing communication effectively reaches consumers by informing them about the places, times, methods and reasons for using products. It also provides information about manufacturers and brands and can motivate consumers to try or regularly use products. These communication tools create connections between products and different people, places, events, experiences and feelings, thus contributing to the creation of positive relationships between companies and their customers. With the arrival of the digital era and the development of the internet, the way companies communicate with their customers has changed significantly. Social networks such as Facebook, Twitter, LinkedIn and Instagram have revolutionised marketing communications. These platforms allow users to create and share content, interact with other users and actively engage with the community. Thus, social media provide a space for interactive communication and the implementation of various forms of marketing, including guerrilla, viral and influencer marketing and others (Hanuláková 2021). In this way, they allow companies not only to promote their products and services, but also to build deeper relationships with their customers. With the rise of social media, a new phenomenon has emerged—influencers, who have become a key element of modern marketing strategies (Přikrylová 2019). These individuals create authentic content that can engage millions of users around the world, making them a new marketing communication channel. One of the key elements to the success of influencer marketing is its ability to convey content that feels authentic and personal. Influencers, unlike traditional ads, interact directly with their followers and often present products in a way that is natural and informal. In this way, they are able to build trust and create deeper connections with their followers, which increases the likelihood that their recommendations will be followed (Bergh and Behrer 2010). The influence of influencers is especially evident with younger generations, who spend a large portion of their time on social media and often find influencers' opinions more trustworthy than traditional advertisements. These consumers are more likely to purchase products recommended by their favourite influencers, leading to increased conversion rates and brand loyalty (Přikrylová 2019). Another interesting phenomenon within influencer marketing is the growing importance of so-called micro-influencers, who have a smaller number of followers, but these followers are highly engaged and loyal. Micro-influencers often operate in specific market niches and their recommendations can be even more effective because their relationship with followers is often more personal and authentic (Alakkas et al. 2022). On the other hand, the challenges associated with influencer marketing also include potential risks related to transparency and authenticity. Consumers are becoming more conscious about sponsored content and may react negatively to inauthentic or overly commercial posts. Therefore, it is necessary for brands to choose influencers who are aligned with their values and are able to communicate effectively with their audience without losing their

authenticity (Singh et al. 2022). Given the rapid development and popularity of influencer marketing, its importance is expected to continue to grow. This phenomenon has also influenced mobile marketing, as mobile devices such as smartphones and tablets provide an ideal platform for distributing influencer content and allow for quick interaction, localised campaigns, and a direct link between content and purchase activities. Mobile marketing has become one of the fastest-growing marketing communications tools, largely due to the widespread use of mobile devices. These devices allow companies to effectively reach their customers through targeted campaigns, which highlights the need for companies to adapt all online activities for mobile platforms (Hanuláková 2021). The development of technologies and mobile applications that enable new forms of mobile communication has radically changed the way companies reach out to their customers, allowing them to gain a competitive advantage in a dynamic market. In this context, consumer behaviour research plays a key role. As consumer behaviour involves dynamic interactions between people and their environment that include emotions, cognition and action (Singh et al. 2022), it is imperative that companies understand and take these interactions into account when developing their communication strategies. By doing so, companies can not only attract customers but also retain their loyalty in the long term, which is crucial for achieving market success. Consumer behaviour is a complex phenomenon that is influenced by a number of different factors and can therefore be divided into multi-faceted segments. For example, Kotler and Keller (2019) differentiates consumer behaviour according to the level of involvement. In high-involvement behaviour, the consumer devotes a lot of time and effort to decision-making, which is typical, for example, when purchasing significant and costly items. On the other hand, low-involvement behaviour involves quick and often routine decisions, such as everyday grocery shopping. Assael (1995), in turn, offers a process-based view of consumer behaviour, distinguishing between complex buying behaviour, where the consumer thoroughly explores different options, and habitual buying behaviour, which is based on repeated purchases of the same products. Consumer behaviour can be further subdivided according to the way in which decisions are made. Engel et al. (1978) distinguish between rational decision-making, which is based on logical deliberation, and heuristic decision-making, which uses single rules to speed up the process. Intuitive decision-making, on the other hand, is based on feelings and instincts. In addition, Rogers (1995) differentiates consumers according to their degree of openness to innovation, where innovative consumers are quick to adopt new products and technologies, while late adopters are more cautious. Tversky and Kahneman (2002) present further categories of consumer behaviour, this time according to their attitudes and values, such as ecological and ethical behaviour. Value-oriented behaviours are based on personal or cultural values such as family values or religious beliefs. Howard and Sheth (1969), in turn, divide consumer behaviour according to the life-cycle of the consumer, where young and single consumers often act impulsively and are experience-oriented, while older people prefer products related to health and safety. Consumer behaviour, as defined by Khayru (2021), is a set of behaviours that consumers exhibit when searching for, buying, using, evaluating and owning products, services and ideas that they expect to satisfy their needs. The scope of these definitions and perspectives on consumer behaviour highlights its complexity and importance for marketing and business practice, as understanding these processes is a cornerstone for long-term success in a competitive marketplace. Marketing communication and consumer behaviour are inextricably linked elements that together form the basis of successful marketing. Effective use of marketing communication tools enables companies not only to inform and persuade their customers, but also to better understand their needs and wants. With the growth of the digital era and the rise of new technologies, marketing communications are constantly evolving and adapting to changes in consumer behaviour, giving companies new opportunities to achieve success in the marketplace. Influencers and micro-influencers have become key players in this process, with their ability to build trust and motivate purchase having a significant impact on consumer behaviour. Understanding consumer behaviour allows companies to adapt their communication strategies to be more

effective and deliver better results. In this way, companies can not only attract customers but also retain their loyalty in the long term, which is key to achieving market success.

3. Results

This section of the paper presents the results of the questionnaire survey. A total of 204 questionnaires were processed and evaluated. The research sample consisted of ordinary Slovak consumers, who were divided into four generations based on age. We considered results that exceeded the 6% threshold to be relevant results.

3.1. Research Question 1: Which Marketing Communication Tools Most Motivate Customers from Different Generations to Purchase a Product?

An important part of marketing communication is the individual communication tools. Therefore, in the first research question, we focused on this area. We monitored the effectiveness with which individual marketing communication tools can motivate customers from four generations to purchase products. For Baby Boomers, sales promotion was the most significant motivating factor for 8.16% of respondents. This result indicates that this generation is heavily influenced by discounts, coupons, and various promotions, which means that this tool should be a priority in marketing communications with this generation. For Generation X, no tool had an effectiveness above 6%, so they are not relevant to this conclusion. The closest to this threshold was sales promotion and personal sales with 5.88%, which may indicate some preference for this tool. Generation Y responds very positively to discounts and promotions. This is confirmed by the result of 10.29% of respondents indicating sales promotion. This is the highest result of all generations, indicating that sales promotion is a key tool for effective communication with this generation. Social media marketing scored 5.39%, indicating that modern digital tools are also important to this generation, but did not reach the 6% mark. For Generation Z, it is again the most significant factor for 9.31% of respondents, confirming that this tool is also effective for the youngest generation. Social media marketing reached 5.88%, which is just below the 6% threshold and therefore not included in the conclusions but points to a possible preference for this tool by Generation Z. Sales promotion is the most effective purchase motivation tool across all generations: Baby Boomers (8.16%), Generation Y (10.29%), and Generation Z (9.31%). This tool should be a key element in marketing strategies targeting these generations. For Baby Boomers and Generation Z, this tool had a similar impact, while for Generation Y, it was even more pronounced. Based on these results, it is clear that discounts, coupons and promotions are effective motivating factors for all generations included in the survey. They should therefore be included as a priority in marketing communications, especially when targeting Generations Y and Z, who show the highest sensitivity to these tools.

ANOVA test results: F-value: 0.338; *p*-value: 0.798. Based on these results, we confirmed the null hypothesis. The *p*-value of 0.798 is much higher than the usual level of significance ($\alpha = 0.05$), i.e., it means that there are no statistically significant differences in the preferences for different marketing communication tools between different generations.

3.2. Research Question 2: Which Factors Most Influence the Purchasing Decisions of Customers from Different Generations?

Just as it is important to know which marketing communication tools influence different generations of customers, it is also crucial to understand which factors enter into the purchasing decisions of customers. For Baby Boomers, price is the most important factor in the buying decision. Price was indicated by 6.22% of respondents. This result indicates that Baby Boomers are very price-sensitive. For Generation X, the quality of the product or service is the most outstanding factor, marked by 7.77% of respondents. This shows that it is important for Generation X that the product or service meets high quality standards, which play a major role in their purchasing decisions. Price is also a key factor which was selected by 7.25% of the respondents. This result shows that in addition to quality, price is also important to Generation X. Like previous generations, Generation Y also identified the quality of the product or service as the most important factor with

a significant share of 14.51% of the respondents, which is the highest share among all generations. This indicates that Generation Y places a high value on quality and is willing to invest in quality products. Brand is the second most important factor for this generation, selected by 6.22% of respondents. This shows that brand has a significant influence on the purchasing decisions of Generation Y. Product or service quality is the most important factor for Generation Z, selected by 8.81% of respondents. Similar to other generations, quality is key in purchase decisions. Brand and customer reviews are equally important, both selected by 5.70% of respondents. This result did not reach the 6% threshold but suggests that Generation Z places a high value on brand credibility and other customers' opinions when making purchasing decisions. The quality of the product or service is a key factor for Generations X, Y and Z, with Generation Y (14.51%) accounting for the largest share. Price is the most important factor for Baby Boomers (6.22%) and is also very important for Generation X (7.25%). Brand has a significant impact on the decision-making of Generation Y (6.22%) and also Generation Z somewhat (5.70%), indicating that these younger generations can be influenced by brand image and reputation. These findings point to the need to focus marketing strategies on quality, price, brand and reviews.

ANOVA test results: F-value: 0.880; *p*-value: 0.465. Based on these results, we confirmed the null hypothesis. The *p*-value of 0.465 is much higher than the usual level of significance ($\alpha = 0.05$), i.e., there are no statistically significant differences between the only generations and the factors that influence purchasing decisions.

3.3. Research Question 3: What Method of Communication Do Individual Generations Prefer?

What kind of communication each generation prefers is just as important as preferred marketing communication tools and purchasing decision factors. Therefore, we focused on this area in the last part of this research. Visiting the point of sale in person is the most preferred method of communication for Baby Boomers. This option was indicated by 6.93% of respondents. This result indicates that this generation prefers personal contact and direct interaction in communication. For Generation X, reviews, comments and ratings are the most prominent communication channel, preferred by 13.37% of respondents. This shows that Generation X relies heavily on the experiences of others to make decisions. For Generation Y, reviews and ratings are the most significant channel of communication, with 16.34% of respondents, the highest proportion among all generations. This result highlights the high level of trust this generation has in the experiences of other consumers. For Generation Z, reviews and ratings are also the most preferred mode of communication, with 11.39% of respondents indicating this option. Reviews, comments and ratings are the key communication channels for Generations X, Y and Z, with Generation Y placing the most emphasis on them (16.34%). Visiting the point of sale in person is still important to Baby Boomers (6.93%), although its importance is declining among younger generations. These findings point to the need to tailor communication channels to different generations, with an important consideration of the preference for face-to-face contact among older generations and an emphasis on online reviews and expert resources among younger generations.

ANOVA test results: F-value: 0.295; *p*-value: 0.829. Based on these results, we confirmed the null hypothesis. The *p*-value of 0.829 is much higher than the usual level of significance ($\alpha = 0.05$), i.e., it means that there are no statistically significant differences in the preferences of different modes of communication between the generations.

4. Materials and Methods

This paper examines customer preferences in marketing communication and their influence on consumer behaviour. The aim is to contribute to the understanding of the consumer behaviour of different generations in terms of the use of marketing communication tools. There are currently four generations of customers on the Slovak market: generations X, Y and Z and Baby Boomers. In this paper, we have defined the theoretical background for each generation, marketing communication and consumer behaviour. We know that several studies have already been conducted in this area. These include the GenZ Report Findings

(2022), Consumer Trends Report (2022) and Deloitte (2023). The Consumer Trends Report survey involved more than 1000 respondents across all generations currently in the market. The Deloitte survey, conducted in 44 countries, included more than 44,000 respondents from Generations Y and Z. The Gen Z Report Finding survey had 150,000 respondents from all generations and was conducted in 10 countries. These surveys focused on the overall characteristics and consumption behaviours of generations of customers. In our survey, we used a questionnaire survey via www.vyplnto.cz (accessed on 16 August 2023) to collect data. MS Excel was used to process the results. The questionnaire contained 14 questions that were dichotomous, closed and semi-closed. We used this combination of question types because dichotomous questions allow for quick and clear answers, which is useful when collecting large amounts of data. This question type minimises the room for ambiguous interpretations and simplifies data processing. Closed-ended questions with predefined answers allow for consistent responses, making it easier to compare data and conduct subsequent analysis. Closed-ended questions are effective when collecting large amounts of data because respondents do not have to create their own answers but can simply choose from the options offered. Semi-closed questions combine the advantages of closed questions with the possibility to obtain further details through an open field where respondents can express their opinion or add information. If the research focuses on exploring opinions or experiences, semi-closed questions can reveal aspects you may not have originally anticipated, leading to new discoveries. This type of question allows for the collection of quantitative data from the closed sections and qualitative insights from the open sections, which can enrich the analysis and provide a deeper understanding of the topic under investigation. These types of questions provide the data collection necessary to meet the research objectives. The questions from the questionnaire used in this paper are as follows:

- Which of the following marketing tools can motivate you the most to purchase a product?
- What are your main criteria when choosing products or services?
- Which of the following communication methods would you use if you needed to obtain information about a product?

The survey was conducted from 9 April 2023 to 16 June 2023. During this period, we reached respondents from all generations. This is a total of 67 days, a period of more than two months. We considered this period long enough to obtain a sufficient number of respondents. The survey was conducted during this period because it gave consumers enough time to resume their usual purchasing behaviours after the end of the COVID-19 pandemic. The sample of respondents was taken randomly via the platform vyplnto.cz. On this platform, we published a link to our questionnaire where various respondents could voluntarily fill it out. The method of selecting participants was subject to the age criterion, when we selected participants according to whether they are in the age range that is borderline for the generations we are writing about. Responses from respondents outside the age range were filtered out, i.e., they were not included in the interpretation of the results. These respondents had different economic and social statuses, especially employed, unemployed, entrepreneurs and students. We received 204 correctly completed questionnaires. The gender distribution of respondents was 55% male (112 respondents) and 45% female (92 respondents). The survey was designed to provide a basic overview of preferences and trends across generations that can serve as a starting point for further, more detailed studies. The results should be seen as an initial insight and interpreted in the context of potential sample limitations. There are currently four generations of customers in Slovakia, and their representation is shown in Table 3.

Table 4 shows the sample of respondents we worked with in our paper. While collecting the data, we tried to maintain a relevant representation of all generations in our survey. After comparing the data, we can conclude that we were partially successful in this effort. As can be seen in Tables 3 and 4, the largest difference is observed for the Baby Boomers and Generation Z. This discrepancy may have been due to the way the data were collected, which was exclusively through an online platform. This method

may have been less accessible to Baby Boomers, who are not as adept at using modern technology as other generations. Another reason why we were not able to recruit enough respondents from the Baby Boomer generation may have been their lack of interest and trust in participating in such research, especially if it is conducted exclusively online. This may also have contributed to the lack of participation from this generation. However, for Generation X, which also belongs to the older generational cohorts, we were able to obtain an adequate number of respondents, suggesting that older generations are gradually adapting to online platforms. This led to the difference between the overall representation of the generation in Slovakia and in our paper. The opposite is the case for Generation Z, which is over-represented in the survey compared to the overall population in Slovakia. We would remedy this shortcoming in future research by expanding the questionnaire to include other methods, for example, paper-based.

Table 3. Absolute and relative frequency of generations in Slovakia (Datacube 2022).

Generation Cohort	Absolute Frequency	Relative Frequency
Baby Boomers	1,132,446	26.86%
Generation X	1,159,851	27.53%
Generation Y	1,101,447	26.12%
Generation Z	821,706	19.49%
Sum	4,215,450	100%

Table 4. Absolute and relative frequency of respondents (own elaboration, 2024).

Generation Cohort	Absolute Frequency	Relative Frequency
Baby Boomers	36	17.65%
Generation X	62	30.39%
Generation Y	52	26.47%
Generation Z	52	25.49%
Sum	204	100%

We used research questions, specifically exploratory and comparative research questions, as the main method in our research. These questions aim to identify new relationships and compare different groups or variables. Research questions are an integral part of the research process; they offer several advantages but also have some disadvantages. Research questions help to focus the paper on a particular problem or phenomenon, ensuring that all phases of research are systematic and focused. They provide a structure for the entire research process and help maintain a logical and consistent approach. In addition, they optimise time and resources by focusing research on important questions, minimising the risk of unclear or ineffective results. Well-formulated research questions ensure that the paper focuses on answering specific and measurable aspects, which contributes to the objectivity and reliability of the results. However, the use of research questions also has drawbacks. If defined too narrowly, they can limit the scope of the study and lead to overlooking important aspects or broader contexts that might be relevant. In addition, research questions may be based on certain assumptions or prior knowledge, which can cause bias. Formulating the right research questions can be challenging, requiring a deep understanding of the research subject and strong analytical skills. Poorly formulated questions can lead to ambiguous results or incorrect conclusions. In our research, we defined the following three research questions:

- Which marketing communication tools most motivate customers from different generations to purchase a product?
- Which factors most influence the purchasing decisions of customers from different generations?
- What mode of communication do individual generations prefer?

As an additional method, we used the ANOVA test to see if there were statistically significant differences between the means across customer generations. We used this method for each research question. We set one common hypothesis for all areas. The hypothesis was as follows:

H0: *There are no statistically significant differences between generations.*

H1: *There is a statistically significant difference in at least one generation.*

The ANOVA (Analysis of Variance) test is a statistical method used to compare means between three or more groups to see if there are significant differences between them. In an ANOVA test, the *F*-value and *p*-value are used to determine if there are statistically significant differences between the means of the groups. Definition: the *F*-value is the ratio between two estimates of the variance. Specifically, it compares the variance between groups (between-group variance) with the pooled variance within groups (within-group variance).

$$F = \frac{MSB}{MSW}\ MSB\ (\text{Mean Square Between}),\ MSW\ (\text{Mean Square Within})$$

The *F*-value measures how significantly the means differ between groups compared to the within-group variability. The *p*-value determines whether these differences are statistically significant. The ANOVA test results in an *F*-value that is compared to the critical value from the *F*-distribution to determine if the difference between the means is statistically significant. If the *F*-value is high enough, we can reject the null hypothesis, which states that there is no difference between the groups. The significance level is the value that is used to decide whether to confirm or reject the null hypothesis. The standard level of significance is denoted as $\alpha = 0.05$. We also used this value in our paper. After using the ANOVA test for each area of research, we found that there are not significant enough differences between the groups to be statistically significant. This is due to insufficient sample size and small differences between generations. We consider this result to be the most significant limitation of the research. Therefore, in further analysis, we focused primarily on the graphical representation and subsequent interpretation of the results.

5. Discussion

In this paper, we conducted research focused on consumer behaviour and preferences of different generations of customers in Slovakia in the context of marketing communication. The statistical method used, ANOVA, pointed out a weakness, which is that there are no statistically significant differences between generations in all areas of research. This is considered to be a significant limitation in our research. Therefore, based on the number of respondents, we were forced to implement only a graphical representation and subsequent interpretation of our results. We considered graphs as the best way to present our limited data, as they provide a visual overview of the trends, patterns and distribution of the data, making them easier to interpret and present. In our research, graphs allowed us to show the minimal differences and similarities between different generations and their preferences in marketing communication and consumer behaviour. These results should only be understood as a certain possible insight into the issue of consumer behaviour in Slovakia. Even with these limitations, however, the results show some non-statistically significant differences in preferences and behaviours between generations that are influenced by technological advances, cultural changes, and personal experiences. Baby Boomers prefer traditional forms of marketing communication such as sales promotion. This generation grew up at a time when technology was not as widespread, which explains their preference for face-to-face conversations and telephone contact, as seen in Figure 1. Similarly, the *Consumer Trends Report* (2022) reports that Baby Boomers prefer face-to-face meetings and telephone communication. Baby Boomers trust personal contact and tend to seek out

high-quality but affordable products. In addition, the *Consumer Trends Report* (2022) states that Baby Boomers prefer traditional marketing communication tools to modern ones and focus mainly on the price of the product when making purchases. Price is important to this generation. This finding was also confirmed by Figure 2. It is important to note that this generation still plays an important role in the consumer market as they often have more purchasing power compared to younger generations. Generation X combines a preference for both traditional and modern marketing communication tools. Although these customers still value personal contact and trust reviews, they are more open to using online platforms. The period in which this generation grew up can be described as a transitional phase between analogue and digital approaches. This has created a unique mix of preferences, where personal contact is important, but also the credibility of information obtained online. Generation X is thus becoming an important target group for marketing campaigns that combine traditional and modern marketing communication tools. The *Consumer Trends Report* (2022) also states that Generation X prefers traditional marketing communication tools. However, in our survey, as can be seen in Figure 1, we observed an increasing trend in the use of modern marketing communication tools. This is a significant difference that can be observed among Slovak consumers. This trend could be part of further research. Generation Y, or Millennials, is the generation that has grown up with the increasing availability of the internet and mobile technology, which explains their preference for online reviews and discussion forums, as shown in Figure 1. Generation Y tends to trust traditional forms of communication less and rely more on the experiences and reviews of other users. This generation is known for their expertise in using social media and digital tools. A Deloitte survey (2023) reports that 91% of people from this generation have at least one account on any social network. This result from the Deloitte survey shows that this generation is focused on social media marketing, as shown in Figure 3. In our paper, as seen in Figure 2, we also observed a phenomenon in which for Generation Y, product quality is the predominant factor in their purchase decisions. Marketing strategies should focus on digital platforms that provide fast and transparent information. Generation Z represents the youngest and most technologically advanced generation. These customers grew up in an era when the internet was ubiquitous, and their behaviour is heavily influenced by the instant availability of information. Generation Z prefers online reviews and peer reviews and relies less on traditional forms of communication. This generation demands immediate responses and high levels of interaction through digital channels, challenging marketing departments of all companies to ensure a constant presence and action activity on social media and other online platforms. The *GenZ Report Findings* (2022) states that this generation is primarily focused on using social media. People from this generation have accounts on a variety of social media sites, highlighting this generation's connection to social media marketing. As can be seen in Figure 3, this can only be considered a partial fact in Slovakia, as social media marketing is the second most popular marketing communication tool. In Figure 2, we see that user reviews play the most important role in purchase decisions. The results obtained have some partial overlap with global surveys. From the graphical assessment, we can say that the results obtained highlight the need to adapt marketing strategies to the preferences of each generation. While older generations prefer a more personal and traditional approach, younger generations expect fast and efficient communication through modern technology, as seen in Figure 1. For companies, this means the need to implement diverse communication channels and approaches that target each generation in a specific way. Another important aspect is the credibility and transparency of information. All generations, albeit to varying degrees, value reviews and ratings, which means that building trust through positive customer experiences is key. Marketing campaigns should be designed to emphasise authentic and accurate customer experiences, thereby reinforcing trust and loyalty. One possible marketing communication tool that could meet these requirements is influencer marketing.

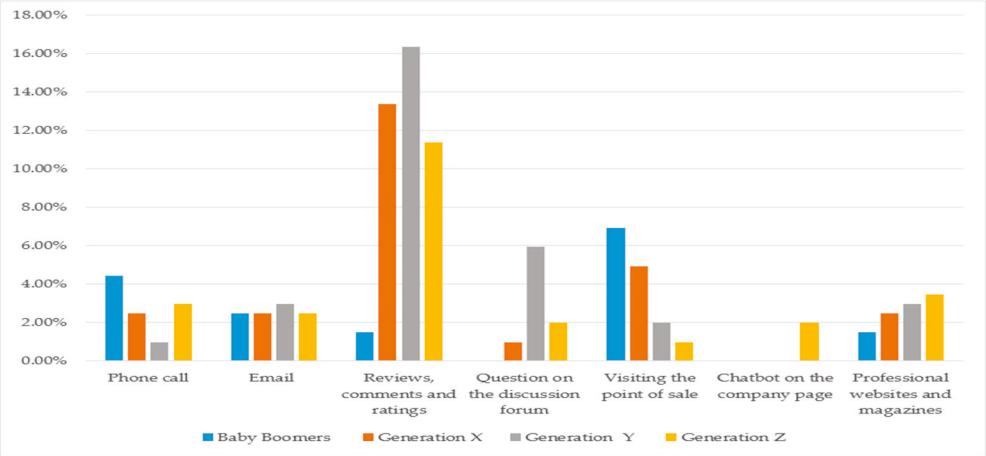

Figure 1. Preferred method of communication (own elaboration, 2024).

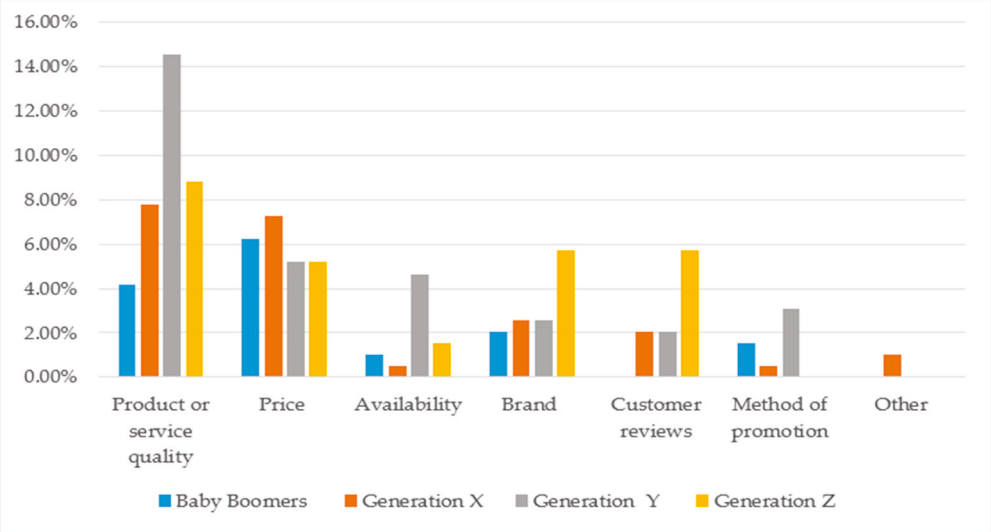

Figure 2. Factors of purchase decisions (own elaboration, 2024).

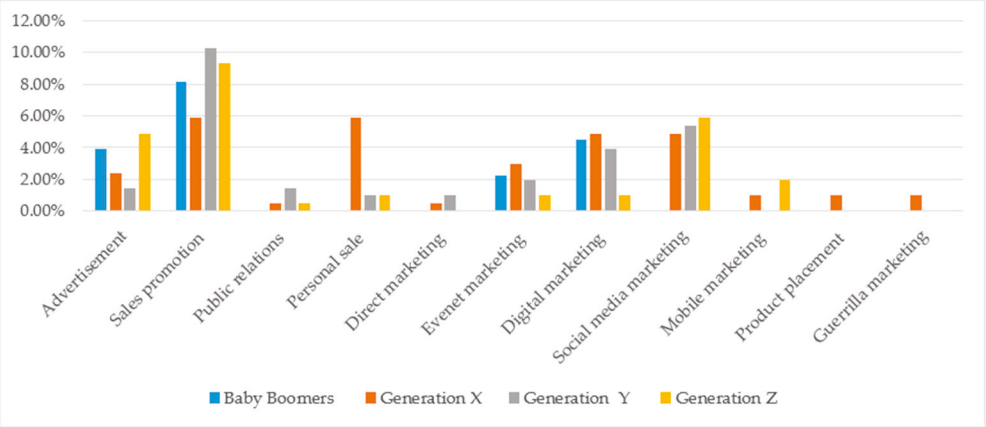

Figure 3. Motivation to buy a product (own elaboration, 2024).

6. Conclusions

When reading and interpreting the results of this paper, certain limitations arising from the nature of the study should be considered. The first limitation is the geographical restriction. The study focuses only on Slovakia, which means that cultural, economic and

social conditions unique to Slovakia may influence the results. We see this with Generation X, for example, where sub-results suggest that this generation does not have exclusive preferences, but trends indicate a growing interest in modern marketing communication tools, which is different from the world view. Therefore, these results may not be relevant or applicable in other countries where consumer behaviour and preferences are influenced by different factors such as culture, legislation, economic situation or technological infrastructure. Generalising these results internationally could be incorrect or misleading. Another limitation is the generational classification itself, as mentioned in the theoretical part; there are many classifications from different authors. These differences are in which years are considered the beginning and end of each generation. These differences may cause the results to be inconsistent, as individuals who are classified in one generation by one classification may be classified in another generation by another classification. This may affect the applicability of the results to a larger population, as research may be based on ambiguous or inconsistent categories, leading to mixed or inaccurate conclusions. In the case of generational theories, even the use of the theory itself may be a limitation because there are authors who do not support it. Obtaining a representative sample of respondents is also a limitation of our paper. A large number of respondents is required to match the representation of different generations in the community, and this is very difficult to achieve. If the sample is not sufficiently representative, the results may be skewed and will not accurately reflect the true preferences of the population as a whole. This limitation may compromise the reliability of the results. Time constraints are also an important constraint, as consumer preferences and the effectiveness of marketing communications can change rapidly due to technological innovation and societal changes. Results obtained over a period of time may not be valid after several years. This may cause problems in applying them to future situations. This factor undermines the reliability of the results, as they may not be applicable in different time periods. This limitation is part of the vast majority of papers that are published in this area. Another limitation is the method of collecting the questionnaires. If a questionnaire survey is conducted entirely online, it may lead to some segments of the population (e.g., older generations or people without access to the Internet) being under-represented or missed altogether. This method of data collection may affect the results, as the sample of respondents may not represent the full spectrum of the population. In our research, we were unable to obtain a representative sample, which was confirmed by rerunning ANOVA tests, which showed that there were no statistically significant differences between the generations. Therefore, we consider it an important part of future research to expand the method of data collection to avoid the same limitations that emerged from this research. We are aware that each study has its limitations, and the results may be influenced by various factors such as the method of data collection or analytical techniques. The analytical techniques used may also affect the results. If the analytical methods are inadequate or inappropriate, they may bias the data and lead to incorrect conclusions. This can reduce the reliability of the results as conclusions may be based on incorrect or incomplete information. In future research, we must consider additional methodological approaches or expanding the sample to obtain more robust results. This paper presented a partial overview of the preferences of individual generations of customers in Slovakia in the field of marketing communication. Considering that the results in this paper were not statistically significant, we decided to take into account only the data that had a value of more than 6%. We consider this value to be the lowest possible limit. These results indicate that it is highly likely that there are differences between generations. These differences are driven by technological advances, cultural changes and personal experiences. Each generation has its own unique characteristics and preferences, which is crucial for creating effective marketing strategies. The future of marketing communications will depend on the ability of companies to adapt to rapidly changing technologies and customer preferences. It is also important to look at how demographic factors such as education, income and geographic location play a role in customer preferences. Based on these findings, it is clear that marketing strategies need to be adapted to the specific preferences of each generation

in order to reach customers effectively. While older generations prefer a more personal and traditional approach, younger generations expect fast and effective communication through modern technology. Companies should implement a variety of communication channels and approaches that reach each generation in a specific way. Additionally, building trust through authentic and genuine customer experiences is key for all generations. Reviews and ratings play an important role in customer decision-making, so marketing campaigns should be designed to emphasise positive customer experiences and transparency. Furthermore, it is interesting to note that for all generations, sales promotion is the most important marketing communication tool for purchasing decisions. This shows the orientation of consumers towards various discounts and promotions when making a purchase decision. Of the factors that influence the purchase decision, the quality of the product or service and the price enter the process most prominently. Future research would focus primarily on obtaining a sufficient sample of resamples. By doing so, we would address the shortcomings that we have created in this research. The direction of future research should be to look at how these preferences change depending on demographic factors such as education, income or geographic location. It would also be useful to examine how global trends and technological innovations affect generational preferences at the local level. Equally, this and other research could provide deeper insights into how companies can effectively communicate with their customers in a dynamic and ever-changing environment.

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administrative sciences

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Article

Measuring Efficiency and Satisfaction in the Context of Digital Transformation

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Abstract: Currently, much attention is paid to digital transformation in all areas, including the public sphere. The latest studies show that it is necessary for the public sector to monitor the efficiency and satisfaction with the services provided. However, there are significant gaps in research in this area, including in Slovakia. This research proposes and applies the measurement of efficiency using the DEA method in the context of e-Government, provides a comparison of the roles of states in the use of public electronic services in the EU, and applies the method of measuring satisfaction using the American Customer Satisfaction Index, focused on the central state portal in Slovakia. The main methods that were used to fulfil the objectives of the work were data envelopment analysis, "DEA", and the American Customer Satisfaction Index, "ACSI". Other methods used include the Mann–Whitney U test, the chi-squared test, and Sperm correlation analysis. From the results of the work, it is possible to conclude that ACSI can be applied within Slovakia. Furthermore, the results show a strong correlation between perceived quality and satisfaction, which is 0.855. Overall satisfaction with the central state portal of public electronic services reached 61.7%. We conclude that it would be appropriate and possible to use ACSI as part of DEA measurement.

Keywords: DEA; efficiency; American Customer Satisfaction Index; ACSI

1. Introduction

Currently, a period of digital transformation is underway, in which almost all information and knowledge are transformed into a digital form, which allows us to store a large amount of data. In addition, it allows us to efficiently process, search, archive and categorize data. Humans are developing ever more advanced systems that extend into the field of artificial intelligence, which is based only on binary computer notation (Harari 2015). Citizens of countries constantly communicate with public administration institutions. Therefore, it is important to improve and simplify communication using information and communication technologies (ICT) that contribute to more effective interaction between the given subjects. Knowledge is becoming increasingly important in our society, and its proper use is a key aspect of success in today's digital world.

Efficiency represents the use of economic resources that bring the maximum level of satisfaction achievable with given inputs and technologies (Beňová et al. 2006).

The efficiency of any phenomenon or process is the result of the relationship between the size of the inputs put into the realization of this phenomenon or process and the size of the outputs that result from the realization of this phenomenon. It follows that the effective unit reaches the value 1 and the other units reach values in the interval (0.1) (Beňová et al. 2006). The goal is to approach the value of 1 in efficiency. In this context, an important question is how to measure inputs and outputs when it comes to the public sector and the

field of e-Government (Beňová et al. 2006). Economy, efficiency and effectiveness represent the 3Es. The 3E principles refer to the following:

1. Economy: performing activities at the lowest possible cost.
2. Efficiency: maximizing output with the minimum input.
3. Effectiveness: achieving the desired objectives or producing the intended effect (Greenlaw et al. 2022).

To ensure the principle of purchasing value for money is applied, it is optimal for the fulfillment of objectives not to assess compliance with the 3E principles individually, but as a whole (see Figure 1) (Sborník Dobré Praxe-Mpvs.Cz 2020).

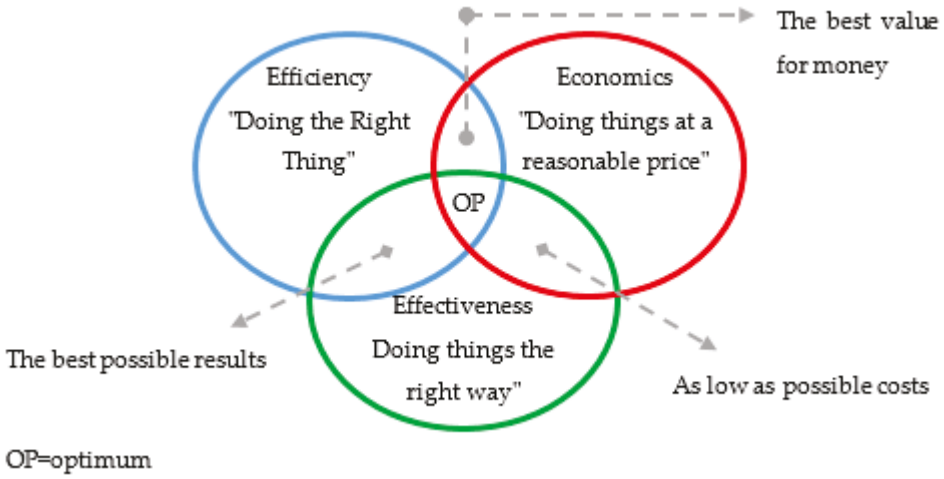

Figure 1. Principle of 3E.

The public sector provides services and brings some new possibilities, so it is important to design new input and output factors. Djellal and Gallouj (2008) divide measurement methods into two categories: index-based methods and threshold value methods. Index-based methods are based on pointers (Djellal and Gallouj 2008).

Digitization can be described as an important technological trend that is transforming society, business and the functioning of the state. Although there are many benefits of digitization, it requires investment and associated costs (What Is Digitalization 2018). Digitization is the technical process of transforming analogue information flows into digital data that have discontinuous values, which are based on two separate states (Feldman 2003). Digital technology takes information and decomposes it into its smallest components. By transforming an analog signal into distinct pieces, digitization enables the manipulation of information, text, graphics, software code, sound and video, i.e., its informing, transforming ability (Gorenšek and Kohont 2018; What Is Digitalization 2018). The extent and impact of the digital economy are determined by the ways in which individuals adopt information and communication technologies (Feliciano-Cestero et al. 2023).

As a result of the ongoing globalization and informatization projects, information and communication technologies are gradually being integrated into the processes of e-government. It is increasingly recognized that e-government is moving towards a holistic approach and that governance in the field of sustainable development requires strategic national planning (UN E-Government Survey 2022). The authors Fine and Johnson pointed out that public sector companies face many similar challenges to private sector companies, especially in the area of digitization (Fine and Johnson 2005). Breaugh and colleagues argue that public administration digitization projects require collaborative approaches for successful development and implementation (Breaugh et al. 2023). In the business sphere, measuring the efficiency of processes is essential, as well as measuring customer satisfaction. Therefore, this article focuses on the importance of measuring efficiency and satisfaction in the context of digital transformation within the public sector.

It is also necessary to mention that in the Slovak Republic, there is no regular measurement of satisfaction with new or existing services. The paper fills this gap and suggests a way in which it could be implemented and possibly adjusted. Similarly, this paper fills a gap in measuring the efficiency of data envelopment analysis (DEA analysis), since similar measurements using several available indicators were not identified within the European Union (EU). Overall, this work presents an overview for satisfaction assessment in e-government services, measuring the efficiency of the state of e-Government and providing a basis for future research in this area.

Citizens outside big cities benefit from using e-Government services. E-Government services can be much more useful for residents who live in rural areas (Roy et al. 2015; Seo and Bernsen 2016). Urban residents use the Internet twice as often as rural residents (Local E-Government Development 2022). The benefits of online communication in rural areas may be greater than in urban areas due to transportation costs, time constraints, or traffic congestion (Roy et al. 2015). The usefulness of online services is especially perceived in terms of flexibility, speed, availability, mobility and education. It is important that the content is expressed in a comprehensible and readable form, in addition to the correct organization of information and security of communication, i.e., perceived trust, which ensures more reliable information when using e-Government services. Government information provided by government institutions on websites can generally be considered and perceived as trustworthy; some requests or information may be misunderstood if not provided verbally or personally (Roy et al. 2015).

E-Government is divided into several levels—e-Government 1.0 to 3.0. E-Government services are constantly evolving, becoming more sophisticated and complex and, thus, increasing their costs for operation and development (Štandardy Vlastností Elektronických Služieb Verejnej Správy 2014). E-Government 1.0 focuses on the provision of transactional public administration services for citizens and businesses. E-Government 2.0 is aimed at increasing citizen participation, as well as openness and accountability. E-Government 3.0 is considered as a strategic response to the growing problems and challenges that modern society has to cope with, i.e., the flood of data from the second generation of e-Government. The goal is to provide support in policy making and solving social problems for the well-being of citizens using new technologies (Vrabie 2023; Charalabidis et al. 2019). The National Agency for the Information Society considers the concept of e-Government 3.0 as a set of measures that provides low-cost, high-quality services designed to ensure the satisfaction of citizens. In addition, it adapts to the needs of citizens, promotes entrepreneurship and increases efficiency and better access to information and services. Consequently, it adapts services to citizens using new technologies (Nam 2013). With the arrival of new technologies, new levels of e-Government services can be defined. It is important to ensure that web portals do not comprise technical problems that can negatively affect the opinions of citizens. In addition, it is important to secure functionality at all levels, so that there are no malfunctions, page slowdowns, etc. (Muhammad and Hromada 2023; Paul and Paul 2023). The development of the levels of e-Government is shown in Table 1.

The efficiency of e-Government is considered by several authors to be one of the most important drivers of progress in e-Government, and the efficiency of electronic public administration includes various disciplinary perspectives (Chan et al. 2008; Purón-Cid 2014). The efficiency of e-Government can also be measured by measuring user satisfaction, process efficiency, security and trust, innovation and adaptability, etc. In addition, it is possible to identify other areas that are closely related to e-Government (Purón-Cid 2014). The improvement of quality in public services is an important issue. The OECD has identified that improving service quality is also a measure of success. In addition, several IT tools were found to improve services, such as online portals, targeted customization, email communication, authentication, corruption reduction, transparency, etc. (West 2004; von Haldenwang 2004; Purón-Cid 2014).

Table 1. Development stages of e-Government.

	e-Government 1.0	**e-Government 2.0**	**e-Government 3.0**
Main intention	Better service	Openness and cooperation	Solving societal problems, ensuring citizen welfare, optimizing resources
Main method	Online public administration	Open and coordinated governance	Intelligent management
Level of use	National	National and local	From local to international
Tools used and service delivery	Web portal (personal visit—one-way communication)	Web portal, social media (two-way communication)	Ubiquitous smart services, smartphones, apps
ICT area	Infrastructure and organization	People and data	Artificial intelligence (AI) technologies and Internet of Things (IoT) infrastructure

An overview of efficiency measurement models was carried out in the area of e-Government. DEA has proven to be a useful tool for measuring performance, as well as the efficiency of electronic public administration and digital development in various countries, such as China, South Korea, Mexico, Taiwan and the European Union (see Table 2).

Table 2. DEA models for measuring efficiency in the field of e-Government.

	Authors	**Input Data**	**Output Data**	**State and Level**	**Models**
e-Government	(Wu and Guo 2015)	GDP index, Internet penetration index, operational maintenance index	Information disclosure index, interaction index, education services index, employment services index	Country Regional	DEA—J-SBM, S-SBM
	(Afonso et al. 2010)	Technical quality of governance, democratic quality of governance, government expenditure	Higher education attainment, child survival rate (HDI), life expectancy at birth, income equality (Gini index), median income, deflation, GDP/capita, employment rate, highway density, share of renewable energy	European Union States	DEA—BCC
	(Luna et al. 2013)	Number of Internet users, number of computer users, number of smartphone users, efficiency of public administration, infrastructure index	Level of information, interactions, transactions, level of integration, citizen participation	Mexico	DEA—CCR, BCC
	(Seo et al. 2018)	IT budget (in 42 central administrations and demand for information systems from 2014 to 2017), number of employees	Number of public services (korea.go.kr), number of open public data (public portal for open data (data.go.kr), Government 3.0 activities (e.g., achievement reports)	States	DEA—CCR, BCC
	(Liu and Tang 2009)	Number of personal computers per hundred inhabitants, ratio of computers relative to the Internet, number of Internet servers per ten thousand inhabitants. share of population on websites, GDP per capita, level of education in the region, level of security of web services.	Information provision, interaction (communication) and information processing on the authorities' websites	South Korea Resorts	DEA—C2R
	(Hsieh et al. 2013)	Number of computers, number of servers., systems development budgets, budgets for maintenance of systems, payments to IT staff.	Annual revenue of government units, number of completed transactions from e-commerce, number of malicious attacks by outsiders, website capacity, time taken to upload/download information.	China Regional	DEA—CCR, BCC
	(Yalçın 2021)	Capital investment (share of public expenditure), investment in human resources (share of civil servants).	Government websites and services (level of online services and their integration in public administration), impact of new media channels in public administration (Government Weibo, competitiveness index)	China Regional	DEA—BCC a Malmquist index

The factors that are most commonly used in the construction of input and output models are the economic factor, the technological factor and the human factor. The main variables include, for example, the level of digital services provided, gross domestic product (GDP), the employment rate in public administration, the information and communication infrastructure variables themselves, etc. A fundamental element in measuring efficiency is data homogeneity, which means that each datum has to be the same within the comparison of DMU units. The main measurement model is DEA, using CCR (Charnes–Cooper–Rhodes) and BCC (Banker–Charnes–Cooper) models. The authors Wu and Guo (2015) consider the measurement of e-Government performance within provincial governments in China to be an important topic and conclude that the authorities are quick to respond to citizens' demands. Afonso et al. (2010) recommend that government officials focus on improving efficiency in new EU member states and that they meet the EU's goals for raising living standards. Seo et al. (2018) state that the Korean government's 3.0 initiative has improved the efficiency of public service delivery (Wu and Guo 2015; Seo et al. 2018).

There are various indices that are relevant and evaluate the levels of digital society and e-Government. These indicators are important in assessing the level of digitization, efficiency and involvement of government digital services institutions in different countries. These indices and assessments are policy-making tools that help countries and regions to identify areas where they can improve their digital level. Individual authors used various international indicators from databases such as Eurostat, The Organisation for Economic Co-operation and Development (OECD), the European Commission, the World Bank, etc., when measuring efficiency.

The United Nations created a database in which data on the development of e-Government in 193 countries of the world are recorded and stored. An important indicator in the development and progress of e-Government is the e-Government Development Index (EGDI). The E-Government development index measures the willingness and ability of certain governments to use information and communication technologies to provide public services. The index can reach values in the range from 0 to 1, where 1 represents the maximum value and 0 the minimum value (E-Government Development Index 2022). Table 3 presents the results.

Table 3. Values of the e-Government Development Index (EDGI).

Ranking 2022	Country	EGDI 2022	EGDI 2020	EGDI 2018	Comparison in 2022			
					in [%] k 2020	in (%) k 2018	Order to 2018	Numbers to 2018
TOP 10	Denmark	0.9717	0.9758	0.9150	−0.41	5.67	/	57×10^{-3}
	Finland	0.9533	0.9452	0.8815	0.81	7.18	+4	72×10^{-3}
	J. Republic of Korea	0.9529	0.956	0.9010	−0.31	5.19	/	52×10^{-3}
	New Zealand	0.9432	0.9339	0.8806	0.93	6.26	+4	63×10^{-3}
	Iceland	0.9410	0.9101	0.8316	3.09	10.94	+14	109×10^{-3}
	Sweden	0.9410	0.9365	0.8882	0.45	5.28	/	53×10^{-3}
	Australia	0.9405	0.9432	0.9053	−0.27	3.52	−5	35×10^{-3}
	Estonia	0.9393	0.9473	0.8486	−0.80	9.07	+8	91×10^{-3}
	Netherlands	0.9384	0.9228	0.8757	1.56	6.27	+4	63×10^{-3}
	United States of America	0.9151	0.9297	0.8769	−1.46	3.82	+1	38×10^{-3}
12.	Singapore	0.9133	0.9762	0.9663	−0.17	3.21	−5	32×10^{-3}
20.	Austria	0.8801	0.8914	0.8301	−1.13	5.00	/	50×10^{-3}
29.	Latvia	0.8599	0.7798	0.6996	8.01	16.03	+28	160×10^{-3}
34.	Poland	0.8437	0.8255	0.7926	0.18	5.11	−1	51×10^{-3}
45.	Czech Republic	0.8088	0.8531	0.7084	−0.94	10.04	+9	100×10^{-3}
47.	Slovakia	0.8008	0.8135	0.7155	−0.47	8.53	+2	85×10^{-3}

The table shows that e-governance is a dynamic process that is influenced to a certain extent by various factors such as policy, the level of investment, implementation and technological development.

The biggest improvement compared to 2018 was achieved by Iceland and Latvia, which means that these countries have recently emphasized the modernization of e-Government. Denmark maintained its leadership compared to 2018, which means stability in the area of e-Government, with constant improvement of services. Even a country with a lower level of economic power can have a high level of e-Government. Other commonly offered online services include applying for government vacancies and business licenses, applying for certificates and paying utility bills.

The evaluation of e-Government is carried out by the European Commission and compares the levels of e-Government in individual countries. The comparison is made in four areas, according to which the indicators for the government are measured (see Figure 2) (E-Government Benchmark 2021). Individual areas are focus on the user, transparency, login and eID and cross-border services. The results achieved by Malta and Estonia indicate that their e-Governments are most focused on users, transparency, technological equipment and services, and they are open to users from other European countries as well. These countries were followed by Luxembourg (87%), Iceland (86%), the Netherlands (85%), Finland (85%), Denmark (84%), Lithuania (83%), Latvia (80%), Norway (79%), Spain (79%) and Portugal (81%).

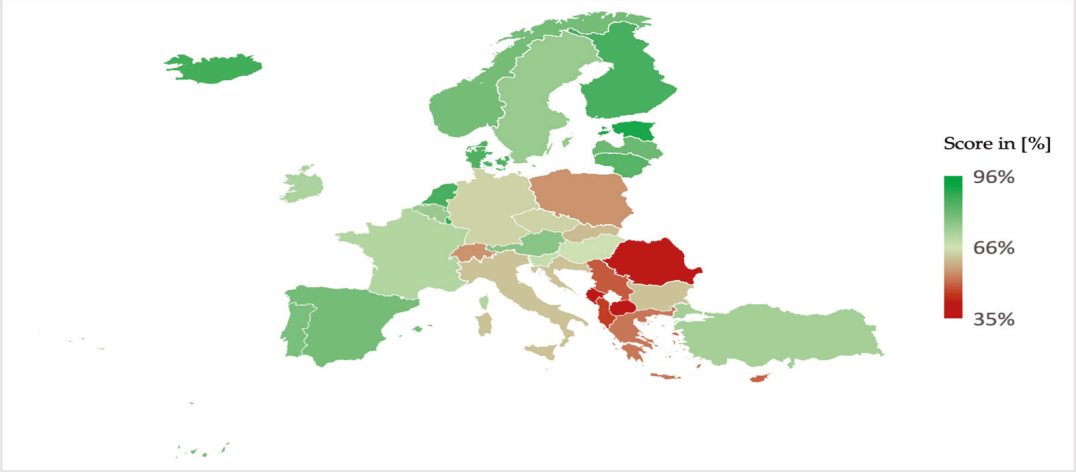

Figure 2. Total e-Government benchmark scores for EU countries (OECD Better Life Index 2022).

From Figure 2, it can be concluded that Denmark and Estonia are significant leaders in the digitalization of public administration and that they achieved above-standard results for most indicators. By contrast, Slovakia achieved lower values in selected indicators, or decreases in some areas. Slovakia should pay more attention to building e-Government and target areas such as education, the better participation of citizens in public sector and involvement in collaborations in the area of e-Government, such as with Estonia and Finland.

When carrying out the analysis in Slovakia and abroad, we also focused on the evaluation of the central portals of the public administrations of individual countries. The central portals in various countries are different. Denmark, Estonia and Finland are also leaders in terms of the results achieved within the EU27 (27 states of the European Union). In some areas, Singapore achieves a better or equal level. In Denmark, Finland and Singapore, citizens mainly access e-Government services via smartphones. In Singapore, this adoption of this approach is as high as 83%. In Slovakia, there is still a large share of citizens who do not communicate with institutions electronically, at approximately 30% less than in other countries. From the performed analysis, we identified a gap in research

on the measurement of efficiency and satisfaction in the context of digital transformation in Slovakia. Efficiency measurement models within the European Union are focused more on EU digitization and not on EU e-Government, which forms part of digitization. For this reason, we decided to measure and identify efficiency within the European Union using available data and indices.

2. Results

The Results section is divided into two parts. The first part identifies the level of portal usage. The testing of hypotheses and comparisons between urban and rural residents were carried out. Furthermore, the second part is the calculation of the American Customer Satisfaction Index (ACSI). The second part is the results of the DEA measurement.

1. Identification of the use of electronic public administration services and measurement of satisfaction with the state portal (Slovensko.sk)—ACSI.
2. Identification of the effectiveness of e-Government in Slovakia—DEA.

2.1. The First Part—Primary Research in Slovakia

The rate of the use of public services through the state portal in Slovakia is 74%, and 26% of citizens do not use this portal. Rural portals are used by 88% and other services are used by 87% of the respondents (see Table 4). Other services include electronic vignettes, e-prescriptions, ePN, the online land registry, etc. The basic access points include the central state portal, Slovensko.sk, the rural portals of municipalities and other electronic services. The skewness may indicate that respondents are less satisfied or have a different experience, which is reflected in the lower-scale values.

Table 4. Descriptive analysis of satisfaction questions from the primary questionnaire.

	Other Electronic Services		**State Portal (Slovensko.sk)**		**Rural Portal**	
Rate of use of basic access points in Slovakia number of respondents in %	yes	no	yes	no	yes	no
	87%	13%	74%	26%	88%	12%
Min	1		1		1	
Max	10		10		10	
Average	6.986		6.621		6.741	
Modus	8		8		5	
Median	7		7		7	
Standard deviation	1.900		1.976		2.355	
Peakiness	−0.050		−0.414		−0.392	
Skewness	−0.512		−0.325		−0.543	
N	368		272		174	

Based on the analysis, hypotheses were established. The hypotheses were tested using the chi-squared test between the city and rural areas. The aim was to find out the difference in use between citizens living in cities and those in rural areas.

The research question (RQ) was as follows: Does the type of permanent residence, i.e., city, influence the central portal for public electronic services or electronic state services?

Hypothesis 0AB (H0A). *There is no significant difference in the level of use of the central state portal for public electronic services (Slovensko.sk) between citizens living in cities and in rural areas.*

Hypothesis 1A (H1A). *There is a significant difference in the level of use of the central state portal (Slovensko.sk) between citizens living in cities and in rural areas.*

Research question 1 (RQ 1): Do you currently live in a city or a rural area?

Research question 2 (RQ 2): How often do you visit the portal (slovensko.sk) (see Figure 3)?

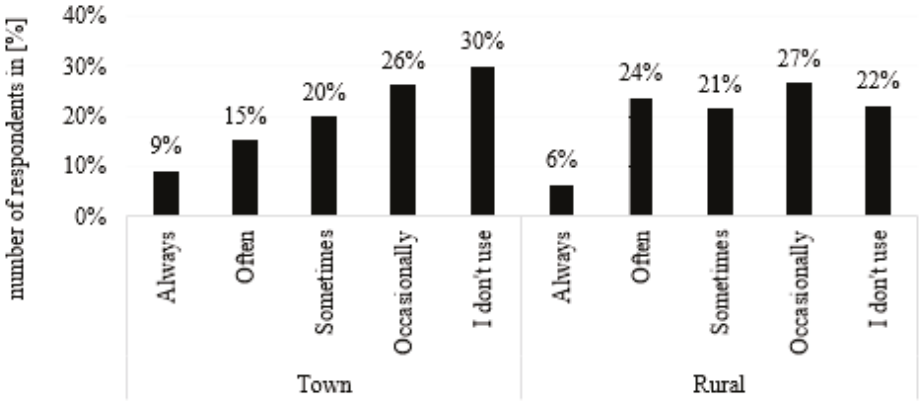

Figure 3. Use of public electronic services (slovensko.sk) for respondents rural and city areas.

The positive answers that were used to represent a "yes" answer were always, often, sometimes, and occasionally. A negative answer was represented by "no"—we do not use it. If Chí X2-test < Chí X2-critical, we accepted hypothesis H0B. In this example, based on calculations, with Chí X2-test > Chí X2-critical, we accept H0B (See Table 5).

Table 5. Chi-squared test results for cities and municipalities in rural areas.

Observed Data	**City**	**Rural Area**		**Total**	
Yes	134	138		272	
Well	57	39		96	
Total	191	177		N = 368	
Expected data	**City**	**Rural area**		**Total**	
Yes	141.2	130.8		272	
Well	49.8	46.2		96	
Total	191	177		N = 368	
Indicator	Degree of freedom	Chi X^2-test	Chi X^2-Critical	Significance level	*p*-value	Decision rule
Values	2	2.905	5.991	5×10^{-2}	8.8×10^{-2}	Accepted H0B

From the results, it can be concluded that there are no significant differences in the use of public electronic services (slovensko.sk) in between the two areas, nor within regions or between cities and municipalities. Respondents from rural areas use the portal to a greater extent and more frequently than respondents from cities.

2.2. Evaluation of the American Customer Satisfaction Index

The American Customer Satisfaction Index questionnaire contains 15 questions from the Government model. The individual questions are focused on information, process, customer service and websites. The mentioned areas represent perceived quality. Furthermore, there are questions about the customer's expectations of the service. In addition to these areas, there are questions on overall customer satisfaction, customer complaints and user trust.

The individual questions on the questionnaire use a Likert scale from 1 to 10, where, for example, 1 is a negative attitude—"do not recommend, difficult, etc.", and 10 is a positive answer—"recommend, easy, etc." By calculating satisfaction and using the American

Customer Satisfaction Index, it is possible to assess the applicability of the consumer satisfaction indicator and the measurement of satisfaction with various services.

The data for determining satisfaction using the American Customer Satisfaction Index were successfully collected (see Table 6).

Table 6. Descriptive analysis of the results of questions from the American Customer Satisfaction Index.

The Areas of the ACSI		Questions	Average	Standard Deviation	Median	Pointedness	Skewness
Perceived Quality	Information	OT2	6.03	2.11	6	−0.25	−0.22
		OT3	6.03	2.26	6	−0.47	−0.22
	Process	OT4	6.61	1.97	7	−0.38	−0.33
		OT5	6.06	2.09	6	−0.52	−0.15
	Customer service	OT6	7.17	1.95	7	−0.79	−0.19
		OT7	7.07	2.02	7	−0.65	−0.24
	Website	OT8	6.38	2.11	6	−0.65	−0.17
		OT9	6.88	1.87	7	−0.41	−0.20
Customer expectation		OT1	6.83	2.32	7	−0.65	−0.35
		OT12	6.09	2.11	6	−0.46	−0.43
Customer Satisfaction (ACSI)		OT10	7.03	2.06	7	−0.34	−0.46
		OT11	6.62	1.98	7	−0.41	−0.32
Customer complaints		OT13 OT13A	Almost no complaints				
User confidence	Fidelity	OT14	7.04	2.38	7	−0.49	−0.58
	Recommendation	OT15	6.78	2.34	7	−0.28	−0.56

In addition, the correlations between individual ACSI areas were determined (see Table 7).

Table 7. Correlations between ACSI elements.

	Correlations between ACSI Core Areas			
	Customer Expectations	**Customer Satisfaction**	**User Confidence**	**Quality**
Customer expectations	1.000			
Customer satisfaction	0.676	1.000		
User confidence	0.594	0.755	1.000	
Quality	0.663	0.855	0.682	1.000
	Correlations between Areas of Perceived Quality			
	Information	**Trial**	**Customer Service**	**Web Page**
Information	1.000			
Process	0.794	1.000		
Customer service	0.489	0.558	1.000	
Website	0.696	0.744	0.605	1.000

The greatest correlation was achieved between quality, customer satisfaction and user trust and customer satisfaction. The domains of perceived quality, process and information were the most strongly correlated, followed by website and process.

The first step in the calculation was to assign weights to the certain questions and areas. The weights are determined using the entropic method. Subsequently, we multiplied the corresponding weight v_j with the corresponding measurable transformation MP_{ij}. It is stated that $I_{ij} = (\mathrm{MP_{ij}v_j} \bullet)$. In this way, all the answers from the respondents were multiplied with the corresponding weight for the relevant question. Next the values were added up for one respondent $I_i = \sum_{j=1}^{n} I_{ij}$. Subsequently, this value could be divided by 10, and we obtained partial satisfaction for one respondent. E represents the overall mean value of the American Customer Satisfaction Index for all respondents. Satisfaction scores for individual respondents for all areas (see Table 8).

$$I_i = \frac{\sum_{j=1}^{n} I_{ij}}{10} = \frac{\sum_{j=1}^{1} 7.5}{10} \times 100 = 70.45\%$$

Table 8. Satisfaction scores for individual respondents for all areas.

Respondent	Partial Respondent Satisfaction
$\mathrm{I_1}$	69.17%
$\mathrm{I_2}$	81.60%
$\mathrm{I_3}$	43.10%
$\mathrm{I_{272}}$	67.92%
E—total value	1783

$$\mathrm{E} = \frac{\sum_{n=1}^{\mathrm{N}} \mathrm{I_i}}{\mathrm{N}} = \frac{7.05 + 8.25 + \ldots + 6.93}{272} = \frac{1783}{272} = 6.557$$

$$ACSI = \left(\frac{E - MIN}{MAX - MIN}\right) \times 100 = \left(\frac{6.557 - 1}{10 - 1}\right) \times 100 = 61.74\%$$

This result represents the level of customer satisfaction on a scale from 0 to 100, while the value of 61.7% indicates slightly higher satisfaction with the use of the state portal, Slovensko.sk, and the assumptions of RQ 1–2 are accepted. We proceeded further in terms of satisfaction for individual areas. The results are presented below:

$$\mathrm{I_{k-1}} = \frac{\sum_{n=1}^{\mathrm{N}} \left(\mathrm{R_{ij}} \times \mathrm{v_j}\right)}{10 \times \sum_{n=1}^{\mathrm{N}} \mathrm{v_j}} = \frac{(7 \times 0.084) + (8 \times 0.098) + \ldots + (6 \times 0.048)}{10 \times (0.084 + 0.098 + \ldots + 0.048)} = 0.712$$

$$\mathrm{I_{K1}} = \frac{\sum_{n=1}^{\mathrm{N}} \mathrm{I_{k-n}}}{\mathrm{N}} = \frac{0.712 + \ldots + 0\,0.615}{272} = 64.2 \times 10^{-2}$$

Additional results were obtained for satisfaction for individual areas of perceived quality (64.2%), customer expectation (64.5%), customer satisfaction (68.2%) and user trust (69.1%).

The total calculated satisfaction was at the level of 61.7%. Among the individual areas, user trust achieved the best rating, at the level of 69.1%, and customer expectation reached the lowest value, i.e., slightly above average. It is necessary to update the central state portal for public electronic services and, thus, increase the level of satisfaction of users with e-Government services.

2.3. The Second Part of the DEA Efficiency Measurement

The next part was focused on the DEA method. The following table (see Table 9) shows the output values of the DEA measurement for the years 2014, 2016, 2018, 2020 and 2022.

Table 9. The results measures of e-Government efficiency for the selected period.

	2022		2020		2018		2016		2014		Efficiency (Max 1)
	Y	X	Y	X	Y	X	Y	X	Y	X	
Finland	7	0.981	5	0.959	6	0.958	7	0.904	1	1	0.960
Denmark	9	0.955	6	0.950	4	0.989	4	0.986	1	1.177	0.976
Sweden	8	0.970	7	0.928	1	1.036	11	0.832	11	0.983	0.943
Netherlands	1	1.009	3	0.980	8	0.934	10	0.845	14	0.936	0.939
Luxembourg	17	0.828	22	0.706	21	0.724	12	0.811	18	0.844	0.782
Malta	10	0.942	13	0.824	19	0.754	20	0.681	15	0.879	0.816
Estonia	1	1.159	1	1.159	1	1.253	1	1.647	16	0.858	0.972
Ireland	1	1.043	16	0.773	10	0.904	1	1.116	1	1.077	0.936
Spain	18	0.809	20	0.745	16	0.794	15	0.734	21	0.789	0.774
Latvia	1	1.903	1	1.621	1	1.475	1	1.928	1	1.440	1.000
Lithuania	14	0.863	11	0.856	13	0.850	9	0.881	1	1.332	0.890
Austria	13	0.892	8	0.927	11	0.887	13	0.790	17	0.857	0.870
Belgium	16	0.841	18	0.753	20	0.737	19	0.697	20	0.825	0.771
Slovenia	11	0.938	9	0.902	12	0.875	16	0.728	1	1.056	0.889
Portugal	21	0.730	21	0.744	17	0.781	8	0.884	1	1.191	0.828
France	1	1.013	4	0.966	7	0.938	6	0.926	19	0.841	0.934
Germany	25	0.651	17	0.761	22	0.669	23	0.620	23	0.697	0.680
Czech Republic	12	0.902	19	0.745	18	0.777	25	0.528	24	0.675	0.725
Croatia	22	0.709	23	0.673	23	0.660	22	0.631	22	0.737	0.682
Slovakia	19	0.772	15	0.794	15	0.794	14	0.775	1	1.060	0.827
Cyprus	20	0.769	24	0.664	24	0.627	18	0.703	13	0.947	0.742
Hungary	1	1.039	12	0.849	9	0.908	17	0.722	1	1.042	0.896
Italy	26	0.508	26	0.458	26	0.436	26	0.452	26	0.520	0.475
Poland	24	0.672	25	0.603	25	0.611	24	0.555	25	0.671	0.622
Bulgaria	23	0.702	14	0.794	14	0.816	21	0.653	12	0.956	0.784
Greece	15	0.844	10	0.868	5	0.958	5	0.957	1	1.139	0.926
Romania	27	0.417	27	0.269	27	0.213	27	0.231	27	0.358	0.297
efficiency in years of years [max 1]		0.841	-	0.796	-	0.800	-	0.760	-	0.866	-

Where Y—ranking and X—super efficiency. The overall efficiency for individual years reached the highest score in the year 2014, followed by the year 2022. The results can also be seen in the overview in Figure 4.

A comparison of the efficiency levels of the electronic services provided by EU countries is displayed in Figure 4. Western EU countries did not reach efficiency in 2014, but in 2022, two countries managed to achieve efficiency, i.e., France and the Netherlands. Their average score is the second highest for all the areas. The development of most countries is growing, except for Germany and Austria.

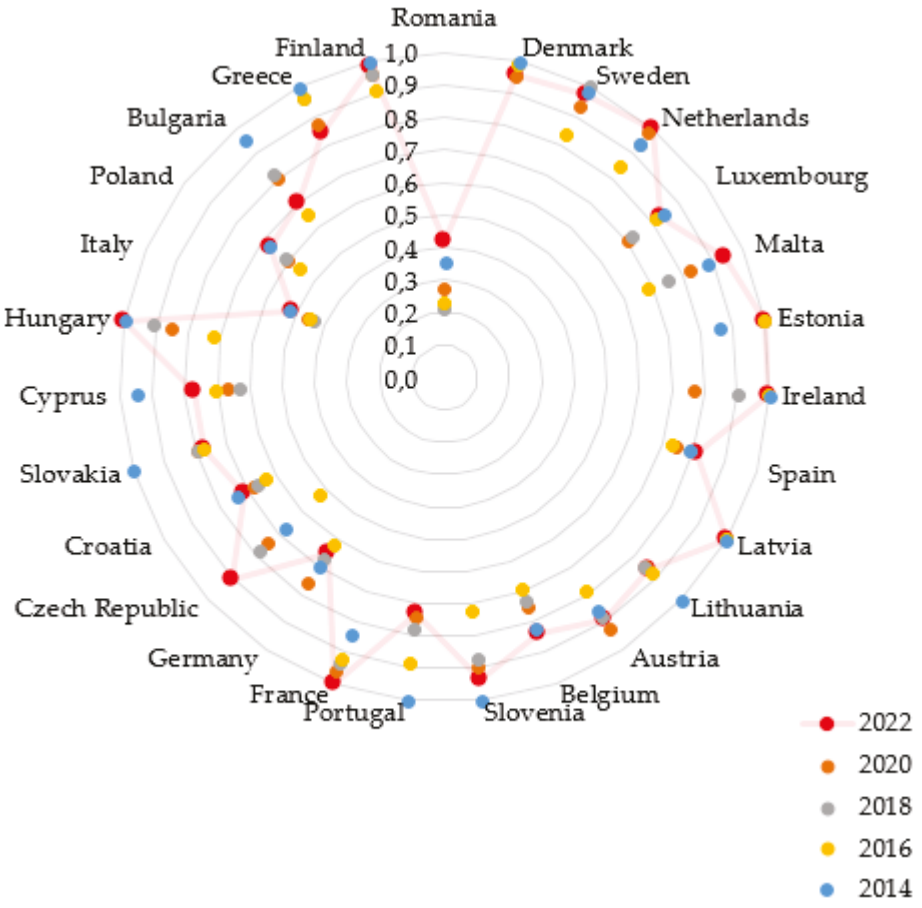

Figure 4. Graphical representation of results.

Based on the results of the DEA analysis and the obtained efficiency values for 27 EU countries, the countries were divided into four areas. Moreover, the results were verified through hypothesis testing using the Mann–Whitney U test, which is primarily used to verify two independent sets due to low numbers of elements. In addition, we tried to answer the question of whether the difference was statistically significant or just random. The following hypotheses were tested for verification:

Hypothesis 0B (H0B). *There is no difference between the efficiency levels of e-Government in selected areas of the European Union.*

Hypothesis 1B (H1B). *There is a difference between the efficiency levels of e-Government in selected areas of the European Union.*

Through the hypotheses H0C and H1C, we verified whether there were differences in the effectiveness of e-Government among four areas of the European Union. The values for the average effectiveness of e-Government for individual years were used for the testing. In addition, when testing the hypotheses, we chose the northern part of the European Union as a control group, as these countries achieved the highest average value for 2022 and 2014 among the other groups. In this example, the alpha value was 5×10^{-2}. However, the file did not contain more than 25 elements per group, that is, U_{crit} was taken from the table for the Mann–Whitney U test. Based on the comparison of U_{min} and U_{crit}, the hypothesis H0C was accepted or rejected. The Mann–Whitney test results are displayed below (see Table 10).

Table 10. Mann–Whitney U test results for EU regions 2014–2022.

Areas Tested	Number of Elements	U_{min}	U_{cirt}	Sign	Level Significance Level	Decision Rule
Northern EU—Eastern EU	n1 = 7 n2 = 6	1	6	≤	5×10^{-2}	H0C reject
Northern EU—Southern EU	n1 = 7 n2 = 6	3	6	≤		H0C reject
Northern EU—Western EU	n1 = 7 n2 = 8	1	10	≤		H0C reject

The calculation was carried out using the Excel program. Based on the results of the testing, it was confirmed that there are differences between the effectiveness of e-Government in countries from the northern EU and the countries from the southern, eastern and western EU. Thus, we confirmed H1C and rejected H0C in all the selected combinations.

The results show that there are EU areas that have a higher level of e-Government. In these countries, the interaction between citizens and public administration is more intensive through e-Government services. We can also observe countries with a lower level of economic performance that offer effective e-Government services.

3. Discussion

It is possible to measure the impact of digitization on the economy, society, management or the environment (Maximizing the Impact of Digitization 2022). Within this research, the impact was measured only in the European Union. The results show that the selected indicators confirmed several authors' conclusions, and that this influence persists and is visible in the EU region (Countries' Performance in Digitisation 2022). Increasing digitization significantly increases societal well-being in an advanced economy. Analyses carried out on 24 EU countries show that a certain increase in digitization score results in an increase in life quality. In less developed economies, other factors than digitization are critical for quality of life (basic needs take precedence, followed by housing, clothing, water and energy, and then health and, finally, transport and communication). Digitization has an impact on quality of life only when citizens have their basic needs satisfied. Increasing levels of digitization also promote better access to basic services, as measured by the HDI, which tracks global access to health and education, as well as overall living standards. The analysis shows that if countries are more digitized, all these aspects improve. The impact of digitization on indicators of health, education and standards of living is more pronounced in developing economies (Maximizing the Impact of Digitization 2022; Digital Around the World 2022; GSMA Intelligence 2022). Future studies should take into greater consideration the sorting of electrical waste, recycling and returning used resources back into the production cycle (UNEP-UNITAR 2023).

Another interesting result is that the rate of use of the portal is high, but satisfaction levels are different for local and other public administration services, as well as the central portal for public services. These levels are alo to some extent influenced by the difficulty of using the services. The results demonstrate that the respondents show a negative attitude towards the development of e-Government if it is compared with the ideal. Therefore, in the future, it will be necessary to carry out further research to determine the ease of use of individual services in the central state portals of all EU countries using the Index Calculation and Maintenance Methodology (CES).

We answered the following question: Is there a difference in the use of e-Government services between citizens living in cities and in rural areas? (Roy et al. 2015). According to Hypothesis 0B, there is no significant difference in the level of use of the portal Slovensko.sk between citizens living in cities and in rural areas. From the results achieved, it is possible to accept the 0B hypothesis and to state that there is no significant difference between the two groups studied. This result can be perceived positively, as it suggests that citizens

use e-Government services even outside urban areas. Moreover, a similar conclusion applies to regions. Roy et al., Seo and Bernsen perceive use by this group as a positive due to transportation costs, time constraints, or traffic congestion (Roy et al. 2015; Seo and Bernsen 2016). However, there are several services that are underutilized, such as mID or app-in-picture. Therefore, it would be advisable to increase awareness of these and other available services for citizens outside urban areas. However, one difference can be perceived in choosing the type of service, since residents in rural areas are in favor of the state portal for public electronic services rather than the Singapore solution, in which an application is used more frequently, but the portal is also available. The respondents see the major advantages of e-Government as saving time, the minimal physical burden and 24/7 availability. The results indicate that among the disadvantages and weaknesses of e-Government, citizens perceive digital literacy and a low level of information. The government should focus on these two aspects by integrating the information portal within Slovensko.sk, as other countries have.

In practice, e-Government should enable citizens to interact with authorities from the comfort of their homes and not force citizens or entrepreneurs to appear in person at an office. This could also reduce costs (the automation of processes could save some human resources) and, last but not least, save the environment (for example, by reducing paper consumption). The prerequisite for the successful implementation of this project is also, above all, the expansion of the Internet to the majority of households and companies in Slovakia. In the case of e-Government in Slovakia, this is already a real and legally expected project. Law no. 275/2006 Coll. about information systems for public administration is about the implementation of this idea in life. The strategy for the informatization of public administration states, among other things, that the benefits at which the strategy, strategic goals and specific steps are aimed are focused on client-oriented public administration (for citizens, entrepreneurs and the rest of the public). The performance of public administration will be possible to implement electronically, using information and communication technologies (through the Internet, mobile phones or other means of communication) and others (Kupka 2008; Marcinčin et al. 2023).

It is possible to measure satisfaction using the American Customer Satisfaction Index within Slovakia, but the results show that it would be necessary to reevaluate the area of complaints, as a relevant number of responses were not obtained in this area. The spplication of the ACSI model and the result show that the overall satisfaction with Slovensko.sk is 61.7%. This contributes to a clearer demonstration that satisfaction with the portal is not sufficient. The portal has been running for more than 10 years, and the state has not been able to finetune it so that citizens are satisfied to a greater extent. A larger group of respondents complained about the reliability and design of the portal. The data contribute to a clearer understanding of the the functioning of ACSI. It is possible to state that the applicability of ACSI is possible to use for several services or solutions within the framework of e-Government in Slovakia. Future research could take into account the modification of ACSI, whether based on the determination of the level of e-Government 3.0 or on the reevaluation and addition of questions to the model (Nam 2013). Since e-Government is also used through mobile applications, such as in Singapore, or the implementation of artificial intelligence in public administration (National Digital Identity 2024; National AI Strategy 2024), if the questionnaire could be used in another country, such as Singapore, it would be appropriate to create a multilevel questionnaire that takes into account the level of service through e-Government in those countries. The results are based on the existing evidence, established by E.Welch, on the recursive interaction between trust and satisfaction: trust leads to satisfaction and vice versa (Welch et al. 2005). The results suggest that citizens who trust the government more are also more likely to be satisfied with e-Government. The results provide a new perspective on the relationship between satisfaction and quality, according to which this relationship is somewhat stronger. As part of quality, it is affected by processes, website and information.

When determining the weights in the ACSI, the entropic method was used, but the primary intention was to also use the Analytic Hierarchy Process (AHP) method. Non-

tropical weighing provides us with a more objective view when determining weights and is more suitable for determining the weight of a complex system. Each method has its disadvantages, so it would be advisable to use the AHP method as well, in order to take advantage of the advantages of the methods of objectivity and subjectivity. For this reason, when calculating the complex weight, the proportion of AHP could be set at 50% and the weight of the entropy method at 50% in future research (Yang and He 2022).

Furthermore, the time aspect of the service was not taken into account during the primary research. How likely is it that there would be a difference in satisfaction if the service were available 1 year or 10 years after release, or if it were a newly launched service, or a portal? It is possible to assume that a certain group of users will adopt the service and that there may be a difference between a user who is using the service for the first time and one who has used it several times already. Future research could also address the question of whether there is a difference in ACSI satisfaction between citizens living in a city and in a rural area. In addition, a suitable solution for when to use the service is to use it at a regular time interval (1 per year), with major system changes or minor updates that could affect the customer experience. It would also be possible to compare (Morgeson and Mithas 2009) who measured the levels of satisfaction with central state portals and private sectors. In one study, the authors found that federal portals do not provide the same level of quality as other electronic services (Morgeson and Mithas 2009). When modernizing and updating the portal, Slovensko.sk, it would be appropriate to carry out such a comparison, as it would be possible to find out whether the updated central portal for public services is comparable in terms of quality with the most modern portals in the field of the electricity trade. The ACSI questionnaire can be used at several levels, whether at the local level or with other portals for public services.

Tan et al. (2008) state in their research that electronic public administration is increasingly becoming a well-known part of virtual countries. However, the lack of public trust caused by the novelty and uncertainty of online transactions hinders the widespread adoption of public electronic services. Taking into account the perspective of technology as a social actor with whom the customer communicates and transacts, we propose a research model that emphasizes the key role of e-Government service quality as the main driver of citizens' beliefs about the trustworthiness of e-government websites, which, in turn, promotes the corresponding adoption of e-Government website services. The findings of this study demonstrate that the quality of e-government websites is important in building citizens' trust in public electronic services (Tan et al. 2008). The results of the study by Li and Shang (2023) reveal that the use of e-government by citizens revives their trust in government indirectly, through the influence on citizens' evaluation of the integrity of public administration, as well as its performance and responsiveness based on the experience of using e-Government, while the mediating effects of citizens' evaluations of the government on the relationship between the use of electronic public administration and public trust are reduced by citizens' expectations of their government. The findings highlight multifaceted strategies to accelerate the adoption of e-Government. Increasing citizens' trust in e-Government systems through increased reliability, security and transparency remains essential. At the same time, it is necessary to take initiatives to cultivate digital access, skills and abilities within segments of the population (AbdulKareem and Oladimeji 2024). The quality of electronic services has a significant impact on creating public trust. The quality of electronic services also significantly affects public satisfaction. Public trust directly contributes to public satisfaction with public services, but other unmeasured factors also play a role in shaping public perception and satisfaction (Taufiqurokhman et al. 2024).

DEA is the measure of efficiency in the European Union. It follows from the results of the work that the countries in the northern part of the European Union are more effective in the field of digitization than the others. The resources they spend on building e-Government infrastructure and services effectively correspond to the outputs. Moreover, when measuring the efficiency of the Mann–Whitney U test, we statistically confirmed that there is a difference between the levels of efficiency of e-Government in selected areas of the European Union. In addition, the ACSI results could be added to the model (in model B) if

such a measurement were implemented across the European Union, and the two output indicators could be the level of online communication with the public administration and satisfaction (ACSI) with the public administration's central state portal or another service. If it were possible to increase satisfaction by "10%", individual states could take a closer look at this index and, thus, increase the required parameters of perceived quality.

When measuring efficiency, countries that are leaders in the field of efficiency were included. These countries include Estonia, Latvia, Finland and Denmark. The inputs of these countries are spent efficiently in relation to the outputs. Even countries with a low budget can achieve a high level of e-Government if the spending of resources is efficient in relation to their outputs, as in Estonia or Latvia. The cooperation of some countries with others, such as Estonia, Finland and others, can also be considered a key factor (Finland and Estonia Deepen Cross-Border Digital Partnerships 2023).

The Recovery and Resilience Plan is intended to assist selected or all countries in their digital transformation (Recovery and Resilience Facility (Country Pages) 2023). These investments and their results will only be visible in a few years. Therefore, it is necessary to monitor how the efficiency of the use of these financial resources was affected by the results of e-Government, either by the increased interaction between the citizen and the public administration, or by the increased number of online services. Digital technologies increasingly contribute to increasing productivity, efficiency, accessibility and, above all, the overall well-being of the population.

Among the limitations we encountered while writing the research, for example, is the low number of articles using the DEA method in the field of e-Government. Other restrictions may influence the cultural and economic nature of the development of this part of Europe. Education in digital skills among the population (digital culture), economic opportunities and investments are needed for the development of not only e-Government, but also the economic and knowledge availability of these services (Taipale 2013). Other limitations include the limited comparability of data for measuring efficiency across the world and the necessary normalization of data. This would make it possible to compare EU countries with Asian countries. Furthermore, countries do not record investments or resources used in e-Government for a certain period to a uniform standard so that these data can be examined for use in the DEA method. The determination of the weights using the AHP method when determining the ACSI area was also an important issue. There was a problem with finding relevant experts who understand indexes, the ACSI index and the AHP method.

Next, a summary of further suggestions for future research is presented. The use of the ACSI, mainly when introducing new services, is recommended. The creation of several ACSI questionnaires that take into account the levels of given countries or measure satisfaction with the local portals of cities and municipalities is also suggested. Furthermore, the use ACSI for new services, such as "mID" and others, is proposed. To use the analytic hierarchy process (AHP method) and the entropy method when determining the weights, in order to use the advantages of both methods of objectivity and subjectivity, is suggested. The use of the DEA method when comparing local regions in Slovakia is indicated. A use for cities and municipalities that provides and most efficiently manages particular budgets to provide the best services to citizens is suggested. When measuring efficiency, it is also important to take into account education levels in mathematics. Future research could address AI solutions within AI countries.

The European Union is becoming increasingly interconnected, with individual countries' economies becoming integrated into a unified digital market. This fact should be taken into account in European Union politics, with a focus on the unification of services provided at the level of citizen identification and the creation of shared services that can be utilized by any EU member state. It would be beneficial for individual nations to engage in more collaborative efforts, both within their own borders and with countries outside the European Union.

The practical implications of e-Government, particularly in terms of policy, warrant further discussion to ensure effective implementation and optimization. Moreover, the search for long-term strategic solutions that are viable for a period exceeding five years is of

paramount importance. The 3E principle was described in this article. The efficiency principle is the main part of the 3E principle, which is the focus of this paper. The DEA method was employed to ascertain the efficiency of each country. The outcome of the DEA model is directly correlated with e-Government efficiency. The cost-effectiveness of the countries in the DEA model is represented by their respective GDPs. The measurement results assist in identifying which countries utilize resources to produce quality e-Government services. Examples of countries that have achieved high levels of e-Government despite low economic strength (GDP) include Estonia, Hungary and Latvia. The DEA model incorporates a temporal dimension, enabling the identification of cost-effectiveness over time.

The efficacy of the countries in question can be represented by the ACSI score, which can be measured in the European Union. It is important to determine whether the individual results have met the expectations of the population, which should be reflected in their satisfaction (Krejnus et al. 2023; Kumar et al. 2021).

4. Materials and Methods

This article contains both qualitative and quantitative data collection. Within the article, mathematical–statistical methods, such as multicorrelation methods and entropic method of determining weights were used. The mathematical–statistical methods of DEA and the American Customer Satisfaction index (ACSI) were empleyed as the primary analytical tools. The procedure for using DEA is presented below. In the framework of primary research, quantitative method in the form of questionnaire survey was used.

A research gap was found in identifying the efficiency of e-Government within EU countries using various indices. This gap was identified by analyzing articles in an international context; the specific countries are mentioned in Table 2. For measuring efficiency within public administration, or e-Government, the DEA method is used using the CCR model. Subsequently, the primary research, aimed at measuring satisfaction in the selected area, was designed using the American Customer Satisfaction Index, Government model, and other questions.

Within the research, following research questions were posed:

- Is it possible to measure the impact of digitization on the economy, society, management or the environment?
- Is it possible to apply ACSI for central state portal, Slovensko.sk? What will be the overall satisfaction with central state portal?
- Are there indicators that can be used to measure efficiency in the European Union, and if so, can they be used in the measurement?
- What models were used to measure the efficiency of e-Government?
- Is there a difference between the use of e-Government services among citizens living in the city and in the countryside?

In order to address the research questions, it was necessary to employ a number of different methods. Methods of analysis, collection and processing of information, excerption and compilation methods were used. In addition, the CCR efficiency measurement model, which is output-oriented, was employed in the measurement process. Within this method, the query method and chi-squared method were used. The research questions are answered in the Discussion and in the Conclusion (see Table 11).

Table 11. Research methods used.

American Customer Satisfaction Index—ACSI	Efficiency Measurements of e-Government—DEA
Within the framework of ACSI, the following main methods were used: the inquery method, the calculation of the ACSI index itself, the correlation analysis between elements, descriptive analysis, the entropic method of determining the weights and the chi-squared test.	Within DEA, the following methods were used: output-oriented CCR measurement model, super-efficiency, correlation analysis, descriptive analysis and Mann–Whitney U test.

Customer Satisfaction Index

The most widely used customer satisfaction indexes in the world are The American Customer Satisfaction Index—Government and the European Customer Satisfaction Index (The American Customer Satisfaction Index—Government 2024). The ACSI government model is a critical control point for evaluating the success of a government's projects and online initiatives. It is one of the more complex and representative reflections of citizens' experiences with government websites. ACSI is used to track user satisfaction with product quality over time. The results can be compared with the results of organizations in both the private and public sectors. The ACSI government model was first used in 1994 (The American Customer Satisfaction Index Science and Methodology 2019). ACSI provides cause-and-effect analysis to better target resources to where improvement will have the greatest impact on product improvement. The government's ACSI model consists of satisfaction factors, satisfaction outcomes and overall satisfaction. Satisfaction factors are grouped into four broad categories that are used as inputs to measure quality (information, process, customer service and website) on the left, overall satisfaction (ACSI) in the middle and satisfaction outcomes on the right (see Figure 5). As one of the solutions, the ACSI model—Government questionnaire was utilized, and it was subsequently used to evaluate satisfaction with e-Government services aimed at the central state portal of the Slovak Republic.

Figure 5. The government ACSI model.

The process of selecting participants was carried out by random selection among citizens of the Slovak Republic. The questionnaire was created in electronic form using the Google Docs tool. Electronic inquiry took place in the time interval from 19 February 2022 to 21 February 2022. The target group was represented by the citizens of Slovak Republic aged 18 to 65 years, with residence in the Slovak Republic and experience using e-Government services. The criteria for inclusion in the sample of respondents were age (18–65 years), residence (Slovakia) and use of e-Government services. Participants under the age of 18, older than 66, respondents residing outside the Slovak Republic and participants who do not use e-Government services were excluded from the survey. The survey involved 423 respondents. The target sample for filling out the questionnaire was 386, which was calculated on the basis of the base set, which is greater than 100,000. The variability of the base set represents a value of 0.5. The confidence interval is 95% and the maximum accessible margin of error is 5%.

Of the participants, 301 were women and 122 were men. There were 225 respondents with current permanent residence in cities and 198 in rural areas. Of the total number, 162 respondents live in the West Slovakia region (38.3%), 106 respondents (25.1%) in East Slovakia and 155 (36.6%) in Central Slovakia. The largest group of respondents was between 41 and 50 years old, with a 2nd degree of higher education and in employment. The methodology of the article is described in Table 8.

The DEA method ranks among the most important management methods. It allows users to evaluate efficiency based on selected inputs and outputs. DEA was first used

in 1978 by Charnes, Cooper and Rhodes as a CCR model. In 1984, Bunker, Charnes and Cooper introduced a variant of BCC that evaluates the efficiency of decision-making units under the assumption of variable returns to scale (Omrani et al. 2020; Charnes et al. 1978).

The basic goal of the DEA method is to compare organizational units, which are also referred to as decision-making units (DMUs). Each decision-making unit uses a certain number of inputs for its activity, and the activity results in certain outputs. Input quantities are those units that are consumed in the given activity, and outputs represent the resulting products. In general, smaller input values and larger output values are preferred. The meaning and purpose of the analysis depends on the selected inputs and outputs in the model. Inputs and outputs should be logically linked, as they are in a production process. In order for inputs and outputs to be chosen correctly, we use correlation analysis. With the help of correlation analysis, we select the relationship between the variables and thus eliminate the variables with very strong and very weak correlation. In addition to a suitable correlation coefficient between the indicators, the inputs and outputs must be adapted to the number of decision-making units (DMUs). The rule used is the sum of the number of inputs and outputs $\leq 1/3$ or $1/5$ of the total number of decision-making units. The CCR model calculates the weights of inputs and outputs, the so-called optimization calculation, so that they are as accurate as possible for the DMU in terms of its efficiency while observing the conditions of the maximum efficiency units of all other units (DEA Modely a Meranie Eko-Efektívnosti 2022).

The model evaluates the electronic public services in a given time period (see Table 9). As in the previous measurement, the maximum number of inputs is calculated based on $m + s < \frac{n}{5}$, where n represents the number of EU countries. The model has a maximum number of indicators for measurement, which are divided into 4 input and 2 output indicators. The indicators meet the criterion that their data are available from 2014 to 2022. Each input indicator was chosen on the basis that a larger input value in a given country would be more likely to provide more effective e-Government services. Interactions with public administration online, which is one of the most important indicators, were chosen as the output indicators. The output indicators provide us with a picture of the use of e-Government services for input taxes, which take into account the performance of countries in key areas of the current economy and the level of e-Government (see Table 12).

Table 12. Input and output DMUs for time model—measurement model B.

Index	Used Attributes from the Index	Index Attribute	Index Direction	
Use of the Internet	Human factor (number of Internet users)	Access	-	
EGDI	Technological factor (level of e-Government)	Access	-	
GDP per capita	Economic factor	Access	-	**Time availability of data From 2014 to 2022**
GBARD share of total government expenditure	Economic factor (share of R&D expenditure)	Access	-	
Submission of completed forms when communicating with the public administration	Human factor (level of communication)	Output	+	
Interaction with public administration online	Human factor (e-Government—e-Government user communication)	Output	+	

The statistical relationship between individual quantities can be determined using the Spearman correlation coefficient. The correlation coefficient r is defined by the following relation:

$$r = 1 - \frac{6 \times \sum_{n=1}^{N} D^2}{N \times (N^2 - 1)} \quad (1)$$

N = number of elements;
D = difference between x_n and y_n i.e., in two rows;
r = correlation coefficient.

The correlation coefficient can take the values $\langle -1; 1 \rangle$. The correlation coefficient takes values from the interval $\langle -1; 1 \rangle$ and expresses the degree of linear correlation between variables. Minus 1 means absolute indirect dependence, 0 means non-existent linear dependence, and 1 means absolute direct dependence between two variables. Within DEA analysis, it is advisable that the correlation coefficient is not higher than 0.8, otherwise the efficiency result may be distorted. The ideal correlation coefficient is between 0.3 and 0.8 (Schober et al. 2018).

A research gap was found in identifying the efficiency of e-Government within the EU countries using various indices. For measuring efficiency within public administration, or e-Government, the DEA method is applied using the CCR model. Subsequently, the primary research, aimed at measuring satisfaction in the selected are, a was designed using the American Customer Satisfaction Index, Government model, and other questions. The correlation between individual indicators was determined for the year 2022. The average value of all correlations for the year 2022 was 0.570, which is in the range <0.3 to 0.8>. Thus, we also confirmed the appropriateness of our inputs and outputs. Correlations between individual elements are presented in Table 13.

Table 13. Identification of the baseline population of interest.

Year 2022	A	B	C	D	E	F
A	1					
B	0.669	1				
C	0.446	0.717	1			
D	0.654	0.425	0.376	1		
E	0.798	0.591	0.311	0.420	1	
F	0.714	0.677	0.473	0.442	0.845	1

Correlation analysis was performed for all years, but we report only one. The appropriate values of the correlation for individual years were (2020—0.541), (2018—0.596), (2016—0.613), and (2014—0.629).

The methodology and procedure of the paper are presented in Table 14.

Table 14. Methodology of the article.

Paper	Information	Method	Research Phase
Main data collection	The data were focused on digitization, e-Government, efficiency	Analysis, method determination	I.
Analysis	Books, scholarly articles on digitization, e-Government, DEA models that have been used to measure e-Government within Asia. Key findings from DEA measurement models.	Analysis, method of collecting and processing information, extraction and compilation methods, method of abstraction	II.
User identification and satisfaction measurement using ACSI	Data were obtained from respondents.	Primary results of entropic data measurement method, chi-squared test, multi-correlation method	III.

Table 14. *Cont.*

Paper	Information	Method	Research Phase
DEA method	Output-oriented CCR model	-	IV.
	From the analysis, none of the indices that can be used have been filled in. The article was targeted at e-Government, meaning that it was necessary to establish input and output data.	-	
	Determination of the number of inputs and outputs, verification of appropriate inputs and outputs.	Multi-correlation method, Mann–Whitney U test	
	Determination of input and output values. Descriptive data analysis. Dividing selected countries into regions and EU areas and determination of efficiency in 2014, 2016, 2018, 2020, 2022. Identification of effective and ineffective countries.		
Conclusion, Discussion and results	The Conclusion determines the level of satisfaction determined by ACSI within Slovakia and the efficiency levels of countries for individual years.	Synthesis method, deduction method, induction method, generalization method, DEA method, comparisons with other studies	V.

Source: own processing.

The article comprises both qualitative and quantitative data collection. In addition, the article uses several methods, such as multi-correlation methods, entropic methods for determining weights, etc. The procedure for using DEA is presented in Figure 6.

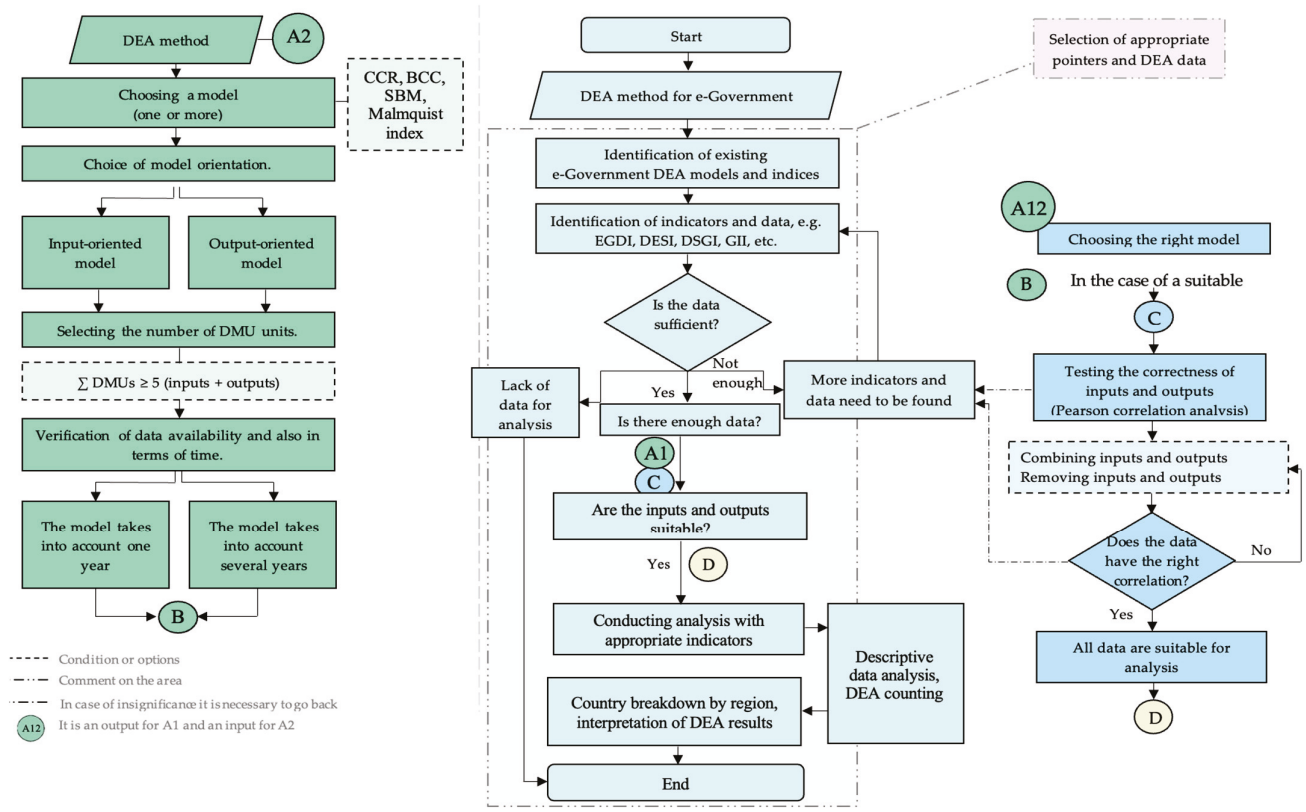

Figure 6. The methodological procedure uses DEA methods.

The graph presents a diagram showing the calculation procedure for the DEA method. The graph can be divided into several parts.

The diagram begins with the identification of existing efficiency measurement models in the examined area and, subsequently, it presents the selection of appropriate indicators and data, with the help of which the goal of DEA efficiency measurement can be achieved. These indicators and data were used for the calculation from which the efficiency ratings were obtained. If there were insufficient data on the examined issue, it was not possible to carry out such a measurement, or it was necessary to look for other indicators and data. This step is one of the most important, as a wider spectrum of information gives us greater possibilities when combining data during measurement.

After this step, it was necessary to move from A1-A12-A2 to select a suitable DEA model. There are several models, which differ in how they calculate efficiency. Therefore, it is necessary to choose the correct direction of the input- or output-oriented model, to know what the number of decision-making units (DMUs) will be and, based on this, to calculate the maximum number of inputs and outputs. Subsequently, it is important to verify, if necessary, the time point of data availability, whether the data are available for a longer period or only one year, etc. In this step, it is necessary to divide the indicators and data.

Furthermore, it is necessary to test the correctness of inputs and outputs based on correlation analysis. A moderate correlation between indicators and data is most appropriate. If the input and output data have inappropriate correlations, it is necessary to find other indicators and try to repeat the correlation analysis. This is also necessary in the case of a longer period of time. If the data are suitable, we can perform descriptive statistics for the data after the correlation analysis.

Subsequently, it is necessary to calculate the efficiency itself using the selected model, determine the order of efficiency, etc. For measuring efficiency over time, it is suitable, for example, to calculate the average efficiency for a certain period. In our case, it is appropriate to divide the countries into regions, or EU regions. In individual steps, it is possible to divide this diagram into 10 steps. In addition, this diagram also serves as a tool for understanding the DEA procedure (Krejnus et al. 2023).

5. Conclusions

This research was aimed at verifying the use of the American Customer Satisfaction Index of the e-Government model in Slovakia and the use of the efficiency measurement method (DEA). For summary of answers to the research questions, see Table 15.

Table 15. Answers to the research questions.

Type of Question	Research Question	Short Answer
First Main	Is it possible to apply ACSI for central state portal, Slovensko.sk? What will be the overall satisfaction with central state portal?	Yes, it is possible. Satisfaction is 67.8%.
Second Main	Are there indicators that can be used to measure efficiency in the European Union, and if so, can they be used in the measurement?	Yes, there are several indicators and they can be used in the DEA method.
-	Which models were used to measure the efficiency of e-Government?	The most commonly used models are CCR and BCC.
-	Is there a difference between the use of e-Government services between citizens living in the city and in the countryside?	Within Slovakia, the difference is not statistically significant.

Both methods were applied, and their applicability was verified. During primary research, the verification of the use of the ACSI model was carried out. From the results, it can be concluded that it is possible to use this measurement model. The research revealed that the overall results of satisfaction with the central state portal for public services was 61.7% (Slovensko.sk). Furthermore, the results of the model showed that quality is the most important, as it has the greatest impact on customer satisfaction and, subsequently, this

satisfaction affects customer trust. Of the qualitative elements of central portal for public services, it is necessary to focus on optimization and improvement of processes. Central portal for public services has several shortcomings, such as outdated design, reliability problems, etc.

In the case of DEA, it was necessary to propose a measurement procedure and then indicators and measurement models were used in the field of e-Government. The conclusions can be drawn from the output that measuring efficiency for the European Union area is possible, and two measurement proposals were introduced, focused on the technological area. This research showed Estonia, Denmark, the Netherlands and Hungary as the effective countries. The above results show that governments should focus on service system connectivity, as well as processes and quality, to achieve utility for users. In addition, of the European Union areas, the western European Union is the most effective compared to the other areas, which was also confirmed by the Mann–Whitney U test. The article showed the applicability of the methods. When measuring DEA, further research would be appropriate to determine the effects between inputs on the resulting efficiency. At ACSI, based on these conclusions, experts could consider e-Government 3.0, reworking questions focusing on the local area of e-Government, or new services.

It is also necessary to mention that within Slovakia, there is no regular measurement of satisfaction with new or existing e-Government services. Thus, the research filled this gap and suggested a way in which it could be implemented and, possibly, adjusted. A similar gap was identified in measuring the efficiency of DEA analysis, in which a similar measurement using several available indicators was not identified within the European Union. Overall, this article provides an understanding for satisfaction assessments, measuring the efficiency of the state of e-Government and a basis for future research in this area. The government should focus on service system connectivity, as well as processes and quality, to achieve utility for users. The combination of the ACSI and DEA methods would provide a more comprehensive view of ACSI areas with the necessity for improvement. The final output model could include the interaction with online public administrations and the ACSI index. If it is necessary to increase the ACSI index, a more detailed examination could be carried out of those elements within the index that do not currently reach a satisfactory level. This would allow for a more focused approach to be taken with regard to quality, customer satisfaction and any areas requiring improvement. With these two indicators, we would determine exactly the levels of satisfaction and interaction. It would be appropriate to measure ACSI in all EU countries in order to compare these results among individual EU member countries. We consider this to be the other limit of this study, but the scope of the research did not allow us to process these data in the study. Future research should therefore focus on the final output model, including the interaction with online public administration and the ACSI index. If it were to turn out that it is necessary to increase the ACSI index, it would be possible to take a closer look at which elements from that index do not reach a high level and, thus, to focus on the areas of quality, satisfaction or complaints. With these two indicators, we would determine exactly the levels of satisfaction and interaction. It would be appropriate to measure ACSI values in all EU countries so that we could compare these results among individual EU member countries.

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The Level of Happiness and Its Relationship with Personal and Occupational Well-Being in Women Leaders at a Mexican University: An Exploratory Study

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Abstract: This exploratory study aims to identify the state of well-being of a select group of women leaders in a Mexican university by analyzing the relationship between their perception of happiness and their satisfaction with their life and work. Through the application of a psychometric battery, this work examined how these leaders manage their well-being within an environment that is simultaneously empowering and demanding. Methodologically, a descriptive statistical analysis was performed, including a correlation analysis of all items. As a result, the research identified positive correlations between the variables age and positive perceptions of work and life, which are strongly associated with high personal and professional satisfaction. In addition, people who find their work rewarding and feel that their life is close to their ideal tend to be more satisfied in general. Although this study intended to be exploratory, it also sought to contribute a deeper understanding of the well-being status of women in university leadership positions in Mexico. In doing so, it filled an important gap in the literature on gender, leadership, and well-being in Latin American academia by highlighting the complexity of managing and supporting women in leadership positions.

Keywords: educational innovation; education for the future; gender; well-being; professional education

1. Introduction

In recent decades, interest in the health and well-being of academicians in higher education institutions has grown significantly. Most studies have focused on the well-being of students, leaving a notable lack of attention to the well-being of employees, especially those in leadership positions (Cuesta-Valiño 2021). This lack is even more pronounced regarding women in leadership roles. Their unique experiences and specific challenges are often not adequately addressed in research. The university, as a social microcosm, reflects the power dynamics and gender roles in society. In Mexico, where patriarchal structures and traditional cultural norms still predominate in many sectors, women leaders face specific barriers that can affect their physical, emotional, and professional well-being (Campos-García 2020).

This study focuses on the well-being status of a select group of women leaders at a Mexican university, acknowledging the unique challenges and opportunities they face in a particularly diverse cultural and educational context. Through the application of a psychometric battery, this work examined how these leaders manage their well-being in an environment that is simultaneously empowering and demanding, considering their states of happiness, life satisfaction, and job satisfaction. Methodologically, this study employed descriptive statistical analysis, including a correlation analysis of all variables. Although this study intended to be exploratory, it also sought to contribute a deeper understanding of the well-being status of women in university leadership positions in Mexico.

This text is structured by beginning with an exhaustive review of previous literature related to life satisfaction, job satisfaction, and how these aspects are related to happiness and overall well-being. It then details the methodology used in this study, including the hypothesized relationships, the variables considered, the instruments used, and the process of implementation and data analysis. After establishing this framework, the results are presented and analyzed using the theoretical framework to identify and discuss the main findings. Finally, the text concludes by presenting the limitations of this study and suggesting possible future research lines that could expand and deepen these findings.

2. Theoretical Framework

2.1. Life Satisfaction

Life satisfaction refers to people's overall assessment of their existence as positive or satisfying (Nani et al. 2024). This concept encompasses multiple dimensions, such as emotional well-being, mental and physical health, and perceptions of personal fulfillment and achievement. For workers, and especially for leaders in institutions, life satisfaction is critical, as it directly influences their ability to manage stress, make effective decisions, and foster a positive environment (Alonderiene and Majauskaite 2016). In academic environments such as universities, where challenges are continuous and expectations high, maintaining a high level of life satisfaction can be crucial for leadership sustainability and institutional success (Rubino et al. 2022). Moreover, university leaders often face the duality of administrative and academic pressures; life satisfaction is a buffer against professional burnout. A fulfilling personal life allows leaders to maintain energy, keep a balanced perspective, and improve their interactions with colleagues and students (Asma 2023). This not only enhances their individual quality of life but also facilitates more effective management, thus boosting productivity and the organizational climate of the entire university (Samad et al. 2022).

For women in university leadership positions, life satisfaction takes on additional dimensions and particular challenges. Historically, women have faced structural barriers and gender biases that can affect both their personal well-being and life satisfaction (Merma-Molina et al. 2022). Therefore, achieving a high degree of life satisfaction is crucial for female leaders to remain resilient and effective (Rohit et al. 2023). An enriching and fulfilling personal life provides them with the emotional and psychological tools necessary to face and overcome professional challenges, thus promoting balanced and empathetic leadership (Caroline et al. 2022).

2.2. Job Satisfaction

In terms of job satisfaction, this concept encompasses individuals' perceptions of their work environment, the tasks they perform, and the relationships they cultivate in the professional environment (Mahadev et al. 2023). Job satisfaction is particularly critical for leaders in educational institutions, as high job satisfaction not only improves individual performance but also translates into more effective leadership and the promotion of a healthy and productive academic environment (Mugira 2022). Leaders who are satisfied with their work tend to be more innovative, more committed to the mission of the institution, and better able to motivate and retain academic talent.

Specifically, in the context of universities, where success depends mainly on the synergy between administration, faculty, and students, leaders' job satisfaction becomes an essential element that directly impacts the morale and efficiency of the entire university community (Cerci and Dumludag 2019). Leaders who experience high role satisfaction are better able to manage the pressures inherent in their positions and foster a work environment that prioritizes the well-being and professional development of all its members, thus ensuring continuous progress and innovation within the institution (Horoub and Zargar 2022).

Job satisfaction is fundamental to fostering a culture of equality and diversity within institutions. Satisfied women leaders not only demonstrate more commitment and productivity but also act as role models for other women in the academic community, fostering a

more inclusive climate (Padmanabhanunni et al. 2023). Job satisfaction enables them to implement policies and practices that proactively address gender disparities and promote a fairer and more motivating work environment for all, which is essential for continued institutional advancement and innovation (Beddow 2018).

2.3. The State of Happiness as a Fundamental Part of Well-Being

Happiness, understood as an experience of satisfaction and fulfillment, is vital to people's overall well-being. From a psychological perspective, happiness correlates with positive emotions and a sense of purpose in life, which are elements that contribute to mental and physical health (Schnurr 2008). In this context, well-being is a multidimensional condition that includes emotional stability, personal satisfaction, and optimal health, all of which are reinforced by happiness (Cuesta-Valiño 2021).

The relationship between happiness and well-being manifests significantly in the workplace. Happy workers tend to be more productive, show higher levels of commitment to their work, and have stronger interpersonal relationships with their colleagues (Cruz-Tarrillo 2023). Happiness at work translates into lower rates of absenteeism and turnover and fosters a more creative and cooperative work environment. These characteristics are particularly valuable in high-demand contexts such as educational institutions (Wang and Milyavskaya 2020).

Happiness amplifies life satisfaction. Individuals reporting high levels of happiness generally evaluate their lives more positively, which reinforces their overall well-being. This positive feedback loop of joy and life satisfaction is critical for maintaining good mental health and promoting a balanced and fulfilling lifestyle (Setiyowati and Irtaji 2017).

Happiness also profoundly influences job satisfaction. In environments where individuals feel joy and contentment with their daily tasks, there is greater alignment with organizational goals and more enthusiasm for collective success (Bautista et al. 2023). This becomes especially relevant in leadership roles, where the ability to convey positivity inspires and motivates entire teams, improving everyone's overall performance and job satisfaction (Raime et al. 2022).

Regarding women leaders, the gender perspective adds complexity to the relationship between happiness and well-being. Women in leadership positions often face unique challenges, including differentiated performance expectations and the need to negotiate their roles in traditionally male-dominated structures (Demircioglu 2014). For them, happiness is not only an essential component of their personal and professional well-being but also a powerful tool for overcoming obstacles and biases in the workplace (Strukova and Polivanova 2023). When these leaders experience high levels of personal and job satisfaction, they are better equipped to implement policies that benefit all employees, thus attaining a fairer and more motivating environment (Campos-García 2020).

Furthermore, happy women in leadership roles can redefine cultural norms and expectations in their institutions (Salas-Vallina 2018). By demonstrating that it is possible to balance personal life with challenging professional demands, these women not only improve their well-being but also become role models for other aspiring leaders, expanding opportunities and improving the work climate for future generations of women (Milhouse 2006). In this sense, happiness is an indispensable element of overall well-being, and its impact is even more significant for women leaders in academia. By fostering happiness and satisfaction in all aspects of life, these leaders enrich their experiences and contribute to the well-being and progress of their communities and organizations (Burkinshaw and White 2017).

3. Methodology

This exploratory and quantitative study aimed to analyze the correlation between happiness among a group of female managers at a higher education institution in Mexico and their states of personal and occupational satisfaction. The research design intended to measure the participants' perceptions of their states of happiness, individual and job

satisfaction objectively. For this measurement, a psychometric battery combined three standardized instruments to quantify these variables, thus facilitating comparisons and rigorous analyses of the data.

The hypothesis of this study is the following:

H1: *Personal and occupational satisfaction is positively correlated with levels of subjective happiness in female managers in a higher education institution in Mexico, suggesting that higher levels of satisfaction in these variables are associated with higher levels of happiness.*

In this sense, the following variables are proposed:

- Independent variables: life satisfaction and job satisfaction.
- Dependent variable: level of subjective happiness

This hypothesis is based on the theory that happiness is multifaceted and can be significantly influenced by well-being in different areas of life, especially in personal and professional environments.

3.1. Context and Sample

This research occurred in a private higher education institution in Mexico. The university has campuses throughout Mexico, so the sample included women from different parts of the country. The study participants were 204 women, with an average age of 43 years, who held managerial positions in the institution and voluntarily participated in the research. The sample was selected with a confidence level of 90% and a margin of error of 10% from the approximate total population of 2430 female managers in positions with the characteristics, including administrative and academic leaders. Notably, the quantitative data collection adhered to the ethical parameters set by the institution, respecting the terms and conditions for organizational research, including the care and confidentiality of the results, which can only be used for academic purposes.

3.2. Data Collection Instruments

This study utilized three validated and standardized instruments:

1. Sonja Lyubomirsky's General Happiness Scale: This scale, developed by Sonja Lyubomirsky, is known as the "Subjective Happiness Scale" (SHS). This self-assessment tool measures a person's overall level of happiness using a scale that includes questions that assess the extent to which people consider themselves to be happy or unhappy relative to peers (comparison). This scale can be helpful in understanding managers' perceptions of their happiness in personal and comparative contexts.
2. Diener, Emmons, Larsen, and Griffin's "Satisfaction with Life Scale" (SWLS) measures a person's overall satisfaction with life. It comprises a series of statements that participants rate according to their agreement or disagreement, providing an overall measure of life satisfaction. This scale is particularly relevant for assessing how women managers feel about their lives in general, beyond the work environment.
3. Wrzesniewski, McCauley, Rozin, and Schwartz's "Work-Life Survey" assesses how people perceive their work activity in three categories: job, career, and vocation. The survey seeks to understand the meaning and satisfaction people find in their work, which is crucial for assessing their well-being at work. The survey helps understand how university managers' work influences their overall well-being and how this aspect integrates into their total life.

These three scales can be interrelated to provide a holistic view of the well-being of women in a sample. While the Lyubomirsky and Diener scales give a general overview of personal well-being and life satisfaction, the Wrzesniewski survey specifically assesses the work dimension, which indeed connects to the concept of general well-being. Combining these tools makes it possible to obtain a complete picture that integrates personal and professional aspects of well-being.

3.3. Implementation and Data Analysis

In order to obtain the data, contact was made with different areas of the educational institution, as well as with leaders who were in charge of women leaders who could participate in this study. The application was carried out by means of digitalizing the instruments into a single Microsoft form, ensuring that each participant expressed their desire to participate and was aware that their responses would be used for research purposes. The implementation was carried out in Spanish.

It is important to note that this implementation is supported by the interdisciplinary research group R4C of the Institute for the Future of Education of the Tecnológico de Monterrey, with the approval of the institutional ethics committee ID: IFE-2024-01, which assessed the implementation as low risk. The entire study was carried out in accordance with the terms and conditions of the Research for Challenges Privacy Notice (https://tec.mx/es/aviso-privacidad-research-challenges (accessed on 18 March 2024)).

Methodologically, this study employed a descriptive statistical analysis, including a correlation analysis.

4. Results

For the sake of clarity, this paper first presents the results by instrument and then aggregates them with the correlation of all items.

4.1. State of General Happiness (SHS)

This instrument's results show that the participants generally perceive themselves as quite happy. The mean of 3.56 on a scale of 1 to 5 indicates that the majority consider their level of happiness to be high; the moderate standard deviation (0.580) suggests low variability in their perceptions. Furthermore, when compared to the majority of people around them, respondents considered themselves slightly happier, with a mean of 3.01 and a more significant dispersion (0.866), suggesting a variable perception of relative happiness.

In terms of resilient happiness, participants tended to see themselves as people who enjoy life and maintain a positive attitude despite circumstances, with a mean of 3.87 (high) and a low dispersion (0.516). On the other hand, although some see themselves as less happy than they would like, the mean of 2.10 suggests that, in general, they do not see themselves as unhappy. However, there is moderate variability (0.723) in these perceptions. Overall, the results reflect positive self-perceptions of happiness among the respondents (Table 1).

Table 1. General happiness status.

	N	Minimum	Maximum	Mean	Std. Deviation
In general, I consider myself...	204	1	4	3.56	0.580
Compared to most of the people around me, I consider myself to be very happy.	204	1	4	3.01	0.866
Some people tend to be very happy. They enjoy life no matter what happens, coping with most circumstances. To what extent do you consider yourself such a person?	204	2	5	3.87	0.516
Some people tend to be very unhappy. Although they are not depressed, they don't seem as happy as they would like to be. How happy do you consider yourself to be?	204	1	4	2.10	0.723
Valid N (listwise)	204				

Regarding the question "In general, I consider myself..." (see Figure 1), the majority of female managers considered themselves to be moderately happy, with a significant portion describing themselves as very happy, indicating a high degree of personal satisfaction. Few

identified themselves as unhappy, reflecting a low level of overall dissatisfaction. There were no neutral responses, suggesting that respondents had a clear perception of their happiness. Overall, the responses indicated a level of optimism or satisfaction with life among the female managers in the study.

Figure 1. In general, I consider myself to be.

In the second item, the majority indicated feeling happier than the people around them, suggesting a high degree of personal satisfaction (see Figure 2). A good proportion also considered themselves to be moderately happier, supporting the idea that these women generally felt happier compared to others. A small segment saw themselves as equally happy as their peers, and a few considered themselves moderately less happy, with none in the less happy category. This distribution reflects a sense of confidence or accomplishment associated with their leadership positions and professional success (Figure 2).

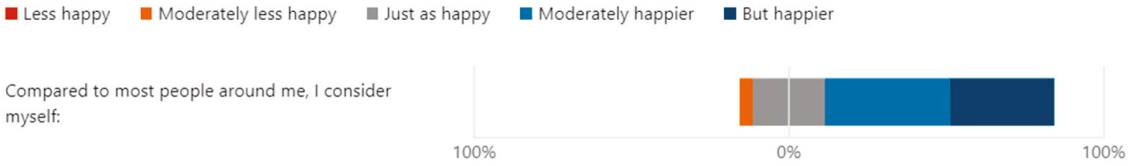

Figure 2. Compared to most people around me, I consider myself.

Regarding the third item (see Figure 3), which focused on the ability to maintain a state of happiness despite circumstances, the majority responded "Many times", indicating that they tend to be very happy and enjoy life despite challenges. A significant proportion responded "Always", suggesting a high capacity for resilience and a consistently positive approach. A small segment responded, "Sometimes", indicating that while they are generally happy, some circumstances affect their moods. Very few selected "Few times", and none chose "Never." This pattern suggests a high level of psychological well-being and a tendency toward optimism among women in leadership roles, which is helpful in facing challenges.

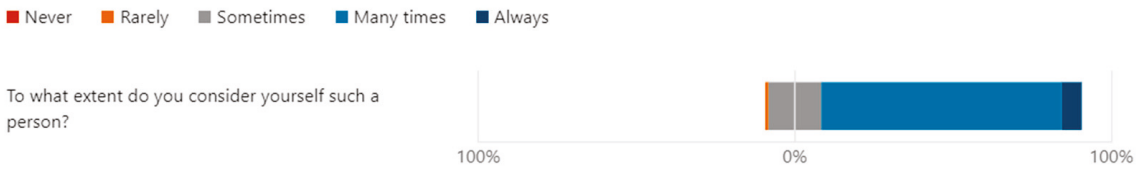

Figure 3. Some people tend to be very happy. They enjoy life regardless of what happens, coping with most circumstances. To what extent do you consider yourself such a person?

The fourth item (see Figure 4) addresses the frequency with which participants consider themselves less happy than they would like to be, without being depressed. Most responded, "Few times", suggesting that they do not usually feel unhappy without apparent cause. This indicates that, although they are not always extremely happy, they do not experience a noticeable lack of happiness in their daily lives. A significant portion responded, "Sometimes", indicating that they occasionally feel that they are not as happy as they would like to be, but not consistently. A small fraction responded, "Many times", and none chose "Always", indicating that few chronically felt less happy than desired.

A relevant segment responded, "Never", showing that some female managers never feel unhappy without an apparent reason. These results reflect a balance in the perceived happiness and well-being among women managers, indicating that most did not feel persistently unhappy or dissatisfied, despite the challenges of their roles.

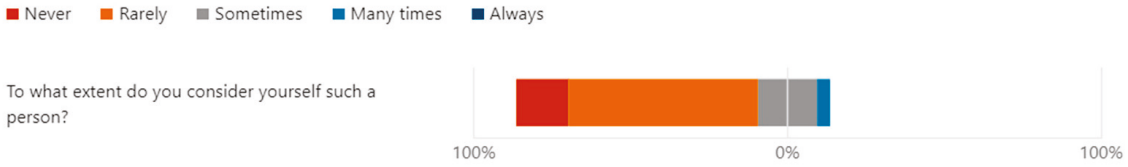

Figure 4. Some people tend to be very unhappy. Although they are not depressed, they do not seem as happy as they would like to be. To what extent do you consider yourself such a person?

4.2. Satisfaction with Life Scale (SWLS)

Initially, the survey participants reported high levels of satisfaction and closeness to their real lives (Table 2). The majority felt that their lives were close to their ideal (mean 8.12 out of 10), with a variability of 1.051. In addition, they considered their life conditions to be excellent (8.25/10) and expressed a high level of satisfaction with their life (8.58/10). In general, the majority were happy in life to the point that, if they were born again, they would change almost nothing (7.96/10).

Table 2. Satisfaction with Life.

	N	Minimum	Maximum	Mean	Std. Deviation
Generally speaking, my life is close to my ideal.	204	5	10	8.12	1.051
The conditions of my life are excellent.	204	4	10	8.25	1.282
I am satisfied with my life.	204	3	10	8.58	1.321
If I were born again, I would change almost nothing about my life.	204	0	10	7.96	2.085
Valid N (listwise)	204				

However, to have a better view of the results of these questions, we used meter or indicator graphs, specifically the Net Promoter Score (NPS). Although these graphs are more common in the business world, we believe that they are more explanatory than a bar chart. It is important to note that the sum of the percentages shows a difference of 3–4%, which corresponds to several responses that are not significant.

In the first question (Figure 5), the responses were grouped into promoters (35%), passives (53%), and detractors (8%). An NPS of 28 suggests that the majority perceived their life to be close to ideal, reflecting significant satisfaction. However, the predominance of passives indicates that, although the majority were satisfied, they did not feel fully realized. This highlights the potential for improving the personal and professional fulfillment of these female managers to close the gap between their current situation and their ideal life.

Figure 5. Generally speaking, my life is close to my ideal.

In the second question (Figure 6), the results show that 44% of female managers were promoters, considering their living conditions to be excellent, reflecting a high degree of satisfaction. Passives, who constituted 43%, were satisfied, but they were not satisfied enough to promote this perception actively. Detractors, 9%, indicated specific areas of dissatisfaction. An NPS of 37, generally considered good, suggests that the majority were quite happy with their living conditions. However, the significant presence of passives indicates that, although many were satisfied, they did not feel that their living conditions met the highest standard of excellence uniformly. This positive perception of living conditions contributes to professional and personal performance, providing a stable and satisfying environment that facilitates effective leadership and individual well-being.

Figure 6. In general terms, my living conditions are excellent.

In the third item (Figure 7), the overall life satisfaction of the participants was evaluated, with the following results: 58% were promoters, indicating a high degree of satisfaction; 32% were passive, being moderately satisfied but without reaching the level of promoters; and 6% were detractors, reflecting only a few with significant dissatisfaction. An NPS of 54 is evidence of a high level of overall satisfaction among women managers, suggesting that most found their lives are rewarding and satisfying. This result is an excellent indicator of personal well-being, and the low percentage of detractors reinforces the idea of minimal dissatisfaction. A high level of personal satisfaction can also positively impact their performance in leadership roles, as satisfaction with personal life tends to improve work effectiveness and motivation.

Figure 7. In general terms, I am satisfied with my life.

In the fourth item (Figure 8), the participants' perception of the statement "If I were born again, I would change almost nothing in my life" was evaluated, with the following results: 47% were promoters, indicating a high degree of satisfaction and acceptance with their current life; 31% were passive, showing satisfaction, but with some reservations about possible changes; and 18% were detractors, expressing a significant desire to change substantial aspects of their life if they had the opportunity. An NPS of 30 indicates that a notable majority of women managers felt that they had lived a satisfying life and made good decisions overall. This satisfaction reflects personal well-being and can influence how they approach future challenges and opportunities, providing a sense of security and confidence in their choices and lived experiences. Although there is room for improvement in how some retrospectively perceived their lives, most felt positive and content with their experiences and decisions.

Figure 8. If I were born again, I would change almost nothing about my life.

4.3. Working Life Perception Survey

The survey results reveal a high overall satisfaction among respondents with their work. Most respondents found their work rewarding, with a mean of 4.41 on a scale of 1 to 5, and believed that it contributes positively to the world (4.39). In addition, they enjoyed talking about their work with others (4.45). Many had aspirations to advance their careers, expecting to be in a higher level position in five years (4.13), and would choose their current working life again (4.27). However, there was notable variability in looking forward to retirement (mean 2.87) and anticipation of weekends (mean 3.51), indicating some level of job burnout.

On the other hand, while some respondents took work home (mean 2.92) and thought about work outside of working hours (mean 2.83), many did not expect to be in the same job in five years (mean 2.32), reflecting a desire for career change or advancement. Financial motivation plays a moderate role in their work, with a mean of 2.92, and while work is important to many (3.66), not all saw it as an absolute life necessity (2.68). Combined, these results suggest considerable job satisfaction but also indicate areas of attrition and aspirations for change in the future (Table 3).

Table 3. Perception of working life.

	N	Minimum	Maximum	Mean	Std. Deviation
I find my job rewarding.	204	1	5	4.41	0.755
I am looking forward to retirement.	204	1	5	2.87	1.169
My work makes the world a better place.	204	2	5	4.39	0.692
I am very conscious of what day of the work week it is, and I look forward to the weekends. I say, "Thank God it's Friday!"	204	1	5	3.51	1.028
I tend to take work with me on holidays.	204	1	5	2.92	1.321
I hope to be in a higher-level position in five years.	204	1	5	4.13	1.002
I would choose my current work life again if I had the opportunity.	204	2	5	4.27	0.886
I feel in control of my work life.	204	1	5	3.70	1.040
I enjoy talking about my work with other people.	204	2	5	4.45	0.700
I see my job mainly as a stepping stone to other jobs.	204	1	5	3.01	0.984
My main reason for working is financial: to support my family and my lifestyle.	204	1	5	2.92	1.115
I hope to be doing the same job in five years.	204	1	5	2.32	0.957
If I were financially secure, I would continue my current line of work even if I were no longer paid.	204	1	5	3.13	1.045
When I am not at work, I don't think much about my job.	204	1	5	2.83	1.265
I see my work as a necessity of life, as much as breathing or sleeping.	204	1	5	2.68	1.144
I never take my work home with me.	204	1	5	1.99	0.966
My work is one of the most important things in my life.	204	1	5	3.66	0.927
Valid N (listwise)	204				

We separated the specific responses into blocks of six items for better analysis. The results of the first group of items (Figure 9) suggest that women managers showed a high level of satisfaction and positive valuation of their work, characterized by perceived gratification and belief in the positive impact of their job roles on the world. There was a clear ambition to move up the career ladder in the next five years, reflecting an optimistic view of career development. Although some expressed a desire to retire, a significant proportion still found satisfaction in their current jobs and did not anxiously anticipate retirement. Most valued work–life balance, showing a tendency not to take work with them on holidays, although there was a minority who did, possibly due to intense work demands or high levels of professional commitment. These findings suggest a healthy mix of job satisfaction, job purpose, and growth expectations, indicating a balanced execution of managerial responsibilities and personal well-being.

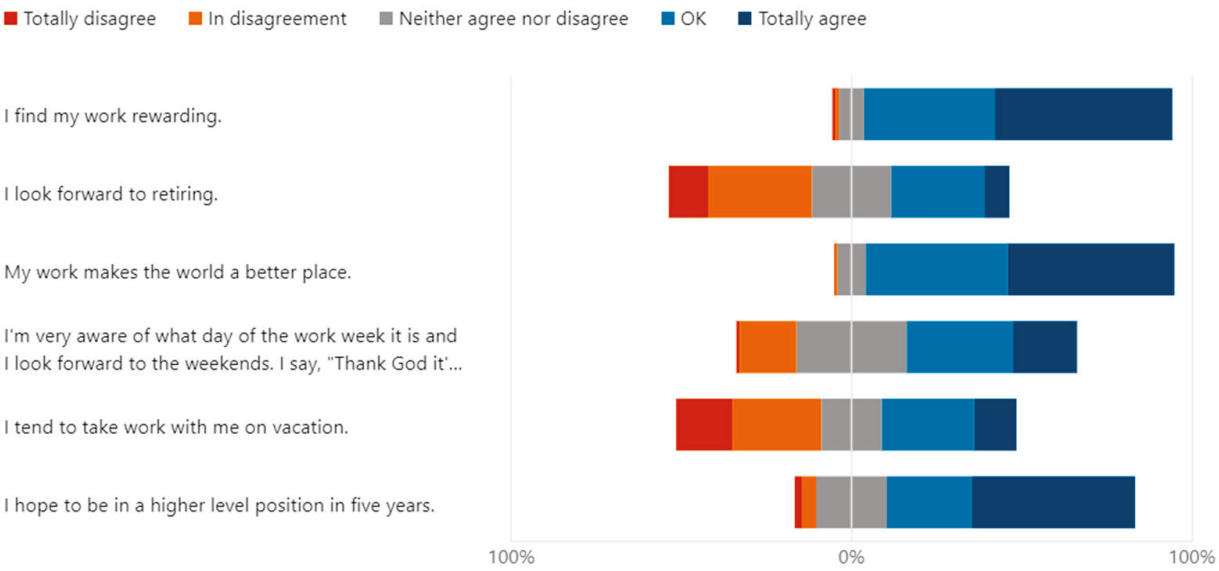

Figure 9. Perception of working life—items 1–6.

The results of questions 7–12 (Figure 10) show that the majority of women managers were delighted with their current careers and would choose their current working life again if they could. They felt in control of their work roles and enjoyed sharing their work with others, indicating a high level of commitment and pride in what they do. While some saw their job as a stepping stone, many valued their current positions as stable and rewarding in the long term. Financial motivation was not uniformly dominant, with some also seeking personal fulfillment, challenge, or social contribution. Most expected to continue doing the same work for the next five years, reflecting satisfaction and positive perspectives of their continued development and contribution in their current roles. These findings underline the diversity of motivations and expectations among female managers, providing a detailed picture of how they perceive their working lives and future aspirations.

Items 13–18 (Figure 11) revealed that women managers showed strong commitment and deep identification with their work. Many would continue in their current careers even without additional remuneration, highlighting a significant emotional commitment beyond financial security. The ability to disconnect from work outside working hours varied considerably, reflecting different approaches to stress management and work–life balance. Some saw their work as essential to their existence, while others did not. Most recognized that work extends beyond official hours, typically in high-responsibility roles. In addition, many perceived their work as one of the most essential things in their lives. They would encourage young people to pursue a similar career, which underlines their satisfaction and the meaning they found in their professional roles. These responses provide a rich

insight into how these women value their work and its impact, both personally and for future generations.

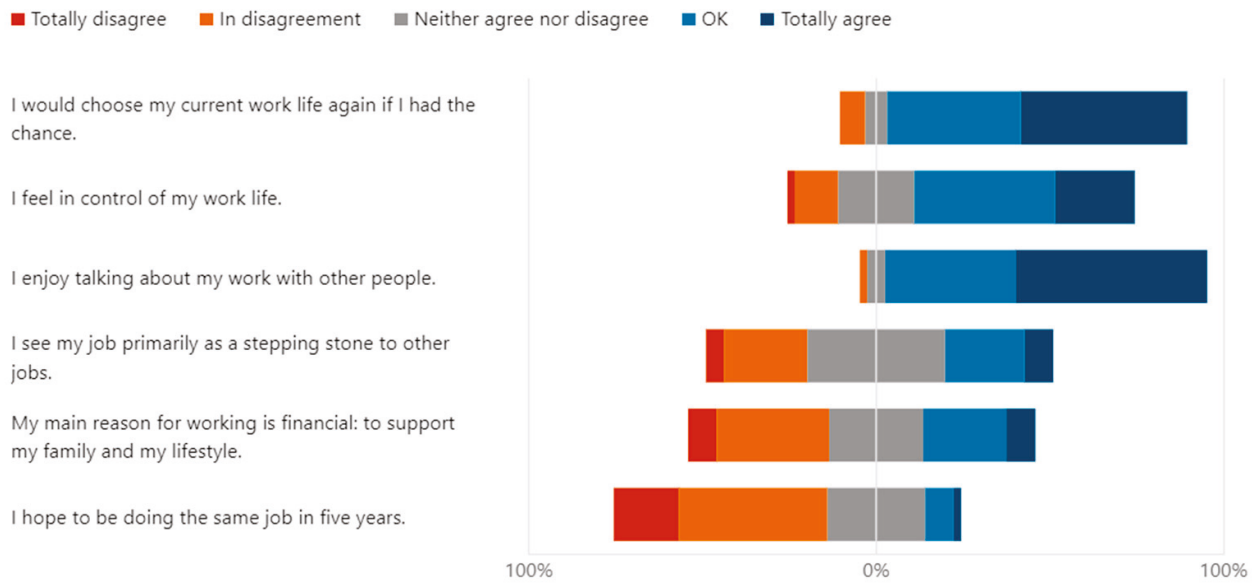

Figure 10. Perception of working life—items 7–12.

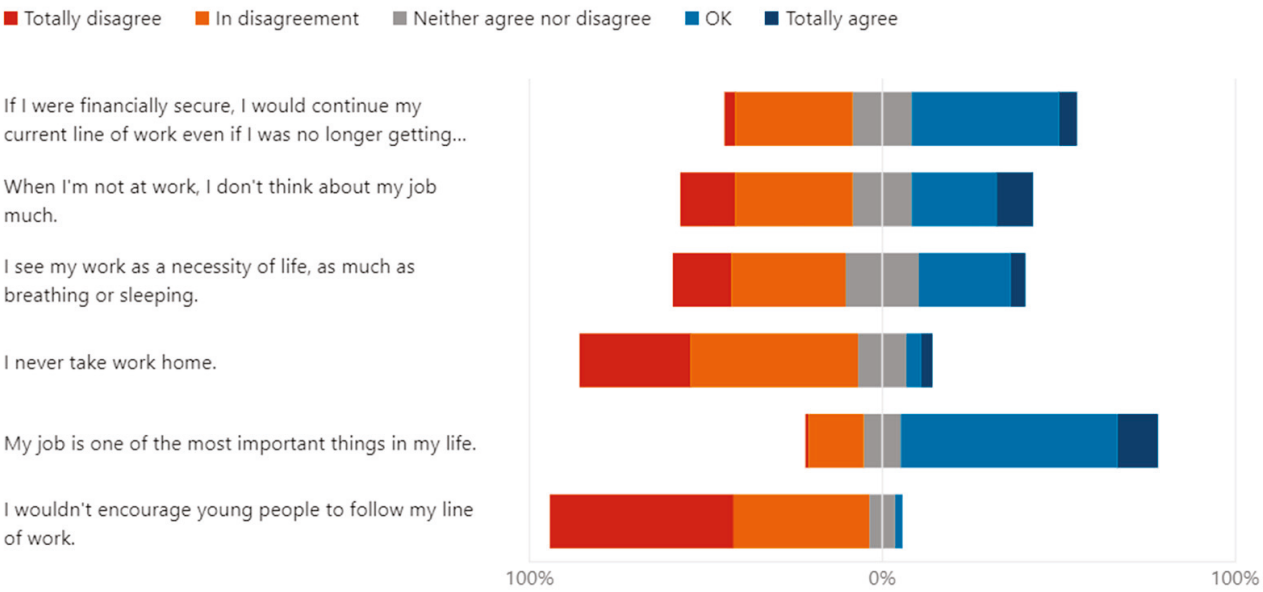

Figure 11. Perception of working life—items 13–18.

4.4. Relationship between the Level of Happiness and the Perception of Personal and Job Well-Being

The results of the Pearson correlation table (Appendix A) present several significant correlations between different variables related to perceived happiness and job satisfaction. First, age shows significant positive correlations with several key aspects of personal satisfaction and perception among the participants. Notably, as age increases, so do positive perceptions of how close life is to the desired ideal ($r = 0.264$, $p < 0.05$), the consideration of living conditions as excellent ($r = 0.318$, $p < 0.01$), general satisfaction with life ($r = 0.204$, $p < 0.05$), degree of job gratification ($r = 0.264$, $p < 0.05$), enjoyment in talking about their work with others ($r = 0.252$, $p < 0.05$), and willingness to continue working even without pay if they were financially secure ($r = 0.272$, $p < 0.01$).

Second, the strong positive correlation between overall self-rated happiness (item 2) and favorable comparison with others (item 3) stands out, indicating that those who considered themselves very happy tended to perceive their lives more positively compared to their peers ($r = 0.421$, $p < 0.01$). In addition, those who reported high levels of happiness (item 4) also showed positive correlations with overall self-rated happiness ($r = 0.389$, $p < 0.01$) and favorable comparison with others ($r = 0.295$, $p < 0.01$). In contrast, the perception of being less happy than desired (item 5) correlates negatively with several measures of personal satisfaction and perceived happiness.

Third, it is evident that people who consider their life to be close to their ideal (item 6) show significant positive correlations with overall life satisfaction ($r = 0.787$, $p < 0.01$) and perception of excellent living conditions ($r = 0.679$, $p < 0.01$). Likewise, finding work rewarding (item 10) is positively associated with general life satisfaction ($r = 0.457$, $p < 0.01$) and considering life close to the ideal ($r = 0.486$, $p < 0.01$).

Finally, regarding the work and personal domain, those who tended to take work on holidays (item 14) showed negative correlations with life satisfaction ($r = -0.323$, $p < 0.01$) and considering life close to the ideal ($r = -0.291$, $p < 0.01$). On the other hand, those who would choose their current working life if they had the opportunity (item 16) showed positive correlations with the consideration of life close to the ideal ($r = 0.385$, $p < 0.01$) and life satisfaction ($r = 0.459$, $p < 0.01$).

5. Discussion

The hypothesis proposed in this study, which postulates a positive correlation between personal and job satisfaction and levels of subjective happiness among women leaders in a higher education institution in Mexico, is confirmed by the following findings:

1. The data reflect high satisfaction in both personal and professional life among female leaders, indicating good emotional balance and overall well-being. The literature suggests that personal well-being can positively impact job performance and satisfaction (Judge et al. 2001). This phenomenon is also supported by resource and job demands theory, which suggests that resources such as a sense of achievement and control over work can buffer the impact of high job demands, mitigating burnout and promoting engagement (Bakker and Demerouti 2007). These aspects, which reflect high levels of satisfaction, are directly related to greater subjective happiness, confirming the study hypothesis.
2. Despite the reported high satisfaction, concerns related to work–life balance were also observed, such as difficulty in disconnecting from work and the tendency to bring work home, which are factors known to lead to burnout and negatively affect mental health (Sonnentag 2012). The effective management of work–life balance is crucial and supported by research emphasizing the importance of flexible organizational policies (Kossek et al. 2011), suggesting that improvements in this area could further raise the levels of subjective happiness.
3. Women leaders showed strong identification with their work roles, seeing their work as essential to their lives. While this strong identification can be a source of motivation and satisfaction, it also carries risks during periods of job change or uncertainty (Ashforth 2001). The caution expressed about recommending their careers to young people suggests an awareness of the challenges inherent in their roles, which may also influence their general well-being and subjective happiness.
4. The diverse motivations for working, from financial reasons to the pursuit of personal fulfilment, reflect a plurality of drivers behind these women's careers. This highlights the need for a human resource management approach that recognizes and cultivates these different motivations to maximize satisfaction and performance (Kristof-Brown et al. 2005). The alignment between personal motivations and job characteristics can significantly improve job satisfaction and thus the levels of subjective happiness.

In terms of correlations between all variables, age and positive perceptions of work and life strongly correlate with higher personal and career satisfaction. People who find

their work rewarding and feel that their life is close to their ideal tend to be more satisfied in general. The negative correlations between performing work on holidays and life satisfaction suggest that a better separation between work and personal life may contribute to greater happiness. In addition, financial motivations moderately impact perceptions of work, indicating that personal satisfaction and control over working life are crucial factors in the respondents' overall happiness.

All these findings strongly support the initial hypothesis, showing a clear correlation between personal and occupational satisfaction and subjective happiness. These results suggest that interventions aimed at improving satisfaction in these domains could have a direct and positive impact on the happiness of managers in higher education.

6. Conclusions

This study contributes theoretically and practically to spotlighting job satisfaction and personal well-being among women in leadership positions. The theoretical implications of this study are that high personal and professional satisfaction among women leaders supports the theory of job resources and demands, highlighting that emotional balance and personal well-being can increase job performance. Furthermore, the strong identification of these women with their work coincides with work identity theory, suggesting that the fusion of self-concept with career success can be both motivating and risky in periods of job uncertainty. The diverse work motivations observed also reflect the person–job fit theory, highlighting the importance of aligning individual motivations with job characteristics to enhance job satisfaction and performance.

The practical implications of this study highlight two critical areas for organizational development. First, the implementation of flexible policies that balance the work and personal lives of women leaders is crucial to mitigate burnout and promote mental health. It involves adapting organizational strategies to manage work and personal responsibilities effectively. Second, organizations must provide strong support for women in leadership roles by fostering support networks that recognize and promote diverse work motivations. This approach can not only increase job satisfaction but also enhance performance in their leadership roles.

6.1. Methodological Limitations

This exploratory and initial study does not claim to achieve a comprehensive understanding of the subjective well-being of women in leadership positions. Instead, it seeks to establish a foundation on which future studies can be built. Furthermore, this study focuses specifically on the context of a private university in Mexico, considering the particularities that this environment can imprint on the experience of well-being. By focusing on women in leadership positions, the research provides valuable findings on how gender and power dynamics influence well-being in the workplace.

The results, although limited by the scope of the quantitative methodology, are significant and relevant, as they provide a starting point for deeper discussions and developing future research that could adopt mixed or qualitative approaches further to explore the narrative and personal experiences of women managers. The findings of this study provide valuable information for policymakers and the university authorities interested in improving the well-being of their staff. They highlight the importance of fostering emotional well-being to enhance work efficacy and satisfaction and emphasize the need for flexible policies that promote a better work–life balance. Additionally, they underscore the gender dynamics and "double burden" faced by women in leadership positions. Moreover, these results allow for the recognition and development of various work motivations, which can maximize both satisfaction and performance. These insights offer a solid foundation for future research and the development of evidence-based policies aimed at creating healthier and more equitable work environments.

6.2. Future Research

To advance understanding of the dynamics and needs of women leaders, we propose several lines of future research. First, longitudinal studies should examine how the perceptions and satisfaction of these women evolve over time and in response to various organizational interventions. In addition, extending the sample to different sectors and regions would improve the generalization of results and reveal cultural variations in job satisfaction and well-being. It would be equally beneficial to investigate the effectiveness of specific policies and organizational practices designed to improve work–life balance and overall satisfaction among women in leadership positions. Complementing these quantitative approaches with qualitative studies would provide a deeper understanding of the experiences and perceptions of these leaders in specific work contexts. In sum, these lines of research would not only strengthen support for women leaders but also improve organizational effectiveness as a whole by promoting a more equitable and satisfying work environment.

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Data Availability Statement: The original contributions and data presented in the study are included in the article, further inquiries can be directed to the corresponding author/s.

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Appendix A. Pearson Correlation

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	Age																										
2	In general, I consider myself	0.199																									
3	Compared to most of the people around me, I consider myself:	0.085	0.421 **																								
4	Some people tend to be very happy. They enjoy life no matter what happens, coping with most circumstances. How happy do you consider yourself to be?	0.282 **	0.389 **	0.295 **																							
5	Some people tend to be very unhappy. Although they are not depressed, they don't seem as happy as they would like to be. How happy do you consider yourself to be?	−0.084	−0.286 **	−0.349 **	−0.316 **																						
6	Generally speaking, my life is close to my ideal.	0.264 *	0.639 **	0.345 **	0.389 **	−0.330 **																					
7	The conditions of my life are excellent.	0.318 **	0.426 **	0.350 **	0.410 **	−0.366 **	0.679 **																				
8	I am satisfied with my life.	0.204 *	0.593 **	0.460 **	0.366 **	−0.389 **	0.787 **	0.658 **																			

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
9	If I were born again, I would change almost nothing about my life.	0.090	0.335 **	0.187	0.096	−0.192	0.493 **	0.374 **	0.494 **																		
10	I find my work rewarding.	0.264 *	0.441 **	0.226 *	0.304 **	−0.212 *	0.486 **	0.310 **	0.457 **	0.315 **																	
11	I am looking forward to retirement.	0.020	−0.101	0.011	−0.047	0.041	0.034	0.036	−0.092	0.123	−0.100																
12	My work makes the world a better place.	0.056	0.322 **	0.465 **	0.233 *	−0.358 **	0.280 **	0.124	0.370 **	0.208 *	0.235 *	−0.074															
13	I am very conscious of what day of the work week it is, and I look forward to the weekends. I say, "Thank God it's Friday!"	−0.255 *	−0.151	−0.055	−0.183	0.124	−0.197	−0.063	−0.290 **	0.020	−0.213 *	0.431 **	0.012														
14	I tend to take work with me on holidays.	−0.063	−0.342 **	−0.132	−0.238 *	0.042	−0.291 **	−0.226 *	−0.323 **	−0.001	−0.263 *	0.156	−0.099	0.276 **													
15	I hope to be in a higher-level position in five years.	−0.045	0.024	0.149	0.201	−0.152	−0.138	0.051	−0.033	−0.013	−0.027	−0.061	0.037	0.063	−0.116												
16	I would choose my current work life again if I had the opportunity.	0.077	0.339 **	0.294 **	0.362 **	−0.346 **	0.385 **	0.237 *	0.459 **	0.159	0.549 **	−0.177	0.325 **	−0.353 **	−0.196	−0.039											
17	I feel in control of my work life.	0.175	0.444 **	0.293 **	0.352 **	−0.365 **	0.480 **	0.366 **	0.397 **	0.194	0.546 **	−0.131	0.284 **	−0.161	−0.222 *	−0.035	0.395 **										
18	I enjoy talking about my work with other people.	0.252 *	0.443 **	0.422 **	0.284 **	−0.345 **	0.385 **	0.310 **	0.454 **	0.416 **	0.552 **	−0.007	0.488 **	−0.155	−0.222 *	0.071	0.433 **	0.473 **									
19	I see my job mainly as a stepping stone to other jobs.	−0.093	−0.087	−0.051	−0.019	−0.017	−0.085	−0.019	−0.139	−0.138	−0.035	0.182	−0.214 *	0.177	−0.091	0.219 *	−0.103	0.088	−0.102								

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
20	My main reason for working is financial: to support my family and my lifestyle.	−0.109	−0.237 *	0.012	−0.112	0.050	−0.196	−0.200	−0.250 *	−0.343 **	−0.195	0.118	−0.201	0.185	0.077	0.223 *	−0.265 *	−0.142	−0.262 *	0.298 **							
21	I hope to be doing the same job in five years.	−0.083	−0.035	0.127	0.041	−0.108	0.091	0.085	0.039	−0.037	0.267 **	0.107	0.088	−0.013	0.071	−0.123	0.179	0.284 **	0.105	−0.108	0.135						
22	If I were financially secure, I would continue my current line of work even if I were no longer being paid.	0.272 **	0.203	0.203	0.213 *	−0.304 **	0.233 *	0.211 *	0.173	0.292 **	0.428 **	−0.165	0.246 *	−0.102	−0.024	0.067	0.326 **	0.376 **	0.470 **	−0.075	−0.253 *	0.230 *					
23	When I am not at work, I don't think much about my job.	0.190	0.192	0.220 *	0.249 *	−0.279 **	0.212 *	0.261 *	0.223 *	0.071	0.040	0.043	−0.035	−0.150	−0.411 **	0.078	0.129	0.059	0.027	0.106	0.022	0.010	0.132				
24	I see my work as a necessity of life, as much as breathing or sleeping.	0.010	−0.086	0.069	0.058	0.012	−0.058	0.092	−0.148	−0.134	0.066	−0.040	−0.060	0.001	0.214 *	0.198	0.108	0.073	−0.006	0.080	0.049	0.046	0.144	−0.151			
25	I never take my work home with me.	0.096	0.109	0.197	0.260 *	−0.108	0.196	0.188	0.142	0.027	0.111	0.028	0.072	−0.084	−0.438 **	−0.010	0.093	0.095	0.040	0.197	0.070	−0.043	0.110	0.474 **	−0.073		
26	My work is one of the most important things in my life.	0.050	0.139	0.005	0.156	0.015	0.165	0.063	0.094	0.155	0.156	0.009	0.193	0.082	0.094	0.119	0.008	0.151	0.343 **	0.004	0.130	−0.070	0.215 *	0.357 **	0.068	0.166	
27	I would not encourage young people to follow my kind of work.	0.117	−0.137	−0.270 **	−0.226 *	0.199	−0.252 *	−0.174	−0.324 **	−0.155	−0.494 **	0.198	−0.231 *	0.229 *	0.139	−0.078	−0.526 **	−0.391 **	−0.371 **	0.006	0.070	−0.220 *	−0.219 *	−0.040	−0.117	−0.053	−0.012

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

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Applying IS-Enabled Telework during COVID-19 Lockdown Periods and Beyond: Insights from Employees in a Greek Banking Institution

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Abstract: The recent circumstances of the COVID-19 crisis have brought significant changes to employees' personal, as well as organizational, lives. For office workers worldwide, this has come as a result of the abrupt and wide adoption of telework, as organizations rushed to accelerate their digital transformation. This research focuses on analyzing the reception and effect of teleworking, as an imposed measure during the onset of the COVID-19 pandemic, on employees in Greek banking organizations. First, the circumstances and utilization of telework by a banking institution in Greece before and during the COVID-19 crisis are compared by utilizing autoethnographic evidence. Then, we conducted qualitative research with employees of the organization, who were asked to work remotely at 100% capacity, focusing on the way teleworking was performed utilizing information systems (IS), and the effect it had on them. Detailed information and results from interviews are presented and compared to autoethnographic evidence to reach our conclusions. We find that the vast majority of employees are in general positive about having telework as an option, while the time saved by not commuting to their offices is reported as the most positive element of telework. Most employees also reported having worked longer hours and more efficiently while teleworking, while a common concern—in a scenario where telework may become permanent in some form—is if the organization would cover their teleworking expenses. Theoretical and practical implications are explored and presented accordingly.

Keywords: telework; COVID-19; banking institutions; employees; information systems

1. Introduction

Telework can be defined as working in a different place than normal while using technology to connect and collaborate with others (Gajendran and Harrison 2007). In general, telework challenges the traditional notions of workplace structure. It also redefines the psychological contract of people, making expectations and trust even more important than before. Organizations need to adapt their management policies to accommodate the new telework standards. A good example is how the people responsible for companies' policies need to take into consideration the economic implications of telework, such us covering part of or the total costs of the employee's telework, such as electricity consumption, internet connection costs, and electronic or other personal device usage and/or wear and tear. As a term, telework came to exist in 1975 (Nilles 1975) and has been the focus of scientific discussion since the 1990s as a product of the mass adoption of personal computing devices that allow teleworking employees (or simply teleworkers) to provide their services from virtually anywhere, any day and anytime, thus abolishing the need for physically transporting to and from their employing organizations' facilities (Di Martino and Wirth 1990). In the modern reality, this is further enabled by the availability of a wide variety of new Information and Communication Technologies (ICT), including the Internet and

increasingly powerful devices that are designed to increase both their utility as well as usability. Moreover, teleworking in the banking sector is very important for the economy. This is evident in banks all over the world, which have utilized some form of telework even before COVID-19. Since banks need to be able to support their customers on a 24/7 basis, they had set up remote sites and branches so they could be able to operate even beyond the normal 9–5 schedule for either back-office work or telephone banking activities (Stanworth 1998). This causes modern companies and especially banks to continuously reinvest in new and cutting-edge ICT infrastructure. Thus, it is safe to say that teleworking introduces both challenges and opportunities.

With the sharp escalation of the COVID-19 pandemic in Greece, in April 2020, organizations were forced to discover, develop and/or adopt unprecedented—for Greek standards—techniques and ways of operation, in order to effectively remain operational during the crisis and subsequent lockdown period, and sustain their productivity. Simply put, "productivity is efficiency in production: how much output is obtained from a given set of inputs" (Syverson 2011). Therefore, in the context of the present research, productivity is studied in terms of how effectively and efficiently a bank's operations can be completed by its employees while teleworking. Fortunately for the banking sector, the technology had already been developed to such an extent that it allowed the smooth operation of banking institutions, even when their employees had to work entirely from the safety and comfort of their homes (teleworking). In the context of this work, the term "telework" refers to work performed by employees remotely (usually from their homes), a scenario that was inevitably imposed on most employees during the COVID-19 crisis lockdown period in Greece.

During the COVID-19 period, telework became an important factor for the smooth continuation of the business. This is supported by recent studies, which suggest that online activities steadily became more and more important during that phase. Telework increased by 31% while teleconferencing increased by 34% in Greece (Mouratidis and Papagiannakis 2021). Although that would not have been possible a few years ago, thanks to greatly improved modern technologies and Informational Systems, businesses all around the world were able to switch to the new status quo in a matter of a few days to adapt to the sudden COVID-19 working crisis. All the above fueled our research questions: (a) What is the effect of teleworking on employee productivity?; and (b) Do its advantages outweigh its disadvantages?

The significance of the present study is that it sheds light on the circumstances in which the COVID-19-induced digital transformation that enforced telework in Greek banks took place and on its future implications. The circumstances surrounding the adoption of teleworking are meticulously documented, as are the unpredicted challenges faced by banking organizations. This analysis not only offers a snapshot of the Greek banking sector's response to the pandemic but also provides valuable insights into broader trends shaping the future of work in technology-driven industries. Additionally, this study examines the impact of telework on employee performance and well-being. This is achieved by capturing the employees' response and perspective to working in this new telework status quo, and how their performance was affected during the work away from the premises of the organization. To answer the research question posed, we follow a case study research approach in the context of a Greek banking institution with more than ten thousand employees.

This holistic approach, besides enriching our understanding of telework dynamics, also informs strategies for fostering employee engagement, satisfaction, and productivity in remote work settings, and also contributes to the advancement of knowledge in telework and teleworking information systems, particularly within the banking sector. Furthermore, by designing our research to revolve around the theoretical framework that the UTAUT (Universal Theory for the Acceptance and Use of Technology) model offers, we can better fathom employees' intentions to use and work in accordance with the new work conditions that the teleworking information system brings forth.

We note that, in the context of the present research, the actions taken by the banking institution to deal with and effectively overcome the challenges of the crisis are described, based on autobiographic evidence. Moreover, the views of several employees in the institution with regards to how they judge teleworking, whether they would prefer it continue to exist, and how they experienced the digital transformation of their employment routine, are recorded through semi-structured interviews.

The remainder of the paper is structured as follows. First, we provide a review of the existing literature on telework, and teleworking information systems, also focusing on the intricacies of their utilization in the banking sector. Then, we present our research methodology, followed by the results of our study, and their discussion, and conclude the paper. This research aims to aid researchers and practitioners in navigating the upcoming future of the professions related to Informatics, in a situation that apparently will occupy us for quite some time and has fueled the transition to a "new normal".

The contribution and the significance of this paper mainly lie in that it covers a specific topic: the Greek banking sector and how it adapted and may look moving forward. Our work therefore helps shed light on how the working conditions changed forever due to the COVID-19 pandemic crisis and what that means for employers in the Greek banking sector specifically, and possibly other technology-based industries. Most importantly, the findings of this study have practical implications for organizations and policymakers alike. By elucidating the challenges and opportunities associated with telework adoption, the research provides actionable insights for organizational leaders seeking to enhance resilience, agility, and adaptability in the face of crisis. Additionally, this study offers guidance for policymakers tasked with crafting regulatory frameworks and support mechanisms to facilitate the transition to remote work and ensure the long-term sustainability of telework arrangements.

Overall, the contribution of this paper extends beyond its immediate context, offering valuable insights into the future of work and the role of telework in driving organizational success and resilience. By documenting the experiences of Greek banks and their employees amidst the COVID-19 pandemic, this research provides a roadmap for navigating the complexities of the "new normal" and embracing the opportunities for innovation and transformation in the digital age.

2. Background

2.1. Telework

Teleworking is "the general term for a person working outside the office through telecommunications hardware and software" (Nilles 1994). It is defined as a flexible work arrangement in which people work remotely from their houses or personal spaces without in-person contact with colleagues but using ICT (information and communication technology) (Di Martino and Wirth 1990). Four types of teleworking have been defined in the literature (Kurland and Bailey 1999):

(i) Home teleworking refers to employees who work from home on a regular basis, though not necessarily (and, in fact, rarely) every day. A person can be said to be a computer telecommuter if their connection to the office is as simple as a telephone. However, telecommunications often use other means of communication, such as email, PC-to-desktop connections, and fax machines. The equipment is purchased either by the company or by the employees (Van Zoonen and Sivunen 2022).

(ii) Satellite offices, where employees work both outside the home and away from the conventional workplace in a location convenient for them or their clients. A satellite office houses only employees from one company; it is, in a way, a branch of the central facilities whose purpose is to relieve the employees.

(iii) A neighborhood work center is essentially identical to a satellite office, with one major difference: Employees from more than one company work in the homes of the neighborhood work center. In other words, many companies can share the lease in an office building and keep separate office space inside the building for each company's employees.

(iv) Mobile work, where, unlike telecommunications workers working from a designated location outside of headquarters and communicating with headquarters electronically, mobile employees are often on the road, using communication technology to work from home, from a car, a plane, or a hotel. Communication with the office takes place from every location.

The aspects influencing telework can be classified into five categories: technological materials, non-technological materials, teleworkers themselves, the work environment of teleworkers, and their family environment. While some of these factors have causal relationships, others have become obsolete and replaced by new ones over time. Several of these factors have been established to have a generally favorable impact on telework (Gohoungodji et al. 2023). Moreover, employees now more than ever use portable technology tools to carry out their work activities from a "virtual office" with great flexibility in the schedule and workplace. However, there is little scientific research on the results of this growing form of work (Hill et al. 1998). Published articles on business accept the emerging "virtual office" as an effective means of reducing costs and enhancing productivity, morale, and the balance between their personal and professional life (Hill et al. 1996). A 2009 forecast showed that the 43 million teleworkers in the US could grow and cover 43% of the US workforce by 2016 (Shadler 2009). However, statistics on telework in Europe show that these figures are much lower. More specifically, in the Czech Republic—the EU country with the highest number of teleworkers/teleworking employees in 2005—the percentage of teleworkers was in comparison only 15.2% (European Foundation 2010).

2.2. Telework in the Banking Sector

Since the 1980s, banks have been constantly innovating through products and services with improved technology. A service based on information systems that is common today is banking services by telephone (telephone banking), as well as mobile banking. As a result, another banking innovation of aggressive computer expansion and communications technologies is emerging: the US Department of Commerce estimates that over 50% of US households had home computers by 2000, and internet subscriptions increased by more than 15% between 1998 and 2000 (U.S. Department of Commerce 2000). These growth patterns have given birth to the rapid growth of the online business sector and have impacted society over the past decade. The banking sector is no exception (Gigler 2012). In particular, banks offer online banking services in which personal banking transactions are available via the Internet or other related technologies. With online banking, users can access the service anywhere, anytime. The online banking market has expanded dramatically since its inception (Wang and Hollander 1999) and is expected to grow even further accordingly. In fact, Informational Systems are now more important than ever in the banking sector, and banks need to be able to support their customers on a 24/7 basis wherever they operate. The performance and usability of IS are strongly connected to employees' performance. A good structure in IS can boost many business aspects, such as organization, better customer support, cost cutbacks, competitive advantage, etc. When it comes to human resources, a high-performing IS can help employees be more effective in their tasks' completion time (Vannirajan and Manimaran 2009).

In 2006 Pakistani banks had a 45% growth in opening online branches. The State Bank of Pakistan recorder a growth of 3.05% in their transaction numbers. This, in parallel with the broadening of the Internet in Pakistan, had the banks offer online services parallel to traditional ones as a result (Zahid et al. 2010). Internet Banking has shown significant growth in Western Europe during the last decade. Belgium is a great example because it had an increase rate of 15% between 2009 and 2014. While in 2014 in the Netherlands, a staggering 83% adopted E-banking (Aydogan and Hove 2017).

2.3. Benefits and Drawbacks of Telework

From the management point of view, the inherent difficulties associated with measuring the productivity of teleworkers can be an obstacle to the adoption of teleworking

(Pyoria 2011; Weisberg and Porell 2011). Thirty years ago, there were less than one million employees working from outside the office in the US for at least a day per week (Hill et al. 1996). Telework grew in the past decade, before the coronavirus epidemic, as an occasional form of work (European Commission 2020). The reduction in corporate costs has been a significant impetus for this large increase in virtual offices and working from home (Martin 1994), as the cost of traditional office space has skyrocketed in recent years, while the cost of portable telecommunications equipment has dropped. Moreover, businesses do not need to spend large sums of money on operating expenses such as electricity and equipment maintenance. As a result, by reducing the office space, significant cost savings can be achieved. It is estimated that it takes less than a year to recover the invested cost of all mobile telework equipment. Initial estimations stated that, after the first year, the company could generate USD 8,000 in annual cost savings per virtual office worker (Hequet 1994). IBM is a great example, because it reported USD 75 million in annual real estate savings in 1999, just because of teleworking alone (Kurland and Bailey 1999).

Pre-COVID-19 estimates suggest savings (for the employer) of approximately USD 10,000 per year for each employee working from home (Shearmur 2020). However, telework does not solely refer to working from home. Moreover, apart from the potential benefits for the organization, research suggests that flexible work is also an opportunity for employees to improve their performance, family and social life, and health, while all together reducing the limitations of office work and thus gaining autonomy for their own personal affairs, mainly from reducing the stress brought to them by daily commuting since, according to (Tavares 2017), (a) The boundaries between working time and non-working time become flexible and are adapted to the needs of individuals in different parts and stages of their lives (study time, family, aging, or simple individual preferences), and (b) Teleworking is a tool for deciding on working hours and adapting them to the needs and preferences of employees.

Noting the historical and statistical evolution of teleworking, which has been around for over 40 years and continues to expand, it seems to be creating a net benefit for individuals (and organizations). If teleworking had a major negative impact on employees' health (and job satisfaction), then eventually the latter would have lost their willingness to apply it and teleworking would have tended to disappear. In addition, working from home provides an environment conducive to better concentration, less noise, less downtime, more privacy (which open office spaces often lack), and better air quality (that can often be questionable in the traditional office).

A moderated mediation model was created and assessed using information gathered from 295 employees in the United Kingdom. The results indicate that COVID-19 work support, including perceived organizational support and accessibility of supervisors, is linked to favorable alterations in employees' well-being concerning their jobs. These changes were mediated by employees' affective commitment to their organization. Moreover, the connections between these two types of support and variations in affective commitment to the organization were influenced by personality traits. Specifically, employees with low core self-evaluations and a high future orientation experienced more favorable relationships (Mihalache and Mihalache 2022). In recent research, data were collected daily from remote workers during two periods, once from March to May 2020 (2222 employees) and again from November 2020 to January 2021 (1268 employees), to explore the influence of personal (goal setting, self-efficacy, home office experience), external (home equipment), and organizational (work-related and social) resources on changes in well-being, perceived productivity, and engagement. Remote workers who reported higher levels of self-efficacy and social support at the beginning of the crisis experienced less decline in well-being and engagement. Additionally, an increase in resources from the first to the second measurement was linked to a lower decrease in well-being, productivity, and engagement (Straus et al. 2023).

Although the organizational benefits of teleworking cover a wide range, including behavioral outcomes, productivity, and legal issues, many challenges can weaken an

organization's willingness to integrate telework into the traditional office environment (Kurland and Bailey 1999). However, teleworking can represent both a resource and a constraint, depending on the degree of employee autonomy and the specific management framework. For example, working from home is sometimes presented as a possible solution to the problems of balancing work and family or, conversely, as a problem in the balance of work and personal life due to challenges related to spatial planning (Taskin and Edwards 2007), as well as blurring the boundaries between working and non-working time (Baines and Gelder 2003). Most teleworkers feel that this form of work gives them more time to be with their family morning and night, to be available for family responsibilities, to be able to prepare children for school or to take care of them in the morning. The extra flexibility of working hours is valued by many as a positive contribution to work–family balance and many show that they can integrate some housework into the workday, thus freeing up the evening or the weekend (Tremblay 2003). Albeit, a major challenge for managers is their inability to observe the performance of employees in real time while they are teleworking (Kurland and Bailey 1999). Based on a recent study, open communication and face-to-face interactions between remote workers and managers could benefit both parties, even if they are through a video call. Managers have the chance to observe the core tasks of the employees and assist them when there is a need (Van Zoonen and Sivunen 2022).

From the organization's viewpoint, the prospect of home teleworking also provides an opportunity to improve workplace productivity. As employees have more scheduling flexibility, they can operate whenever they prefer, and thus improve their productivity, while teleworking employees need fewer sick leave days, resulting in less absenteeism, higher job satisfaction, and higher job performance scores (Kurland and Bailey 1999). Most companies adapted to new working practices and in extreme cases some companies even stopped having physical offices. The cause for this was that employees started valuing the benefits of the flexibility that teleworking provides more than they did before the COVID-19 pandemic (Newman et al. 2022). The positive or negative effects of teleworking can be summarized into six main factors: productivity, flexibility, work–life balance, employee morale, teamwork, and end of working hours (Hill et al. 1998). In terms of productivity, in a study that looked at the impact of the virtual office, respondents reported increased work efficiency and greater productivity anytime, anywhere. In addition, a productivity increase of between 10% and 30% was observed in a review of telecommunications studies. At the same time, in a virtual office study job satisfaction increased due to increased flexibility in location and working time. Virtual offices are considered to provide more flexibility in location and working time, and this is good for the individual, the workplace, and the family. On the factor of work–life balance, some scholars argue that telework flexibility is what employees need to balance work and home responsibilities (Hill et al. 1996). Others see the virtual office as having the potential to blur the line between work and home. In any case, the virtual office adds a new level of complexity as employees try to tackle flexibility and "trace" the permeability of their own work and personal/family life boundaries (Nippert-Eng 1996).

Focusing on employee morale, the results of existing research are sometimes contradictory. For the majority of employees though, teleworking improves morale, because it potentially offers large savings on fuel or commuting via public transport expenses on the employees' side and removes the need for large office space on the employers' side. Furthermore, teleworking is undeniably better for the environment since through it, fewer carbon emissions are being produced (Hill et al. 1996; Ruth and Chaudhry 2008; Banister et al. 2007). On the other hand, it was later found that job satisfaction measures did not differ significantly between a telecommunications team and a non-telecommunications control team (Kraut 1987). As expected, the literature seems to also agree that teleworking tends to negatively affect teamwork. Most of the communications with associates were less effective than in the traditional office environment (Hill et al. 1996). More specifically, in a qualitative study, it was found that the virtual office negatively affected the communication and interaction with partners and tele-managers (Hill et al. 1998).

Finally, regarding the working hours, it is observed that employees from home can return about half the travel time to the company in the form of longer working hours (Nilles 1994). That being said, there is also the matter of procrastination for some people working from home. Employees might postpone working on their tasks and become distracted by other things, such as browsing the Internet and having longer breaks. Also, some employees with families, especially those with young kids, might frequently pause their work due to family demands. So, their working hours might be longer in the end due to these factors (Wang et al. 2021).

All things considered, it cannot be understated that if organizations and their leaders internalize these teachings, they can enhance the welfare of their workers and their families, and, ultimately, gain advantages for their businesses by lowering deviance and raising employee productivity (Becker et al. 2022).

Based on all the above, the present research focuses on investigating the following research questions:

a. What is the effect of teleworking on employee productivity?
b. Do its advantages outweigh its disadvantages?

2.4. Related Evidence from Recent Literature on Telework in the Context of the COVID-19 Crisis

According to a recently published review of the existing literature, although the scant practice of full-time teleworking could be found prior to the pandemic, since the start of the COVID-19 pandemic, thousands of people have experienced teleworking and this practice is becoming increasingly commonplace (Antunes et al. 2023). Home offices have gained way and will likely become an essential part of the working environment even after the pandemic (Krajčík et al. 2023). It has also been suggested that the effect of telework is such that, after the COVID-19 crisis, "the future of work is being redesigned by the world's largest telework experiment as a consequence of the global pandemic" (Caraiani et al. 2023). Accordingly, although telework-enabling technologies have been known since as early as the 1970s, their level of wide adoption in workplaces remained low until the advent of the COVID-19 crisis (Godefroid et al. 2024).

A review of articles published between 1999 and 2020 on telework identified five key themes with regard to the extant opportunities and challenges to sustainable remote workplaces in the long term—(1) key characteristics, (2) work–life boundaries; (3) health and well-being; (4) social interaction; and (5) leadership—and at the same time identified the potential role of information systems in encouraging more sustainable remote workplaces in the long term (Asatiani and Norström 2023). However, all in all, the impact of new ways of working on organizations and employees' well-being and performance has not yet been adequately systematically analyzed in the literature and therefore needs further analysis (Renard et al. 2021). Albeit, some varied insights have been recorded in the recent related literature that focuses on the adoption of telework in organizations worldwide during the COVID-19 pandemic.

The distance from the workplace induced in the context of telework during the COVID-19 pandemic generated new dilemmas in work performance (Ficapal-Cusí et al. 2023). Moreover, it has been suggested that "to make telecommuting the 'new normal', it is essential to not only change the legal system and employment contracts but also reform organizational processes" (Yanagihara and Koga 2023). Following the advent of the increase in telework adoption after the COVID-19 pandemic, teleworking has begun to dramatically change the work dynamics for all stakeholders, and the relations between employer and employee are "expected to become based more and more on cooperation and less on subordination", utilizing the telework model (Stanciu et al. 2023). Organizational culture is a critical factor in implementing telework, as it may influence the workers' attitudes toward this model of work, as well as their overall happiness (Junça Silva and Coelho 2023). In fact, organizational factors seem to greatly influence the teleworker's experience and are critical to the success of telework (Brandão and Ramos 2023). According to the findings of a recent study, although telework can be a job resource promoting positive work attitudes, this ben-

eficial impact decreases (and can eventually become negative) as employees telework more extensively, while the quality of employee–supervisor relationship can act as a moderator enhancing the benefits of extensive teleworking or exacerbating its drawbacks (Park et al. 2023). Recent work has also shed light on the role of individual and social antecedents (fatigue, trust, and social isolation) on telework outcomes (performance): (a) fatigue was found to be the factor that mostly affected telework performance (negatively), followed by trust (positively) and social isolation (negatively), while (b) social isolation and fatigue mediated the relationship between trust and performance during telework (Mirowska and Bakici 2023). All in all, according to the findings in recent studies, organizations should implement and manage teleworking programs considering workers' perceived benefits and willingness to remain teleworking (Brandão and Ramos 2023). According to the findings of a recent study during the COVID-19 pandemic, the teleworking experience of workers was essentially positive, with most expressing an intention to maintain it after the pandemic, while factors that strongly influenced workers' perceptions of the advantages and disadvantages of teleworking included the conditions offered by their organization and the existence of an adequate workspace at home during telework (Brandão and Ramos 2023). Although remote work makes labor relations more flexible and "expands the possibilities of conducting professional activities balanced with fulfilling personal needs", ensuring the equality and confidentiality of employees requires special attention, as well as adhering to the legal and ethical aspects of the regulation of remote work (Bayazitova et al. 2023).

The COVID-19 pandemic in essence forced organizations to adopt telework (many of which without any prior preparation), thus influencing not only daily organizational routines but also workers' well-being and happiness (Junça Silva and Coelho 2023). A recent study conducted during the COVID-19 pandemic found the following: (a) several factors, such as flexible working hours, family time, and autonomy, have a positive influence on the decision to telework; (b) IT security risks, interruptions, and virtual meetings do not negatively influence the employees' decision to telework; (c) the social consequences of telework (mental stress, lack of socialization and the difficulty of separating working time from family time) lead employees to prefer other forms of work (Dimian et al. 2023). However, although full-time telework brings important changes in working conditions and has the potential to affect the living and health conditions (psychosocial factors) of teleworkers, part-time teleworking may, on the contrary, have a positive impact on psychosocial risk factors, favoring work–home balance, communication, and social relationships (Antunes et al. 2023). Accordingly, in the context of a higher education institution, although during the COVID-19 lockdown periods, both positive and negative motivational consequences of teleworking were observed, the effect on employees' productivity was ultimately negative (Rietveld et al. 2022).

Although home-based telework does not pose an inherent risk for job stress, it can affect it in two opposite directions: (a) it may cause a change in the employees' behavior in the form of increasing work during free time and presenteeism, which can in turn lead to an increase in job stress, and (b) it can lead to a decrease in stress, once these behaviors (increasing work during free time and presenteeism) are controlled (Goñi-Legaz et al. 2023). In a recent qualitative study on existing and emerging technostressors in teleworkers during the pandemic, the authors identified "techno-isolation" (a previously unreported technostressor), which arises from a heavy dependence on information communication technologies for professional social interactions, and is affected by the characteristics of the teleworking IS platform employed in the context of telework (Goñi-Legaz et al. 2023). The existing literature also highlights an increase in telework-related stress levels in remote workers (with higher stress levels reported for female workers); therefore, remote workers need to be provided with emotional and technical support to prevent telework-related stress (Gualano et al. 2023). The results from a study with Romanian employees in the context of the COVID-19 crisis revealed an important tendency to appreciate the positive effects of teleworking on other aspects of life (Stanciu et al. 2023). The findings of a recent US-based study indicate that, compared to teleworkers, non-teleworkers perceive

less positive impact of telework on employees and organizations, thus shedding light on the fact that managers and supervisors should also be mindful of possible feelings of unfairness and ineffectiveness that non-teleworkers may perceive about coworkers' telework, in cases where some employees are teleworking and some are not teleworking (Lee and Gascó-Hernandez 2023).

The use of enforced telework during the COVID-19 crisis has also shed light on the importance of co-presence (the felt sense of presence mediated by information and communication technologies instead of physical proximity) for managing employees on a by-distance basis (Taskin et al. 2023). It seems that the faster the adoption of Information and Communication Technologies (ICTs) in an organization, the more difficult it becomes for teleworkers to become accustomed to them, thus leading to feelings of anxiety and stress known as "technostress", that, in turn, directly affects employees' satisfaction, anxiety, and performance ("the lower the technostress, the higher the satisfaction and performance, and the higher the technostress, the higher the anxiety and the lower the satisfaction") (Fernández-Fernández et al. 2023). It has been acknowledged that the challenges faced by many workers in their transition from the office to the home-based work environment during the COVID-19 pandemic have put stress on their daily routine and professional lives: Teleworking had rather negative effects on employees' well-being, as "many teleworkers tended to suffer mental and physical exhaustion and social deprivation when working from home" during the pandemic (Raišienė et al. 2023). The COVID-19 pandemic has also made teleworking a widespread form of work for contact center workers in Portugal, who are already used to work processes supported by technological platforms and digital workflows. Based on the findings from 14 semi-structured interviews, 7 factors emerged that characterize teleworking as being capable of reinforcing well-being at work: performance, relationship, money, workplace, technology, time, and family (Santos and Pereira 2023).

While teleworkers who live and work in the same space are, in general, "vulnerable to conflicts between personal life and work", the COVID-19 pandemic increased this risk, along with its intensity, as teleworkers were faced with "difficult personal situations and often ill-equipped telework environments" (Weinert and Weitzel 2023). Moreover, the conflicts between personal life and work during telework have adverse effects on job outcomes such as work exhaustion, job satisfaction, routine, and innovative job performance, and the IT telework environment moderates these effects (Weinert and Weitzel 2023). Recent research in Japan has also reported a positive correlation between telework supported by ICT and perceived work autonomy (Yanagihara and Koga 2023). At the same time, it has been suggested that, to realize telework, it is necessary to allow for the making of one's own work visible and collaboration with others, enabled by information systems (Koga 2023). It has been noted that the main changes with regard to COVID-19 and people management have occurred in the processes of work and safety, training, work organization, recruitment and selection, induction and onboarding, and communication, with a prominent increase in the use of teleworking, while, according to human resource managers, the most evident changes in the future will be associated with the use of technology, teleworking, and work organization (Gonçalves et al. 2021). Moreover, although, under regular circumstances, telework could benefit the integration of work and family life, imposing mandatory telework during the COVID-19 pandemic led to unforeseen challenges that can potentially fuel work–family conflicts, mostly via the effect of role overload, after-hours work-related technology use, and low job autonomy (Andrade and Lousã 2021). In a case study at the Visegrád Group in Central European countries, 84.4% of teleworkers were found to be satisfied with working from home, due to the fact that they were better enabled to allocate the gained time to social–personal activities, whilst most local teleworkers have the intention to work from home if given the opportunity in the future (Alassaf et al. 2023). Finally, although teleworking can increase a worker's well-being by eliminating travel (commuting) time, it presents several risks, as it can intensify work through increased pressure to meet objectives and targets (shedding light on the relationship between telework and work intensification, as well as its effects on working conditions and workers' well-being) (Rebelo et al. 2024).

A number of additional issues have been identified in the literature in this context. It seems that although the COVID-19 pandemic has changed the concept of telework and turned it into an often desired employee benefit, employers tend to in many cases consider it a temporary setting (Krajčík et al. 2023). Employees in Slovakia and Kuwait value time flexibility, although localization flexibility is also growing in importance, with a hybrid work model evolving as the most suitable solution in line with the employees' preferences (Krajčík et al. 2023). A study in the context of the COVID-19 pandemic in an industrial setting has shed light on the concerns and challenges that come into effect with telework in regard to communication, trust, control, and productivity, highlighting the importance of establishing clear policies on teleworking and remuneration, expense reimbursements, equity between teleworkers and on-site workers, as well as new demands on aspects such as ergonomics, negative habits (food and physical inactivity), communication, and work–life balance (Fontaneda et al. 2023). The teleworkers' gender, age, residency situation, and status as national or foreign employees, along with many other parameters, led to a fluctuation in their perceived experience of telework in the context of the pandemic (Raišienė et al. 2023).

Finally, recent studies have also shed light on the adoption of telework by banks worldwide in the context of the COVID-19 crisis. In a qualitative research study on the adaptation of bank headquarters employees to telework during the COVID-19 pandemic in Turkey, although the interviewed participants had mainly privacy concerns that made them hesitant to continue teleworking, they were inclined to transition to telework at least in a hybrid scenario of work, should privacy issues be resolved (Öcal 2021). In another qualitative study on telework in French banks during the COVID-19 pandemic, the authors observed the emergence of "new forms of control based on behavior (micromanagement, increasing the number of meetings) and inputs (increasing the time devoted to training)", and highlighted the "increase in technological control and the emergence of a more diffuse form of self-control through the collaborative development of a business culture based on urgency, hyper-responsiveness, and a high degree of accountability and peer control" (Meyer et al. 2022). In a study in the context of Nigerian banks, the authors report that although there was a significant self-reported negative relationship between telework during the COVID-19 pandemic lockdown and bank marketers' performance (in the form of the ability to achieve sales targets, the ability to convert leads into customers, and the ability to retain both customers and high-net-worth customers), which was especially evident in female participants' responses, 55% of respondents agreed to engage in regular home-based telework in the future, while high-income earners' willingness to continue teleworking was even higher (Uford et al. 2023). The results from two studies conducted in banks situated in Portugal during the COVID-19 pandemic show that, although family-supportive supervisor behaviors were related to positive outcomes for the work–family relationship and the well-being of banking employees, many of these associations were conditional upon the levels of intensity of telework imposed (Chambel et al. 2023).

All in all, as noted in an article by the American Bankers Association, while "an all-telework environment is a big change" even for a bank that was fully telework-ready before the COVID-19 crisis, the major considerations for the rapid telework transition that arose include: maintaining a secure IT environment (especially in an environment where many employees are using personal devices), ensuring multi-factor authentication is in place for system access, and requiring VPN or other secure access portals for applications that access or house sensitive customer data (Sparks 2020). Moreover, in a study on the application of telework in banks in Brazil during the COVID-19 pandemic, the authors stress the fact that, although the pandemic was a global event, "its developments in an area are local and permeated by demographic, historical, economic, political and regulatory aspects", and suggest that research on telework in banks worldwide "should take into account the different factors that shape and have shaped relationships between workers, organisations and government in different countries" (Sousa-Duarte 2022).

3. Research Methodology

3.1. Theoretical Framing

As the use of information and communication technology (ICT) to enable telework is expanding worldwide, there is also a need for further research on the cultural aspects and impacts of ICT. A better understanding of the factors that contribute to the acceptance or rejection of information technology in general is, after all, the first step towards solving the problem (Gigler 2012). User acceptance is often the central factor and focus of Information Systems Implementation (IS) research in determining the success or failure of an information technology product. The availability of information technology does not necessarily lead to its acceptance, as most information system failures are due to a lack of user acceptance rather than poor system quality (Igbaria and Guimaraes 1992). In order to organize our research and determine the themes it shall revolve around, in the present research, we examine telework information systems through the lens of the Unified Theory of Acceptance and Use of Technology (UTAUT).

The UTAUT model was developed by Venkatesh et al. (Venkatesh et al. 2003) to anticipate the adoption of information technology by users. With empirical analysis, this theory derives that performance expectancy, effort expectation, social influence, and facilitation conditions are the main factors determining the user's adoption. Among them, the expectation of performance is similar to the perceived usefulness and the relative advantage. Expectation of effort is like perceived ease of use and complexity. Social influence is similar to the underlying norm. Since its inception, UTAUT has been used to explain the adoption by users of a variety of information technologies (Kijsanayotin et al. 2009). In essence, according to UTAUT, it is the users' intention to utilize a solution that determines whether the solution will be utilized by them. An adapted illustration of the UTAUT model in the context of the present study (telework information systems in banking institutions) can be found in Figure 1.

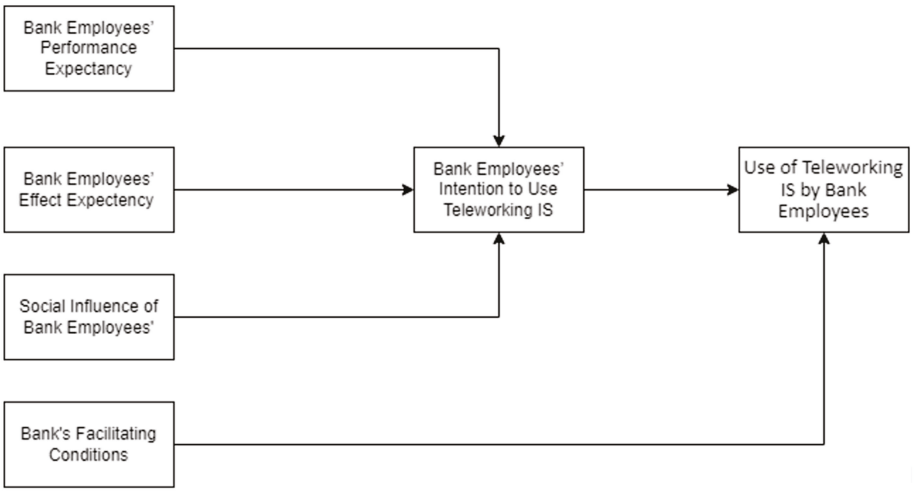

Figure 1. The UTAUT model in the context of telework in banking institutions—adapted from (Venkatesh et al. 2003).

3.2. Related Background on Qualitative Research Methodology

In terms of methods employed, our research approach mostly lies within the bounds of both interpretive ethnography (accessing lived experiences and uncovering culturally relative patterns of meaning) (Mahadevan 2020). Ethnography is "understood as a multi-paradigmatic mindset" that contributes to Human Resource Management's (HRM's) double focus on people and technology by considering the role of objects and technology as non-human social actors in the context under research (Mahadevan 2020). Although studies that follow the positive paradigm (that builds on objective data and epistemology, and usually includes the measurement of social phenomena with variables, among which there

might be mathematical statistical relationships) are undoubtedly dominant, compared to the number of studies conducted in the constructivist paradigm (that builds on subjectivist epistemology and ontology, and focuses on emerging themes), there is an overall picture of paradigm plurality in the field of HRM (Primecz 2020). Moreover, it has been argued that, based on the fact that constructivist research is close to actors' perspectives, "their interpretations and sense-making can renew social science, including HRM, because, above all, the actors' perspectives might result in more valuable theories for practice" (Primecz 2020). Therefore, there is a recorded need for further constructivist research in the HRM field. However, leveraging the full potential of ethnography for HRM studies requires a multi-paradigmatic approach, where ethnographic research strategies are chosen "consciously, reflexively, and as their research interest demands for" (Mahadevan 2020). In essence, one must also bear in mind that ethnography provides HRM with the "natives' point of view" and can also deliver deep insights into "how HRM works" (Bate 1997; Watson 2011; Mahadevan 2020). It can thus reveal "how employees experience and react to HR policy and practices" in more depth than other exclusively interpretive methods (Mahadevan 2020), by focusing on the employees' experiences in conjunction with the underlying structures within their social and/or material context (Bate 1997; Mahadevan 2020), and contribute to the development of improved practices within the workplace (Harris 2000; Watson 2011; Mahadevan 2020).

Interpretive ethnography is useful for HRM studies in multiple ways: it can uncypher employees' everyday experiences in large organizations, and new insights for HR theory and practice can be inferred from this "thick description" of lived experiences (Mahadevan 2020). In practice, in the present research, we followed a "social construction of reality" method (Yin 2003), where a single case study was utilized as a facilitator (purposeful sampling) using a retrospective longitudinal autoethnographic approach combined with existing theory. The objective was to enrich our understanding as per our pre-defined research question by employing autoethnography expressed through an immersive action research approach. Case study was selected as fitting to our purpose of study for a number of reasons. First of all, the central notion of case studies is to develop theory inductively (Eisenhardt and Graebner 2007). Obtaining contextually rich descriptions and a holistic understanding of the case helped us recognize patterns of relationships between constructs, and to explore their underlying explanation. Another reason is that this approach is ideal for answering the "how" and "why" questions (Yin 2003). As per the reasons for selecting to study this specific case, it was selected intentionally on the basis of it being "typical" and "revelatory" (Benbasat et al. 1987). More specifically, the selected bank was one of the four largest banking organizations in Greece (a representative example of the Greek banking system), which faced the effects of the COVID-19 crisis the same as all other Greek banks (due to the evenly distributed containment measures that were in effect on a national level). Similar to other companies, the banking institution utilized a software platform that allowed the employees to connect to their desktop PCs in a matter of seconds and have full access to their files and applications. This made the transition from the office to the "virtual office" seamless, while, at the same time, the security of the bank was guaranteed because nothing could "leak" outside the bank's network security.

Autoethnography is a form of qualitative research whose meanings and applications have evolved in such a way that a precise current definition is actually difficult to compile (Ellingson and Ellis 2008). In essence, it is "a form or method of research that involves self-observation and reflective investigation in the context of ethnographic field work and writing" (Marechal 2010), in order to "connect the autobiographical and personal to the cultural, social, and political" (Ellis 2004). Adhering to this research method, in essence, involves the utilization of the researcher's personal experience to describe and critique cultural beliefs, practices, and experiences while acknowledging and valuing their own relationships with others, and recording their behavior in the process of "figuring out what to do, how to live, and the meaning of their struggles" (Adams et al. 2015).

Immersive action research (IAR) involves conducting research in the organization where one is employed, while, in order to gain integrity in such a research design, integrating first-person with second- and third-person inquiry has been suggested (Coghlan 2007; Coghlan 2019). Context affects the readiness and capability to participate in IAR (Nzembayie et al. 2019; Coghlan 2019). The immersive nature of IAR presents challenges because the researcher is close to the problem under study, which is connected with (Coghlan 2007): preunderstanding—"a person's knowledge, insights and experiences before they engage in a programme" (Gummesson 2000)—including both explicit and tacit knowledge that can be beneficial as well as detrimental to the study (Coghlan 2019); role duality—being both in academia and practicing work within the case (Williander and Styhre 2006)—which can become overwhelming and confusing as the researcher may experience competing commitments (Kegan and Lahey 2001); and organizational politics, as ethical concerns may arise from gaining access, using data, and disseminating and publishing findings of IAR.

3.3. Research Approach

Acknowledging the fact that ethnography can make a strong contribution to HRM studies (Mahadevan 2020), the research approach we followed in the present study included two steps that involved both a closed (within oneself) as well as an open (in interaction with others) reflection (Mahadevan 2011) of the events that took place, and their effect on the participants:

- **Step 1:** A qualitative, auto-ethnographic collection of evidence that was based on two different sources:

On one hand, an autobiographical recording of the personal experience of the first author from the application of telework in the banking organization where they were employed at the time of the COVID-19 crisis onset. Auto-ethnography is an emerging qualitative research method that allows the author to write in a highly personalized style, drawing on their experience to broaden their understanding of a social phenomenon (Wall 2006). This constituted a closed (within oneself) reflection of the events that took place, and their effect on the participants (Mahadevan 2011).

On the other hand, to further assist in the accurate recording of facts and events that took place in the context of the uptake of telework by the organization during the COVID-19 crisis, the organization's instructions to employees were revisited and utilized as additional evidence.

- **Step 2:** Semi-structured interviews were then conducted with 15 employees of the organization, following a convenience sampling approach, through which, employees of different levels of the company, expressed their personal views and how each one individually experienced the change in their daily duties, such as how easy was it to fulfill their daily duties, what were the benefits of this change, and how did they manage it, as well as what were the obstacles they encountered, which made their daily work difficult. This constituted an open (in interaction with others) reflection of the events that took place, and their effect on the participants (Mahadevan 2011). We note that we utilized the insights from the previous participatory observation step of our research, in order to learn about the activities of people under study in the natural environment through observation and participation in these activities. Therefore, following guidelines from the qualitative research literature (Musante and DeWalt 2002), this insight assisted us in fine tuning the framework for developing our sampling guidelines and interview guides. The interviews were ultimately accordingly conducted based on an interview guide that consisted of 21 guiding questions/discussion themes, which was built also considering the model proposed through the Universal Theory for the Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) (that we adapted to our context as already described in Figure 1).

The interview guide we utilized was built by taking into account the parameters included in the UTAUT model (as already presented in Figure 1) and can be found in Table 1.

Table 1. Semi-structured qualitative interview guide.

#	Interview Questions
1	Was this your first time working in telecommuting mode or using solutions that allow you to work remotely?
2	What was your personal experience from teleworking? (Describe your experience of using teleworking.)
3	What were your daily activities at work? Did they change due to working from home?
4	How easy was it for you to adapt to the system and the new way/working conditions? What problems did you face?
5	Was it easier or more difficult to fulfill your daily obligations, in relation to working in the office?
6	Have your working hours changed due to the situation? Did you work the same number of hours in teleworking mode (more/less/same)?
7	Did you keep your regular working hours in teleworking or did you work different hours? Did you have time for extra activities?
8	Do you generally prefer teleworking to traditional on-site work? If yes/no, for what reasons?
9	Would you be willing to take advantage of teleworking in the future if you had the option to do so? Why?
10	Would you like to work permanently in teleworking status if you had the choice? Why?
11	How was your performance during the telework? Better or worse? For what reasons?
12	If you communicate with customers in the context of your duties, how did they see the level of service you provided to them when you were in teleworking status compared to before (better/worse/same)?
13	What did you miss most (from your job) while working in telecommuting?
14	What do you think is the best and worst feature of teleworking?
15	Are you worried about the future of your job after the crisis? Please explain.
16	How optimistic/pessimistic are you generally about your job after the crisis? Please explain.
17	What do you think are the benefits of teleworking for at least three days a week for the next three months?
18	What do you think are the disadvantages of working in telecommuting for at least three days a week for the next three months?
19	What else comes to mind when you think of working telecommuting for at least three days a week for the next three months?
20	Please list any factors or circumstances that would have facilitated or made it possible for you to work in telework mode for at least three days a week for the next three months.
21	Please list any factors or circumstances that would make it difficult for you or prevent you from working in telework mode for at least three days a week for the next three months.

In order to record the insight offered by the participants during the discussion, notes were taken throughout the interviews. We note that existing research has shown that the data quality between audio-recorded transcripts and interview scripts written directly after the interview is comparable in the detail captured, while in some circumstances, not recording is the best approach (Rutakumwa et al. 2020). In our case, the participants were employed in a banking institution, where privacy is of the utmost importance. Hence, they declared their preference to not provide recorded interviews. Acknowledging all of these facts, as well as that "an effective interview is in part about enabling an environment in which participants feel comfortable to say what they want about a particular topic" (Rutakumwa et al. 2020), we decided to therefore keep written notes instead of recordings of the interviews.

After the information from the interviews was recorded, all information collected during the interviews was content analyzed and coded into categories pertaining to the present research (based on the aforementioned interview guide that had been decided

upon before the interviews). In the case of disagreement on the classification of any particular statement, the disagreements were resolved upon joint discussion with the researchers involved.

In addition, for a better understanding of the results, a simple analysis of the respondents' demographics followed (calculation of mean values and percentages). Our aim was to understand why some views were different, depending on the profile characteristics of the participants. This was an important step in the analysis since the sample included employees of different ages, positions, and educational backgrounds. The aforementioned was performed using tools such as SPSS and Microsoft Excel in order to visualize the differences that demographic or role-based factors could generate between employees' answers (in the form of descriptive statistics).

Finally, after collecting, coding, and analyzing the aforementioned qualitative data, a comparison was made between the acquired insight from the interviews and the recorded recollection of the first author's daily experiences in the organization, as well as the collected insight from the literature review, to draw and support our conclusions.

Taking into account all of the above-mentioned details regarding the design and execution of our research, our research methodology is summarized in Figure 2.

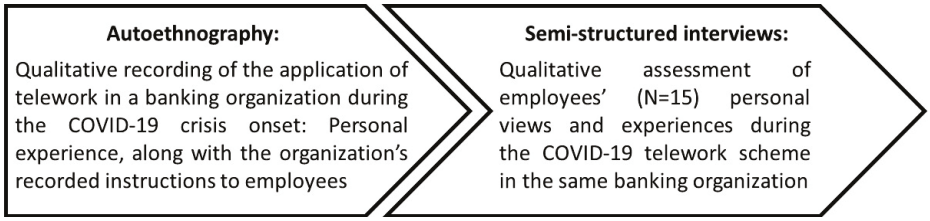

Figure 2. Outline of research methodology.

4. Results

The analysis of results is carried out separately for the two phases of research (autoethnography and semi-structured interviews) included in our research methodology.

4.1. Auto-Ethnography

For the analysis of the operations in the banking organization for the three time periods, before the pandemic, during the crisis, and after the end of the pandemic, an auto-ethnographic report was conducted. The sources used were participatory observation, the instructions of the organization to the employees, the emails, and the announcements on the company website. At the time of the onset of the COVID-19 crisis, the first author of the paper was working for the General Administration of Informatics of one of the largest banks in Greece. The following self-recollection of events, moreover, aims to explain in simple terms the process of abrupt and forced digital transformation in the banking field with the increase in telework and how it changed the daily life and the work schedule of banking employees. We note that wherever the term "I" is used within this sub-section, it refers to the first author of this paper.

4.1.1. Self-Recollection of Events

Before the coronavirus crisis broke out, teleworking was avoided and not suggested in general by the banking organization. This is because any remote connection requires the purchase of a license and, of course, a new framework of cooperation between employee and employer should be defined (insurance, salary). As we analyzed earlier, teleworking was used only in cases of critical need, in the context of stand by (the term stand by means the availability of the employee to connect to the bank system and provide a solution to a production problem if and when needed, this availability is paid extra). The Bank acted cautiously and in a timely manner in my opinion. Three weeks before the government was forced to declare a total ban on unnecessary business operations and traffic, IT Services

Operations Management, in collaboration with people from every directorate and sub-department, gathered the data of all employees and began remote access procedures. Remote access means the connection to use the Remote Desktop service from a computer outside the bank's network.

Typically, we had to declare if we have a personal computer, which we do not share with anyone else in our home, and if it is running Windows 10, for compatibility with the operating system used for Remote Desktop. After the personal details of the employees and their computers were sent to the relevant department, the provision of accesses started slowly. But this was not something that could be achieved from day one for everyone, because it needed to buy hardware, such as computers for those who did not own any, network support tools, i.e., single serial channels (USB) with internet data, software (license for each employee), as well as headphones (headset), which were able to block peripheral sounds. Also, in non-IT departments, it was often necessary to supply corporate laptops to employees.

As early as the next week, access began to open and people who had to be present in the office with a physical presence were dwindling. I remember that a percentage of 20–30%, depending on each sub-department, was set to work from home. I was fortunate to belong to this first group that was called upon to support this new order of things. What made a very positive impression on me is that from the first day, I did not have any problems with connectivity or "crashes", although the internet connection I had back then at home was not good and at the same time it was used by my family. Phone calls were now made through a well-known software company program that provides messaging, voice and video calling, screen sharing, voice messaging, and teleconferencing. The bank supplied us with headphones from the same company, which blocked peripheral sounds, and the communication between the users was excellent.

During those two weeks leading up to the complete quarantine and curfew, more and more colleagues received remote access privileges, even if they continued to work from the office. When the time to go back to the office came and for the second 30% of my team to work from home, unfortunately, the situation with the virus in our country seemed to be becoming worse. So, instead of those who were missing the previous two weeks returning, the rest had to "work at home". During this period, daily "shifts" were set and the necessary travel documents were issued by HR. That is, every day, only one of each address went to the office so that a computer could be restarted if needed or perform a test that cannot be carried out remotely. For example, tests on ATMs and POS. Of course, people belonging to vulnerable health groups, as well as people who could not go to the office by car, were excluded from these shifts. So, each of us had to go to the office once every 14 days. Thus passed the days when the pandemic had reached its peak in Greece.

In conversations I had with my colleagues, whether they belonged to the same department as me or belonged to another, the following phenomenon was observed. We all worked many more hours, which resulted in our productivity rising sharply. I estimate that I worked about 15% more and I was about 10% more productive. Of course, I must emphasize that this was not a product of additional pressure from our superiors. On the contrary, the relations of all of us have improved and my personal feeling is that this was due to the anticipation to be able to overcome the situation and the difficulties, and to be together again in the same place. Our productivity had gone up, as we saved a lot of time from our daily commutes to and from work. Personally, I need 45–60 min to go to the office every morning and even more time to return. If we add to this the fact that on some days, I completed my schedule at 22:00 pm, as I also had to attend courses at the university, one understands that there were few hours left for mental and physical rest. But in the middle of quarantine, I had the opportunity to rest more, to have a balanced life between personal time–studies–work and thus to be more productive during the day and with better psychology. It is also worth noting that many times I remained connected to my work PC, reading and replying to emails several hours after my working schedule was over. Personally, it helped me a lot to be able to reply and read emails throughout the day,

as this way the projects I was involved in progressed much faster. I also had full access to the programs I use in my work. Thus, in parallel with the emails, I could create, respond to, and complete requests (tickets), control the bank flows I was responsible for, and monitor the systems.

As I collected the evidence for this research, we were in a transitional stage. Restrictive measures due to the pandemic had eased and most businesses were operating. For example, restaurants operated normally only with the use of a mask, and shops accepted customers but only up to a certain number depending on their size. The travel bans were lifted and we returned to the office in small groups of 4–5 people per sub-department for a period of 2 weeks—10 working days. Those who belong to high-risk groups or those who have a doctor or nurse spouse are still excluded for health safety reasons. The latter are still working from home.

On the days I have returned to the office to carry out my "shifts", my colleagues "shine through their absence", i.e., their absence from the space is felt. The space is the opposite of how it was before coronavirus. At the peak hours of 14:00–18:00, when the phones literally do not stop ringing, there is a silence that makes you wonder if you are in the period of August holidays, where the office is "empty" and only you are left behind. The meeting rooms, which in the past were constantly reserved and in order to reserve one you had to do it 2–3 days in advance, are now empty and free to use, because all meetings take place remotely.

In conclusion, I believe that the COVID-19 crisis—apart from its vastly negative impact on society—has also had a positive side effect on re-inventing the way we work. I think that in Greece, we were trapped in the traditional way of working in the office. I vividly remember the trip I made with two of my colleagues to London (February 2020) and how positive it was to see people constantly working in a café with their laptops. The digital transformation that emerged from the coronavirus crisis has helped us evolve and seek new and creative ways of working and collaborating. However, if I were asked to decide, I would keep the changes that took place in our daily work environment, but without completely "Teleworking". People need to have separate areas for relaxation, work, and leisure. When everything is completed from the home office, these spaces are confused, and, in the end, none of the above is conducted properly. One must also bear in mind that working remotely has proven to be very helpful to parents with young children, students, and people in general who live a long way from their place of work. According to discussions I have had with my colleagues and friends who also work in companies outside the banking sector and had to work remotely, I believe that keeping, for instance, one week reserved for teleworking each month is an optimal scenario for employees. This gives them the opportunity to escape from their daily routine, such as driving on the streets, the stress of anticipating other obligations, and cooking for the next day, but without the problem of losing contact with their work environment.

4.1.2. The Organization before the Pandemic (Until March 2020)

On a typical day, the average employee has to travel a distance of 40–60 min, including traffic to travel from home to the office environment. Most employees must be in the office by 9:30 a.m. As a result, they usually wake up 2 h before the start of their hours to get ready and go to the medium they use to travel to work, because the organization's facilities are located in an industrial area. During their working hours, they performed actions depending on their responsibilities and their position in the organization. For example, in the case of managers and project managers, their day included several meetings, especially at the beginning, in different meeting rooms at the group's premises. For the most technical positions such as developers and testers, employees started writing code in the morning and answering any user problems. The staff lunch break was flexible, and each employee could manage it as they wished and at any time. The typical time of completion of employees' working hours was 17:30–18:00.

Prior to the COVID-19 crisis, there was no organized process for teleworking staff. Only those responsible for supporting the productive operations and systems of the organization had remote access to the bank's systems. This access was there so that employees could connect and solve critical problems in case of need. Remote access was achieved via Remote Desktop, which is a technology that allows employees to connect remotely and securely to their work terminals, having full access to their installed computer programs. This practice took place under the "stand by" mode of waiting (the term stand by means the availability of the employee to connect to the bank system and provide a solution to a production problem when needed, this availability is compensated extra). More specifically, the employee was ready to connect to the bank's environment, outside of their working hours or on weekends and holidays, and to provide solutions to production problems. This procedure did not have a predefined application time because a problem could be solved immediately or it would take a long time to find a solution, with the result that the employee had to stay connected for a long time. But the days when the employee was stand by, were predetermined from the beginning of each month.

However, it should be emphasized that this additional availability of the employee to provide a solution if necessary was additionally compensated by the company. The bank used popular remote access software which requires a purchased license for each access/employee. This category includes executives of the General Directorate of Informatics of the Group. More specifically, they belong to the sectors Group IT Operations & Infrastructure and Systems Management and Group IT, as well as to departments such as Transaction Banking Systems as well as to their sub-departments.

In fact, from the beginning of 2020, a pilot program was launched which was addressed to 40 IT employees of the organization whose permanent residence is far from the Bank's premises. The staff selected for this program were parents of young children and were temporarily working from home for one week each month. Those who participated had responsibly stated that they have office space in their homes and that they will be available throughout their working hours. It is worth noting that the bank fully insured them during their work from home, even in cases of accidents. This was a program that was positively received by the company's employees but as mentioned above, the people selected by the bank were few at the beginning of the program. As a result, it was not possible for more than 1 employee per department to participate.

Nevertheless, there was a plan to generalize the program and increase the number of employees who would participate, but everything was overturned due to the pandemic. We can safely state that due to COVID-19 the process accelerated dramatically because all companies were forced to digitally transform the work in a very short time.

In Figure 3, we can see how teleworking was employed. At the beginning of the month, the days that will be stand by (teleworking under conditions of service need) are defined by the employees of each IT department. If there is a serious reason which makes an employee unavailable on the appointed day, then the plan changes, until all employees can be available. When a problem arises, the employee who is on "stand by" that day connects directly to the PC of their work (in the bank's infrastructure) in order to solve it. The employee stays connected until the problem is resolved (no matter how long it lasts) and confirms the correctness of its operation, after the necessary corrections. When this is completed, they disconnect from the system. Unless there is a problem, the employee is not connected to their work computer.

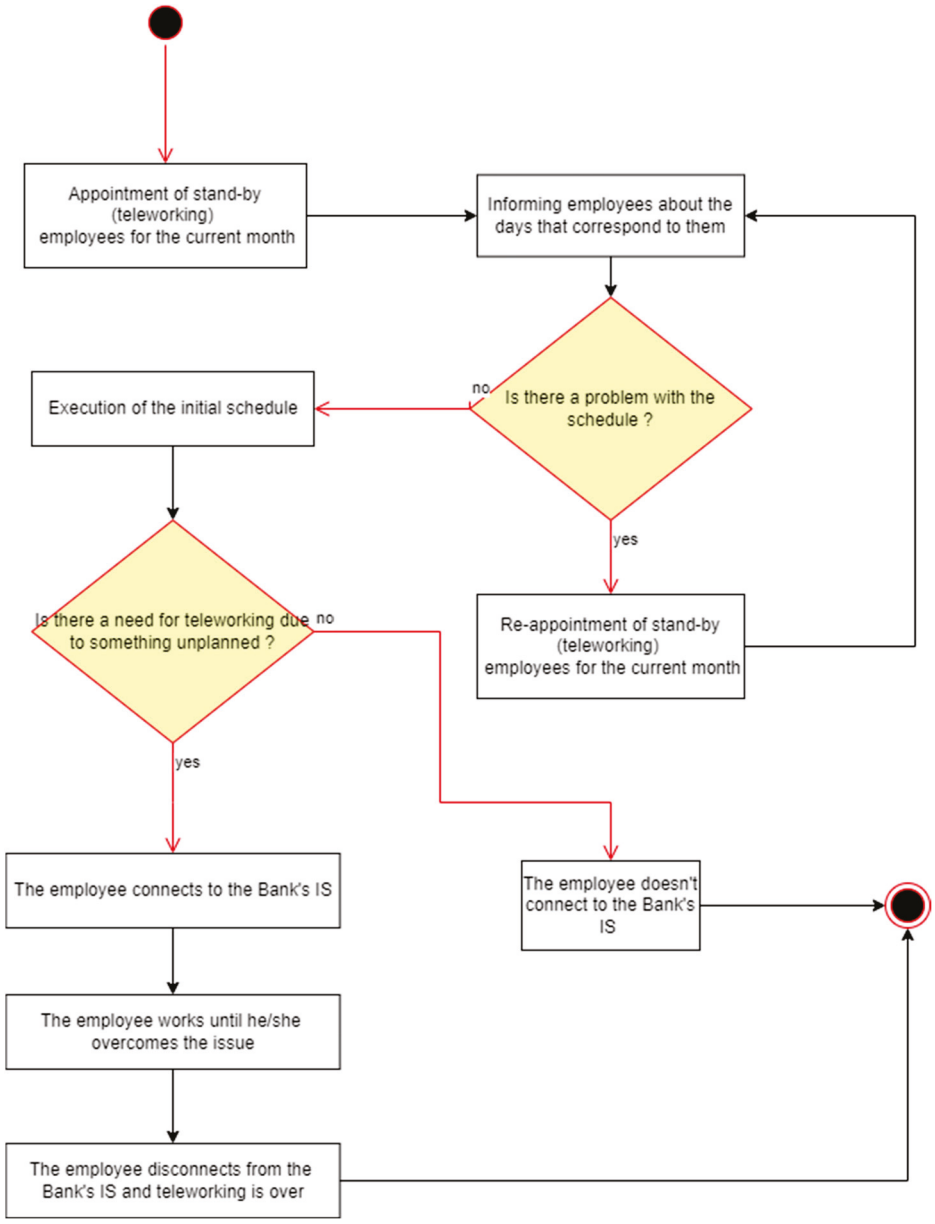

Figure 3. Teleworking scenario before the COVID-19 crisis (UML Diagram).

4.1.3. The Organization during the Crisis (April–September 2020)

Typical day: During the pandemic and quarantine, the employee no longer needs to go to work because they work full time from home. Therefore, it saves transportation costs and time from their personal life. They have the option to choose what time they wake up provided they are logged on to their office computer by 9:30 a.m. Regardless of the position of the employee, at 9:30 a meeting is planned with all the colleagues in their department, which aims to inform and discuss current projects. When this inclination is completed, which lasts about an hour, the employee can return to their daily tasks. Here, it is observed that there is a bigger difference in the managerial positions because all the meetings are now held online and not in person. The schedule formally and officially remains the same, but it is at the discretion of each employee if they want to stay connected longer. At the end of their work schedule, the employee has only to be disconnected from their workstation.

The organization acted in time in the pandemic crisis and started giving the staff of the IT Department remote access, before the massive lockdown. So, the evacuation of the offices gradually began. One member from each group started working from home,

which accounts for about 30% of each department. All employees were asked if they had a personal computer and internet access. Where the latter did not exist, the corresponding supply actions were launched from the bank to the employee (provision of a laptop and USB Drive with internet data) as well as headphones (headset) that block peripheral sounds. Of course, this was true in departments outside of IT, such as the accounting department and the Call Center.

But, in order to achieve mass teleworking for all employees, it was necessary to purchase equipment. So, the infrastructure of the servers was increased, and routers were purchased so that teleworking could be supported by all employees. Of course, it is very important to mention that all the equipment was purchased in twice the amount that was necessary because it is crucial for the bank's operations to be able to support its DR (disaster) infrastructure. All banks and large organizations have DR infrastructures, and these are facilities virtually identical to those of production of each company, which ensures that if something happens to their basic infrastructure from internal or external factors, the operation of the organization can switch to a DR environment without any impact on the customer.

In Figure 4 we see that, after the initial difficulties were overcome and now all employees have access from home, and with the general social uncertainty due to the quarantine and its validity period, a review of the security level had to be made. The IT Security Sector had to ensure that there was no risk of the bank leaking its information to third parties. The Risk Department also revised the Operational Risk for COVID-19. Employees were instructed to be especially careful with their emails to third parties, while increasing the rules for filtering incoming and outgoing emails. As a result, the messages that the system considered suspicious were blocked and examined individually by a security officer upon request. In addition, communication via landlines was abolished, and well-known and paid communication programs were installed, while at the same time, the use of other communication programs in addition to the above was prohibited due to security gaps.

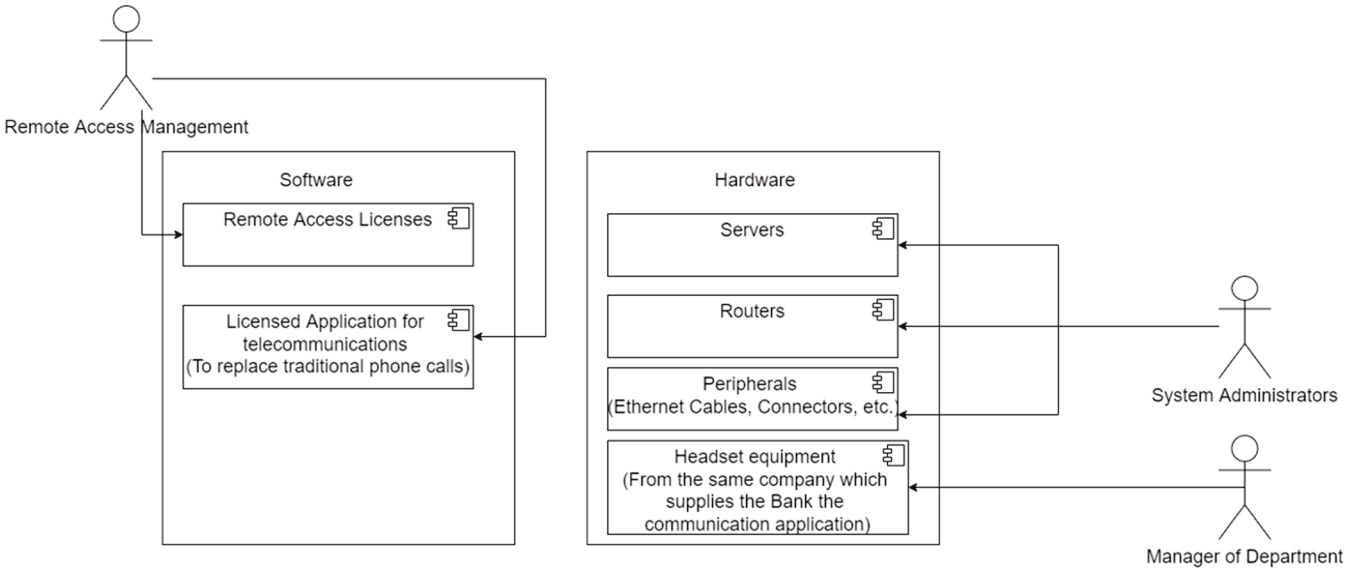

Figure 4. Equipment procurement process before the COVID-19 crisis (UML Diagram).

Finally, with regard to Figure 5, during this period, daily "shifts" were set, and the necessary travel documents were issued by HR. That is, every day, only one employee of each department went to the office so that a computer could be restarted if needed or perform a test that could not be conducted remotely. For example, tests on ATMs and POS. Of course, people in vulnerable health groups were excluded from these shifts, as well as people who could not travel to the office by car. Each of us should go to the office

once every 14 days. Thus passed the days when the pandemic had reached its peak in our country.

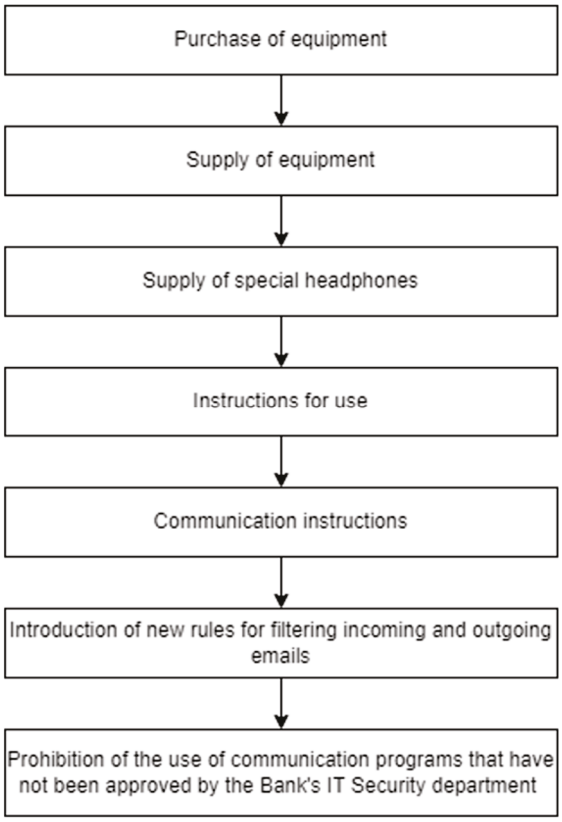

Figure 5. Steps taken by the organization to effectively transition to a teleworking scheme.

At this stage, the following instructions were given for the better organization of the work of the teams:

Communication:

- Every morning from 9:30 to 10:00, a conference call takes place in which the external associates of the bank also participate. The instructions of the day are listed there, any problems that exist and concern the employees are mentioned, but also messages of the management to the staff are announced.
- The 3 h weekly project status report continues through a conference call.
- The time 13:30–14:00 was declared as lunch break time and whoever wanted could enter a predetermined "meeting" and strictly converse with one another about off-topic issues.

Work organization:

- At the end of the day, everyone has an obligation to record in a common Excel sheet what tasks they are going to do the next day. The next morning, there will be a discussion about the tasks that could not be completed (what were the causes, and what measures we are taking).
- Communication groups have been created in a well-known instant messaging application (two for each address, one for staff exclusively, and one with outsourcers). They are widely used for immediate information but also for maintaining good relations between the teams.
- For the time being, there is no need to use extra tools, in addition to what has been mentioned before.

In addition, the following summary instructions were given:

Work style:

- From Monday 23 March 2020 in the office will be only one employee from each department (Cards/ATM and Payments) as security staff. Its main role is to help in case an operation is needed on a colleague's PC (e.g., restart) and to perform test scenarios that cannot be performed remotely (e.g., POS testing). The attendance planning has been sent to everyone and posted on the Portal of the sub-department.
- The employee is advised to use a private means of transportation to travel to work if that is possible, to clean what they intend to use before sitting down and to do the same for what they used before leaving (e.g., PC, keyboard, screen, POS, etc.). Antiseptic bottles will continue to be available in the offices.
- Those who are on telework every morning (until 10:00 at the latest) or for a week at the most, should inform the success factors (SAP application) about their absence with the reason "Teleworking" and comment "COVID-19".
- It is noted that on the day when someone is in the office, they should not declare it as "Teleworking". For the days that the employee will be in the office and having used the traffic certificate that has been issued for them, they must register in the system success factors status "Traffic Certificate/COVID-19". The selection will be open from 24/3 in the morning. The registration must be carried out retroactively if necessary, covering 23/3.
- If someone needs to be absent from "Teleworking", they have to inform their manager first.
- The employee who will be in the office has to update the presentation (physical file) of the outsourcers with the appropriate indication: "T" for Teleworking.

Respectively, the colleague who will be in the office will update the electronic presentation of the department no later than 11:00 based on the attendance plan. In case of change, the heads of the premises must have informed them in time.

Technical Guidelines:

- All PCs in the office must be turned on with closed screens and it is recommended to be in logon mode with the user locked.
- Every morning, those who are under telework status should have connected to their work PC by 10:00 at the latest.
- Phone calls that will be made through the program provided for use by the organization should not be made using video except in extremely urgent cases. An alternative way of communication (chat, voice, video) remains the above-mentioned instant messaging application, in the groups of which everyone must be registered ("Cards Staff" and "Cards All" for one address and "Payments Systems Staff" and "Payments Systems All" for the other). Outsourcers are included in the "All" groups and are preferred for routine issues.
- It is recommended that calls through the communication program be made to the caller's email and not to the call numbers (old landline).
- Everyone should have forwarded the calls from their old landline to their communication plan:
    a. On the landline, we type * 5xxxxxx where xxxxx is the 5-digit call number of our communication program;
    b. The diversion is canceled by entering # 5 on the landline.

General information—instructions:

- The colleague who will come to the workplace should take care to reset the password or passwords he uses.
- Stickers with the name of each colleague have been placed in the offices to facilitate mainly people of operations who will need to visit the site for work. (Do not destroy them and replace them where needed if they are worn.)
- Calls for scheduled conference calls are made to the following collaboration *meeting rooms, as follows:*

a. CMR for Cards/ATM Division;
b. CMR for Payments Division;
c. CMR for Tuesday meetings (project status report);
d. CMR for Thursday meetings (release meeting);
e. Contact IT Datacomm Operations for technical support regarding CMRs.

- The one who will be in the office should take care of and water the flowers of the place.
- The following communication methods are at your disposal for any additional support you may need:
  a. Email group;
  b. Through internal communication;
  c. Through external communication.
- There is an obligation to comply with all the rules of proper and safe use of the digital infrastructure of the group, including those of telework/work at home (remote access), collaborative tools, email on mobile devices, etc.
- All the instructions that have been issued from time to time will be posted on the portal of the respective COVID-19 instructions.
- All staff must strictly follow HR instructions.
- In order to provide immediate support to our colleagues who need medical advice and guidance, in cases in which they are experiencing symptoms or their family members or members of their working group, a new Helpline has been created, to which a specialized team of doctors responds.

And the most important instruction: "We stay at home".

Furthermore, it is worth noting that every employee had to update the bank's Enterprise Resource Planning (ERP) system on whether they work from home or the office. The ERP is a software system that can manage all the business operations, targeting the increase in business performance. In addition, business trips were stopped, even in the international department, and whoever traveled abroad for personal reasons, upon their return, automatically entered the teleworking regime for a period of at least two weeks.

4.1.4. The Organization after the End of the Outbreak Phase of the Pandemic

On a typical day after the end of the outbreak of the pandemic, a mass return to the office and working from home on certain days of the month is foreseen, such as, for example, three weeks of the month working in the office and one week of the month teleworking. Of course, the teleworking week from home will not be common for all employees, but it will be defined by alterations, e.g., 25% of employees will work the first week from home, 25% the second, etc. In addition, the employees who will work from home will not all belong to the same sub-department.

Through the unprecedented situations that came with the COVID-19 crisis, many companies were called upon to achieve in a short period of time digital transformation steps that would otherwise take months or even years to implement. As a result, from the height of the pandemic until today, when measures are gradually being reduced, almost 20,000 people have left their offices in Greek banks and are working remotely (EFSYN Artemis Spilioti 2020). According to the organizations' own reports, a total of 5,000 employees worked remotely (37.5%). The infrastructure was set to withstand up to 4,000 simultaneous users and at the peak of the pandemic it had reached the maximum of its capabilities. In all, the organization was completely satisfied since the digital transformation was completed with absolute success. It is stressed that for the entire banking sector, much of the successful response to the new conditions is due to the fact that Greek banks had already invested huge sums in their digital transformation and the creation of new digital products. During and after the quarantine, new active customers increased by 114% compared to the same period in 2019 and by 50% compared to February 2020. Ultimately, 31 March 2020 was the day with the highest use of digital channels. At the end of March, there was an increase in e-banking by 40% in users and by 20% in transactions (compared

to March 2019), while in the bank's mobile app, there was an increase of 60% in users and 80% in cash transactions (EFSYN Artemis Spilioti 2020). New customers have an increased proportion of "viewers only", as they are unfamiliar even because older people want to be informed about whether the pension came in and what money they have left.

At the technical level, the organization has as a plan and goal for the next five years, to "upload" all the Windows profiles of users (terminals) in a private cloud so that they can be used from anywhere in the world. Even when employees go to the office, they will use the computers that will be there to connect to a virtual desktop that will be located somewhere remote. There is a need for the above to happen because the new COVID-19 virus has introduced a new reality to the business work environment internationally and locally, without knowing when and if we will return to the pre-virus era. In addition, after completing the digital transformation and addressing the difficulties, the bank found a reduction in its operating costs such as electricity, equipment wear and tear, and the daily facilitation costs of its employees, without reducing employees' productivity. Unfortunately, at the time of this study, not enough time had passed since the pandemic so that we could compare operating costs and wear and tear with the situation in the corresponding months of previous years, before COVID-19. However, we can compare the expenses of the company to the convenience of its employees. These include the allowance of an amount (depending on the position of the employee in the agency) for the purchase of fuel. This was reduced for each employee by a percentage of 40% of the amount awarded.

As mentioned above, the bank intends to "upload" all Windows user profiles (terminals) in a private cloud so that they can be used from anywhere in the world, within the next five years. The planned teleworking scenario in the banking institution after the onset of the COVID-19 crisis is depicted in Figure 6.

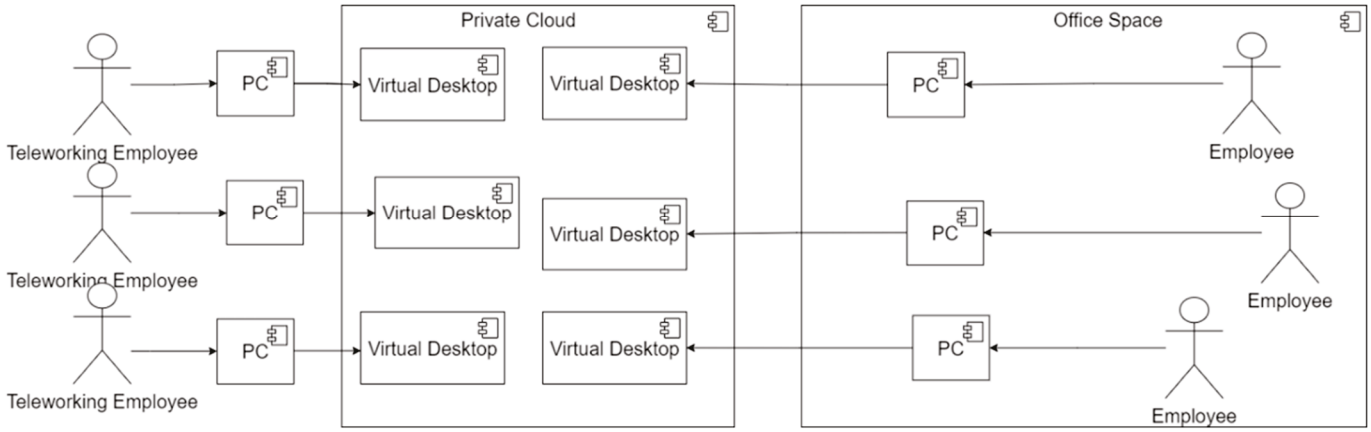

Figure 6. Teleworking scenario after the onset of the COVID-19 crisis (UML Diagram).

According to this scenario, when the employee goes to the office, they will not use their own personal computer at work. Instead, they will use "shared" desktops or "workstations" to connect to the virtual desktop staff, which will be located in a remote private cloud. Similarly, when working in a telecommuting mode, they will use their personal computer to connect to the same virtual desktop. This reduction in computer and peripheral equipment, such as mice, keyboards, monitors, etc., is expected to be beneficial to the company's finances because we must also add the reduction of electricity costs and other operating expenses and benefits to employees to the above equipment reduction (reduction in the amount provided for the purchase of fuel), and of course the saving of space in its facilities.

4.2. Semi-Structured Interviews

Following the autoethnographic recording of events, we conducted interviews to collect further primary data. More specifically, through a discussion and a personal interview

with employees of the organization, information, and views were gathered on telework, the problems and difficulties encountered, and also on the advantages of this new reality.

4.2.1. Sample Characteristics

Extant research suggests that what is determined as an appropriate sample size for one qualitative study is not necessarily an appropriate sample size for another qualitative study (Guest et al. 2006; Leese et al. 2021). However, although this remains true in the context of IS studies—where sample size (and the number of interviews conducted) has a subjective nature—it has been noted that for qualitative IS research to gain wider acceptance relative to quantitative research, rigor in sample size determination is critical (Marshall et al. 2013). However, it is also essential to acknowledge that in the context of qualitative research, "it is not the number of cases that matters, it is what you do with them" (Emmel 2013; Chitac 2022).

Saturation is widely accepted as a methodological principle in qualitative research (Vasileiou et al. 2018), which is commonly taken to indicate that, "on the basis of the data that have been collected or analysed hitherto, further data collection and/or analysis are unnecessary" (Saunders et al. 2018). Adhering to the concept of saturation can ensure credibility and quality in qualitative research, as well as conserve time, energy, and budget expenses (Rahimi 2024). Saturation is considered a key methodological concept in qualitative research that is used as a criterion for discontinuing data collection and/or analysis (Leese et al. 2021). Accordingly, it is often used by qualitative researchers in making decisions related to the adequacy of their sample size (Francis et al. 2010). Moreover, the quantity of data (or number of interviews) is not necessarily theoretically important to achieve saturation across all qualitative approaches (Leese et al. 2021). Furthermore, it has been acknowledged that saturation in qualitative research is context dependent (Saunders et al. 2018; Rahimi 2024).

In the present study, we performed in-depth, semi-structured interviews with a representative sample of employees in the banking institution, as a small number of interviews can produce data capable of addressing a set research goal, selected with careful sampling and a thorough collection technique (Holloway 1997). Furthermore, following the theoretical saturation rule of qualitative research, we sampled until no new information or insights were produced—also exceeding ten cases, consistent with the suggested valid range of case sampling (Eisenhardt 1989). Our approach was also in line with the suggestion that the best and most rigorous justification for sample size of interviews in IS research emerges with statistical demonstration of redundancy in codes (saturation) (Marshall et al. 2013). At the same time, it was also in line with existing insights that suggests single case studies should generally contain 15 to 30 interviews in IS qualitative research (Marshall et al. 2013). Moreover, it is also in line with the fact that, according to a recent review of published qualitative work, studies using empirical data—and particularly those with relatively homogenous study populations and narrowly defined objectives—reached saturation within a limited number of interviews (9–17) or discussions (4–8) (Hennink and Kaiser 2022).

The sample of respondents was limited by the fact that personal interviews were conducted with the employees. Nevertheless, it is evident that the interviewees come from several hierarchical levels and work in technical, advisory, or administrative positions. Therefore, as is logical in the conclusions of some questions, there is a distinction between those who perform purely technical tasks and those whose role is administrative or advisory. In Table 2, the size of the sample (15 employees), their position in the company that falls into 4 different categories (manager, software engineer, software analyst, and business analyst), their gender (man, woman) and the level of education that have (Bachelor's degree, Master's degree, Ph.D.) can be reviewed.

Table 2. Interviewees' sample characteristics (N = 15).

	Category	N	%
Age	25–35	4	26.7%
	35–50	8	53.3%
	50+	3	20%
Position	Manager	2	13.3%
	Software engineer	7	46.7%
	Software analyst	4	26.7%
	Business analyst	2	13.3%
Sex	Male	11	73.3%
	Female	4	26.7%
Education	Bachelor's Degree	8	53.3%
	Master's Degree	7	46.7%

The largest portion of the surveyed employees were men (73.3%), and/or aged 35–50 years (53.3%), followed by those aged 25–35 years (26.7%), and those aged > 50 years old (20%). Almost half of the respondents are employed in software engineering (46.7%) or are software analysts (26.7%), and hence perform exclusively technical tasks during the day. Finally, half of the respondents have completed their undergraduate degree and the rest are currently completing their first or their second postgraduate diploma.

4.2.2. Results from the Semi-Structured Interviews

In this section, the recorded insights we collected from the semi-structured interviews is provided in a per-question mode.

Question #1: Was this your first time working in telecommuting mode or using solutions that allow you to work remotely?

Most employees had never worked in a teleworking state (9/15). Nevertheless, there were many (6/15) who have worked away from the office before, because due to their role, they already had access to their workstation, but also to the bank's systems. In fact, one of the interviewees was part of the pilot program that was mentioned in a previous part of the paper, during which they worked full time from home for a week every month.

Question #2: What was your personal experience from teleworking? (Describe your experience of using teleworking.)

Most employees identified both positive and negative characteristics of teleworking. More specifically, many argue that the following are classified as positive (11/15):

- More and better work;
- Save time on a daily basis for transfer to and from the office;
- Fuel savings due to not moving to the office;
- Comfortable working conditions in my personal space without the noise and interference from the conversations of colleagues;
- Freedom in working hours;
- Fewer meetings and unnecessary travel inside the premises since most meetings had been canceled or replaced by conference calls;
- All of the above helped towards greater productivity at all levels;
- Completion of the basic activities every day, resulting in more free time, if there was not an emergency at that time;
- Good telework organization and a sense of security due to less travel.

The following are classified as negatives (15/15):

- The power supply, the Internet, and the use of a personal computer are borne solely by my own financial budget and not by the company I work for. Abroad, the "bring your own staff" service is paid very expensively, while in the case of the company, it passed as something logical, self-evident, and even inevitable without any reference to covering these costs.

I believe that telework loosens working ties and that, as a result, any possible future decision to terminate a business partnership now becomes a formal procedure simply by terminating the employee's access to the bank's systems. This condition, if consolidated, can create an employment status that the working community is not yet ready to accept in Greece.

Finally, it is worth noting that colleagues with children stated that they had to adapt to working conditions with more noise due to the fact that there were small children in the house.

Question #3: What were your daily activities at work? Did they change due to working from home?

In general (13/15) the content did not change; nevertheless, the way and the intensification of contact with the team of each department changed. It is worth noting the difference in responses between technical and administrative roles. More specifically, the people (2/15) who hold an administrative role in the organization said that their daily activities included physical meetings, which were replaced through a digital platform. This change is characterized as positive, as according to them, there was a greater consequence from all involved in terms of the start and duration of each meeting. This differentiation did not affect the efficiency of the respondents' work as the projects were progressing in a satisfactory time and there was great flexibility through the use of computer and mobile in a large number of tools used by the company.

Regarding the technical positions (computer programmers), everyone stated that their activities through teleworking did not change and remained exactly the same.

Question #4: How easy was it for you to adapt to the system and the new way/working conditions? What problems did you face?

Due to their role, many employees (6/15), as mentioned above in question 1, already had access to their workstations and the bank's systems from home long before all remote work was activated. This helped them adapt to the new working conditions in almost no time without any problems. In addition, the majority (14/15) of employees stated that adapting to the system and the new way of working was easy. However, there were technical and procedural problems related to the adaptation of employees to the new working conditions. Some of them are, for example, a small computer screen (1/15), which, as we were told, had not been bought for work but was also used when experiencing slow network problems because the home network was also used by the other members of the family for their own participation in taught lessons.

Additionally, one of the problems that arose was that some employees had to spend most of their day (10–12 h hours, as well as their personal time) in front of a computer screen, something that did not happen in the office because they often had to go to other buildings and talk in person with their colleagues.

Question #5: Was it easier or more difficult to fulfill your daily obligations, in relation to working in the office?

For many employees (5/15), completing their daily tasks was much easier than working in the office, as working conditions at home were and are much better than those in the office. Phenomena such as frequent breaks to engage with questions/answers from colleagues, and even the observance of a specific dress code in the case of working from home do not exist. A smaller portion of employees (3/15) argued that working from the office is easier because there is direct contact and there is no need to resort to calls and emails. Finally, there were several employees (7/15) who stated that the difficulty or ease of performing daily activities did not change.

Question #6: Have your working hours changed due to the situation? Did you work the same number of hours in teleworking mode (more/less/same)?

Working hours from home were longer than working in the office (11/15). The following facts helped:

Working conditions at home allowed work to continue until the late evening hours, as obligations that in the past had to be performed immediately after working hours and

were time sensitive (such as grocery shopping before the stores were closed), during the period of teleworking took place remotely.

- During the period of quarantine and traffic restrictions in Greece, there was no option to leave the house without a valid reason and without a SMS message stating the reason being sent first. Also during this period, all shops, cafés, restaurants, shopping malls, and cinemas were closed. As a result, the employees stay at home and at the same time continue to work late into the night on a daily basis. This was possible since all employees had access to their work files constantly. Finally, the extra working time in which the interviewees worked was basically the time they saved daily from their commute (1–2 h), something that they reported as very positive many times during the course of the interviews.

Question #7: Did you keep your regular working hours in teleworking or did you work different hours? Did you have time for extra activities?

From the majority of the answers (10/15), it is understood that a large percentage of the employees in the teleworking state did not just work during their regular working hours. Their working hours were extended by about 30% compared to office work. The reasons for this change in working hours were mentioned above. Despite the increase in working hours, however, it is observed that there was generally a little more time for additional activities, mainly due to the "profit" from not moving to and from work.

As for the managerial positions, due to these circumstances, it was not possible to maintain a regular working schedule. The need for multiple remote meetings did not allow work at different times. However, there were times, even after the end of the working schedule, when several issues had to be progressed via email due to the increased volume of issues to be resolved.

Question #8: Do you generally prefer teleworking to traditional on-site work? If yes/no, for what reasons?

Due to the variety of answers, two main conclusions can be drawn.

(a) Slightly less than 1/3 of the respondents, i.e., (4/15), prefer teleworking to working at the organization's facilities, for the following reasons:
   - Time saving: specifically around 2 h daily commuting to the company's facilities;
   - Savings on fuel due to not driving to the office;
   - Comfortable working conditions in the personal space of each person without distractions to concentration from other employees;
   - Flexible working hours;
   - Fewer meetings and less travel inside the buildings, and their replacement by conference calls;
   - Higher productivity and faster completion of activities.

(b) About 2/3 of the respondents, i.e., (11/15), do not prefer permanent teleworking but they would like teleworking to exist as an option. It would be a good measure if it was applied on rotation with working on the premises. As a result, employees will be able to take advantage of working from home whenever they want for a few days each month. This would save time moving to and from the organization's offices. An alternative scenario that also emerged from the respondents' answers is that there could be a middle ground where they would be working maybe half the month from home and the other half from the office. That way, they would not lose touch with colleagues and their offices. In this way, employees would better balance their working time and personal time, which would be of particular benefit to working parents who would have the opportunity to supervise their children.

Of course, it should be noted that in the above there is a risk of having two-speed employees, where some of them need to work overtime in order to cover for the overall performance of the team in which some members take advantage of teleworking and underperform. In general, despite the increase in efficiency through teleworking, concerns are reported regarding the exclusive use of the latter, such as:

- Difficult communication with other sectors is significantly delayed;
- Gradual change of culture in all the staff in this direction. This is not the case today, making cooperation difficult and time consuming in many cases;
- There is alienation between colleagues that in the long run will create communication and trust problems with an impact on the workplace.

Question #9: Would you be willing to take advantage of teleworking in the future if you had the option to do so? Why?

Based on the answers of the respondents (15/15), it can be said with confidence that all employees would take advantage of teleworking, as it is not an obstacle to the immediate execution of their professional duties and provides them with more time at home. Especially for employees with families and young children, it allows them to supervise them when they return from school or, if they are at home, to work from the comfort of their own house, and to avoid the time of preparation and transportation.

Question #10: Would you like to work permanently in teleworking status if you had the choice? Why?

Most of the employees would not like to work permanently in telework (11/15). More specifically, there is a belief that working remotely on a permanent basis loosens work ties and results in the loss of personal contact with colleagues. For most employees (11/15), interpersonal relationships are important both for cooperation and for avoiding alienation. In addition, there are various tasks for which the employee must be present (rollouts, production problems, etc.). In addition, with the physical presence of the team that cooperates in the same space, each employee can react to an issue that concerns them and be informed more directly compared to whilst on a teleworking status.

Question #11: How was your performance during the telework? Better or worse? For what reasons?

Most employees (9/15) noticed an increase in their efficiency and productivity. More specifically, the results were obvious, not only at the individual level but also at the level of the whole team. The lack of lost hours when attending and leaving meetings (at least half an hour lost in each meeting for off-topic discussions) was a very important element. Also, the fact that there were no external factors such as noise to distract employees was an additional positive element that contributed to the qualitative and quantitative improvement of employees' work.

Question #12: If you communicate with customers as part of your duties, how did they see the level of service you provided to them when you were in teleworking status compared to before (better/worse/same)?

Due to the fact that the respondents do not communicate with external partners themselves (9/15), we had to rely on a survey conducted regarding the satisfaction of customers with their service during teleworking. According to a common confession of the employees who were informed about the results of the survey (6/15), there was absolutely no difference in the level of service provided by the organization compared to before. Maintaining the level of customer service is very important especially in times of crisis like the one that occurred with the pandemic.

Question #13: What did you miss most (from your job) while working in telecommuting?

Primarily (12/15), the respondents were missing personal human contact with their colleagues, whether it was during work or a break. According to the employees, interpersonal contact is what builds the teams and is the biggest disadvantage of teleworking.

Question #14: What do you think is the best and worst feature of teleworking?

Interpretation: Admittedly (15/15), the biggest advantage of teleworking is that employees save time from commuting to and from the office as well as comfortable working conditions in their personal space (see Figure A14 in the Appendix A). The biggest benefit of the above is the better utilization of time and the reduction of work-related time, as the time of traveling to the facilities of the organization is eliminated. On the other hand, the biggest disadvantage is the transformation of work into an impersonal situation. This

means looser bonds between colleagues, and the interpersonal contact between employees is lost. This translates into difficulty in communication and small delays in activities that require cooperation, difficulty in understanding and accepting common goals, and, of course, more difficult integration of new entrants.

Question #15: Are you worried about the future of your job after the crisis? Please explain.

Respondents are not so worried about their own work (8/15); however, they are quite concerned that important sectors of the country's economy are affected, a fact that can gradually affect many social groups. More specifically, they state that the crisis has reached the brink of impoverishment for low-income people and that the blow to tourism, which is the country's most important industry, will affect the global economy in the long run. In addition, many believe that telework has come to stay. It will initially be piloted with a small percentage of employees (I estimate 25%, initially) and, over a 5-year period, will be implemented to all employees. Led by the big computer companies of America, which in the guise of "innovation" will adopt distance work purely for financial reasons, the activation of telework will be launched to all employees, mainly of lower working ranks. Although such a development is not in the interest of the workers of the developed countries, it does not cease to help the workers of the developing countries. It makes sense that large IT companies prefer to pay 10,000 employees who work from their personal computers at home every morning in India, South Africa, Europe, or Latin America rather than pay 10,000 employees and the costs of the buildings that will host them every morning.

In addition, there are concerns that a change in the level of insurance contributions from companies to insurance funds or insurance companies around the world will inevitably follow, with this being possible at all levels of everyday life. For example, a conglomerate would certainly prefer to cover an employee's insurance premiums in Bombay, for example, than to cover the extremely high insurance premiums of an employee in an expensive area of California.

Question #16: How optimistic/pessimistic are you generally about your job after the crisis? Please explain.

Most respondents are not particularly worried about their jobs and are optimistic about the future (9/15). On the other hand, there are respondents who stated that they are moderately optimistic (3/15), due to the problems and risks mentioned above not only for Greece but also for the international environment.

Question #17: What do you think are the benefits of working in teleworking status for at least three days a week for the next three months?

In general, the advantages mentioned by the respondents are about the same. All (15/15) are concentrated on saving travel time, the most relaxed working environment, the better concentration at work due to lack of distraction, the flexibility of working hours for the employee, the better organization of time according to the program, as well as the reduced risk of transmitting the virus. Employees do not need to spend money and time commuting to work, as well as money for coffee and food from shops daily. Finally, added to the above advantages is the contact with colleagues and the maintenance of the sociability of the employees since teleworking would not be of concern all days of the week.

Question #18: What do you think are the disadvantages of working in telecommuting for at least three days a week for the next three months?

Most of the employees (12/15) reported that there may be a lack of direct communication. Nevertheless, there is generally a positive reaction to teleworking for certain days of the week (15/15). This is mainly because the work method is a combination of office work and working from home. This way, employees do not feel that they will lose contact with their colleagues and the office. Instead, they consider the hybrid method the best way to have a change of scenery during the working days.

Question #19: What else comes to mind when you think of working telecommuting for at least three days a week for the next three months?

Many respondents (5/15) believe that this combination will be the ideal solution and that they will enjoy more relaxation, flexibility, and time for themselves. Nevertheless, there is a general concern about who will cover the fixed costs of electricity, Internet, and possible damages to personal computers after continuous use (3/15).

Finally, one respondent stated that they would like this mixture of office work and work from home to be under a normal situation, as in extreme situations there is emotional tension that can affect the behavior of the employee and those around them (family, partners, and friends). More specifically, during the period of quarantine and restriction of movement, the demands were increased for teleworkers who had to satisfy the needs of their children, i.e., help them with school-related tasks and, at the same time, help vulnerable groups, like their older parents, with grocery shopping, etc., so they would not have to go out themselves.

Question #20: Please list any factors or circumstances that would have facilitated or made it possible for you to work in telework mode for at least three days a week for the next three months.

Most of the respondents (11/15) want the company to provide additional compensation for teleworking, since the employee provides the company with their own means (internet connection, computer, office space, and equipment), while from the employment contract, it is stated that the means of providing the work are provided by the company. Otherwise, respondents want the company to offer the needed equipment in order to perform their work efficiently.

In addition, respondents want to have remote access to all the tools they use in the office in a satisfactory response time, to have a way of evaluating the performance of each employee as a whole in the team, to not consider teleworking a privilege, to be able to manage time between work and other activities, as well as to comply with the basic rules set out in the new way of working. Some examples are for everyone to return calls, be consistent with the meeting schedule, and not affect employee productivity.

Question #21: Please list any factors or circumstances that would make it difficult for you or prevent you from working in telework mode for at least three days a week for the next three months.

Some key factors that would make it difficult for employees (15/15) are the low quality of equipment, the difficulty in communication, and, of course, the slow response to possible problems. The lack of all the factors mentioned in question 20 would make it difficult for employees, as they would have to offer their work to the organization with their own means and expenses. This refers mainly to equipment because every employee has bought a laptop for personal use, to cover expenses, and losses, because after systematic use, the machines will need maintenance, but even if they are missing, employees would like the allotment of additional compensation.

In addition, for employees who are in the process of training, it is reported that teleworking is likely to complicate their training due to the need to observe other colleagues and build relationships as new members of a team.

4.2.3. Summary of Results

Our results were based on comparing personal experience with the experience of other employees and, according to our analysis, they were found to be compatible. Through interviews with employees, this study captured firsthand accounts of teleworking experiences, allowing for a deep exploration of individual perspectives and concerns. Crucially, the findings from personal interviews were found to align closely with existing evidence from the literature, highlighting a high degree of compatibility between individual experiences and broader trends. For example, respondents' concerns regarding equipment and electricity costs mirrored similar sentiments expressed in prior research. Similarly, the positive impact of telework on flexibility and work–life balance, as reported by interviewees, resonated with the existing literature on the subject. By combining personal experiences with the

experiences of others, this study offers a holistic understanding of telework dynamics, enriching our knowledge base and informing future research and practice in this area.

In general, it is understood that all respondents are positive about the telework status (100%). Nevertheless, they do not stop thinking about its disadvantages, such as the burden of their expenses related to telework and their distance from the rest of their colleagues. More specifically, in a large part of the respondents (80%), what was most lacking during the permanent work-from-home period was contact with their co-workers, whether it was direct communication about a professional issue or a personal issue or some discussion during the employees' break so that they can rest and "get away" for a while from their work. For this reason, most (73.33%) prefer teleworking as an option so that they can adjust the days they will work from home. This way, they feel more freedom and flexibility when working away from the office, and, in addition, they feel that they can better organize their time so that they have time for other activities or responsibilities. Employees who have young children prefer the hybrid model of telework since they can supervise them when they return from school, while at the same time performing their daily activities. Here, it should be emphasized that an important role in the release of hours during the day when employees work from home is the lack of hours commuting to and from the organization. The majority (73.33%) of the respondents need 1–2 h traveling to and from the office.

An important part of the results is the efficiency of the employees in the teleworking regime. More specifically, many (60%) reported an increase in their efficiency because they were more focused, without interrupting their work for non-professional discussions or being distracted by external noises. The level of customer service remained just as high, which in itself reflects the success of the organization's digital transformation, as the period under review in this study was a crisis for many companies. Most respondents are satisfied with their qualitative and quantitative productivity, as they completed their work faster every day, especially those who did not need employees to communicate with each other. For the above reason, there is a belief (about 30%) that the teleworking regime has come and will remain, even to a lesser extent than during the quarantine period, such as, for example, 5 days a month working from home.

The following table (Table 3) summarizes and thematically aggregates the insights recorded. The first column contains the main respondents' comments and the second is the percentage of agreement. Moreover, a more detailed graphical representation of the attained results (in the form of pie charts and bar graphs) can be found in Appendix A.

Table 3. Summarized and thematically aggregated insights.

Respondents' Main Comments	N (%) Agreement
Lacking contact with co-workers during telework	12/15 (80%)
Positivity regarding telework	15/15 (100%)
Establishment and maintenance of teleworking as an option	11/15 (73.33%)
Need for 1–2 h daily commuting when not teleworking	11/15 (73.33%)
Increase in efficiency during telework	9/15 (60%)
Belief that teleworking will remain to some extent	5/15 (33.33%)

5. Discussion

Having explored existing evidence from the literature, in the present research we formulated the research questions: (a) What is the effect of teleworking on employee productivity?; and (b) Do its advantages outweigh its disadvantages?

Reviewing existing insights from recent studies in the context of the COVID-19 pandemic, we found that the main suggested considerations with regard to the widespread application of telework are regarding:

- *Organizational issues*, including work performance (Ficapal-Cusí et al. 2023; Mirowska and Bakici 2023); employee–supervisor relationship (Park et al. 2023); issues with communication, trust, control, and productivity (Fontaneda et al. 2023), especially

in the context of banking institutions (Meyer et al. 2022); the need to reform organizational processes (Yanagihara and Koga 2023); focus more on cooperation than subordination and increasing autonomy (Junça Silva and Coelho 2023; Stanciu et al. 2023); need to reform organizational culture to fit the telework model while focusing on trust equality and confidentiality (Junça Silva and Coelho 2023; Mirowska and Bakici 2023; Bayazitova et al. 2023); and re-structure organizational benefits policy to fit the telework model (Brandão and Ramos 2023; Fontaneda et al. 2023), as well as utilize flexible working hours (Dimian et al. 2023).

- *The effect of telework on employees' emotional status and work–life balance*, including the need to focus and alleviate issues with the social consequences of teleworking in the form of stress and/or technostress (Goñi-Legaz et al. 2023; Dimian et al. 2023; Gualano et al. 2023), and techno-isolation (Goñi-Legaz et al. 2023); the effects of telework on the workers' social lives (Stanciu et al. 2023); work intensification during telework (Rebelo et al. 2024); feelings of unfairness on behalf of the employees not teleworking (Lee and Gascó-Hernandez 2023; Krajčík et al. 2023; Fontaneda et al. 2023); a decreased need for commuting that leads to time saved for personal life (Rebelo et al. 2024); and a general preference for part-time/hybrid work model rather than full-time teleworking (Krajčík et al. 2023). These effects have partly been reported as moderated by employees' demographic profile in terms of gender and age (Raišienė et al. 2023), or—in the case of banking institutions—employees' position in the organization and level of remuneration (Uford et al. 2023), as well as the level of intensity of telework imposed (Chambel et al. 2023).
- *Issues revolving on the implementation of telework and the utilization of IS (information systems) and IT (information technology) means,* including allowing for the co-presence of employees (Taskin et al. 2023), as well as monitoring and tending to employees' technostress in telework scenarios (Fernández-Fernández et al. 2023; Raišienė et al. 2023), the need to focus on the effects of utilizing technology to telework on parameters revolving around employees' well-being (Santos and Pereira 2023), and—especially more so in banks—the need to focusing on IT and IS security issues during telework (Sparks 2020), as well as the effect of country/context-specific nature of banking on telework characteristics and application scenarios (Sousa-Duarte 2022).
- *Work–life conflict during telework scenarios,* which may lead to effects such as exhaustion, decrease in job satisfaction, and work performance (Weinert and Weitzel 2023), the effect of technology utilization in telework scenarios on employees' work–life balance (Gonçalves et al. 2021; Andrade and Lousã 2021; Alassaf et al. 2023), the moderating effect of IS and IT on the relationship between telework and employees' emotional and organizational response (Koga 2023) and issues of privacy (especially for banking employees) (Öcal 2021).

Bearing the above in mind, and reviewing our findings, we accordingly find that our research results point out that teleworking indeed increases employee productivity in the Greek banking sector. We found that telework was well received by employees of different ranks and educational backgrounds, and especially by parents with young kids, who were able to spend more time with them while working from home. In line with reported evidence in past studies (Dimian et al. 2023; Weinert and Weitzel 2023), everyone in our sample had mainly pleasant things to say about remote working, which helped them have a better work and personal life balance during the COVID-19 pandemic. The only negatives noted were in regards to the support they received from the organization in terms of the non-coverage of their work-related expenses, such as the provision of a laptop and the extra cost incurred for electricity/internet. Moreover, the vast majority of the participants in this research reported that during telework they became more productive and the advantages of teleworking, such as avoiding daily commuting to the office, outweighed the disadvantages and the minor inconveniences. This is something that was observed in previous studies we have reviewed, as it is observed that employees who work from home can return about half the travel time to the company in the form of longer working

hours and thus be more productive. In essence, employees see great value in teleworking. Avoiding their daily commutes and investing this "lost time" back into their families, friends and personal activities is priceless for them. On the other hand, the suggestion that "teleworking is the best option for everyone involved", as the literature may have suggested, was partly rejected since many interviewees stated that they wanted to come back to the office and be able to work in person and socialize with their colleagues, even if it is just for a couple of days every now and then. Therefore, as already suggested in the extant literature (Antunes et al. 2023), 100% telework is not for everyone. Most of the employees who were interviewed in this study also stated that by working remotely they were able to organize their time better and be more productive. Furthermore, the freeing up of their time from commuting helped them relax more and see an improvement in their mental health. Summarizing, it is suggested that, in line with existing insights from the literature (Gualano et al. 2023), organizations should listen to their employees and give them the freedom to choose the working format that best works for them, which is either full teleworking or a hybrid model, in which employees could choose their own days to come into the office. Additionally, they should invest in making teleworking accessible to everyone that could successfully complete their tasks, regardless of their position or role in the company.

Going back to our second research question, it is observed in both our research and existing findings in the literature (Caraiani et al. 2023) that if organizations can create a good environment and culture for those employees who are willing to work remotely, the positive outcomes seem to outweigh the negatives by a large margin.

5.1. Theoretical Implications

Examining the aforementioned findings in our study, we find that they tend to support the evidence in the existing literature. As mentioned in the existing literature, in some cases employee morale and job satisfaction had increased due to increased flexibility in location and working time (Tavares 2017). This was confirmed in the present survey as the majority stated that they would like teleworking to remain an option because it offers them flexibility, saves time spent commuting, and increases quality time with their family. On the other hand, it is evident from both the existing literature, as well as our study findings, that teleworking tends to negatively affect teamwork. More specifically, about 90% of the respondents in a virtual office sample in a past study (Hill et al. 1996) and 100% of the respondents in the present study stated that communication with associates was less effective than in the traditional office environment, especially when there were tasks that required collaboration or operated in a chain and the work of one team member affected the others.

According to existing evidence, working from home provides more flexibility in place and time of work, as well as offering a quiet environment in which no external noise interferes (Tavares 2017). Consistent with the previous literature (EFSYN Artemis Spilioti 2020; Kijsanayotin et al. 2009; Nzembayie et al. 2019), our study underscores the positive correlation between telework and increased employee morale and job satisfaction, primarily attributed to the enhanced flexibility in work location and schedule. In our interview sample, all respondents answered that the most positive features of teleworking are comfortable working conditions, flexibility in position and working time, and more concentration at work without frequent distractions. Regarding the factor of balance between work and personal life, existing evidence from the literature is mixed (EFSYN Artemis Spilioti 2020; Musante and DeWalt 2002; Eisenhardt and Graebner 2007). Some suggest that the flexibility of teleworking is what employees need to balance work and home responsibilities; that is, to organize their time and perform more non-professional activities, as well as to have more time for their family but also for supervision of their children (Tavares 2017). Others report that working from home has the potential to blur the line between work and home. The latter observation may also be related to the factor of working hours (Tremblay et al. 2006). Our findings seem to support the latter position, as

most of the respondents reported an increase in working hours and the replacement of their commuting time at the organization's facilities with additional working hours from home.

We stress that the aforementioned theoretical findings constitute a contribution to the existing literature, as existing evidence specifically targeted toward banking institutions is sparse, if not non-existent. Therefore, we contribute to existing theory by adding insight into the reception of telework by employees in banking institutions and confirming or refuting similar insights from studies performed in different contexts.

However, our study also highlights the challenges associated with telework, particularly in terms of its impact on teamwork and communication. Building upon the existing literature (Taskin and Edwards 2007), our findings also reveal that teleworking tends to hinder effective collaboration and communication among team members, especially in tasks requiring close coordination or operating within a chain. This aligns with prior research indicating that the absence of face-to-face interaction can impede workflow efficiency and team cohesion.

Most importantly, our research contributes to filling a critical gap in the literature by providing targeted insights into the reception of telework within banking institutions. By focusing on this specific context, we offer valuable contributions to existing theory, enriching our understanding of the unique challenges and opportunities associated with telework adoption in the banking sector. Through our findings, we confirm and extend insights from studies conducted in different contexts, thereby advancing our knowledge of telework dynamics in organizational settings.

5.2. Practical Implications

Apart from their theoretical contribution, the findings from this study can also find practical application in organizations. Banking institutions could directly utilize the collected insights to make teleworking schemes more efficient for both the organization, as well as its employees. By directly applying the collected insights, banking institutions can enhance the efficiency and effectiveness of their teleworking schemes, thereby fostering greater employee engagement and satisfaction. Based on the findings from the interviews, an important step towards keeping the employees engaged and satisfied in participating in teleworking scenarios is the coverage of equipment and electricity costs.

One crucial takeaway from the study is the importance of addressing equipment and electricity costs associated with teleworking, a finding that is also in line with previous research (Kijsanayotin et al. 2009). As revealed in the interviews, employees perceive coverage of these costs as essential for maintaining their engagement and satisfaction with teleworking arrangements. Given that teleworking involves performing work-related tasks, employees argue that they should not be burdened with using their personal equipment or bearing the costs of maintenance and upgrades over time. In line with existing evidence from the literature, businesses can have major financial gains by saving operational costs due to teleworking (Martin 1994). Organizations can benefit by tending to the employees' morale by investing some of these expected profits towards remunerating their employees' personal equipment and electricity costs. The employee needs to be equipped with a PC and a mobile device that meets the requirements of the work standards by the organization. In some cases, the employee may also need to be provided with a printer, scanner, etc. Also, as already noted in the literature (Quoquab et al. 2013), it would benefit both parties if the teleworker's costs for a—preferably—high-speed internet connection were covered by the employer, facilitating seamless communication and collaboration.

By implementing these practical measures, banking institutions can optimize their teleworking initiatives, driving greater efficiency, productivity, and employee satisfaction. Furthermore, by aligning with best practices identified in both the current study and the existing literature, organizations can position themselves as forward-thinking employers committed to supporting their workforce in navigating the evolving dynamics of remote work.

6. Conclusions

Prior to the coronavirus crisis, telework was sparsely used in organizations in Greece, and Greek banks in particular. As mentioned above, the Information Departments of the banks used this technology only in case of emergency. The employees remained available in their homes so that if there was a need, they could be connected remotely to the company's infrastructure and provide the quickest possible solution to the respective problem. The goal was not the work itself, but the quickest possible solution so that there are minimal delays in the bank's operations, such as remittances, payroll, etc. However, due to the forced quarantine imposed during the COVID-19 lockdown period, large organizations had to explore the telework solution on its full scale. This was something very new for the workforce in Greece, where such remote work scenarios had not been previously widely preferred.

The aim of the present study was to provide insight into how, but also at what time the digital transformation of telework in Greek banking institutions took place, how the employees perceived the telework scenario, and how their performance changed during work carried out away from the premises of the organization. The results provide indications that the digital transformation of telework in Greek banks took place very quickly because the infrastructure and know-how had already existed to an extent. Problems were immediately overcome and in the aftermath of the crisis, telework for employees is no different from working in the office in terms of technicalities. Interpersonal relationships are of course something that cannot be replaced remotely. More specifically, most of the employees stated that what they lacked during their permanent work from home was contact with other colleagues, something that while working in their office helped them to escape from the work environment and relax. Also, according to the surveyed employees, telework is a more flexible way of working, through which they "save" time from daily commuting to and from the office. Hence, all respondents have adopted a positive stance with regard to the existence of telework in the future and would be willing to adopt teleworking from home for five to ten working days each month, even beyond the COVID-19 crisis. In general, most of the respondents suggested that they can better organize their time so that they have time for other activities. For instance, employees who have children, prefer to telework to some extent, as they can supervise them when they return from school, while at the same time working from home. Moreover, the important role of freeing up hours during the day should be emphasized, since the majority of the respondents needed 1–2 h for commuting to and from the office, and teleworking meant that they saved significant time.

The results of this research also bear their limitations. Firstly, they were drawn based on the insight collected in large banking organizations. This presents challenges in translating the results in different contexts. For example, a small IT company may not have the capabilities to adopt the teleworking model of operation as easily as a large banking institution. Different sectors may also feature vastly different work contexts—for example, employees not working in office environments have a much different experience when it comes to telework. Therefore, the above conclusions may not be generalizable to all companies or employees. Also, the present research was carried out on a sample that was employed exclusively by one Greek banking institution. Therefore, to be able to generalize the results safely throughout the banking sector, future studies can be performed in other organizations (and possibly also in an international setting). Another limitation stems from the fact that the sample size was limited to 15 participants. Studies with larger samples may enable greater generalization and confirmation of the collected insight. At the same time, the research and the compilation of the present paper took place during the first wave of the COVID-19 crisis (March–September 2020). Therefore, a more extensive inter-temporal investigation of the application of teleworking should follow under different—and normal—conditions so that richer conclusions can be drawn.

Apart from the aforementioned suggestions for future work, it would be interesting to further investigate the effect of telework on the financial results of banking corporations. Moreover, a more extensive survey of employees in companies from different fields and

sectors of the economy who are working or have worked in a teleworking scheme during the COVID-19 crisis would provide more generalizable insights. Finally, future research could also focus on the effectiveness of teleworking under the conditions of the "new" normal that will emerge after the COVID-19 crisis has completely subsided.

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Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Graphical Presentation of Research Results (Charts and Graphs)

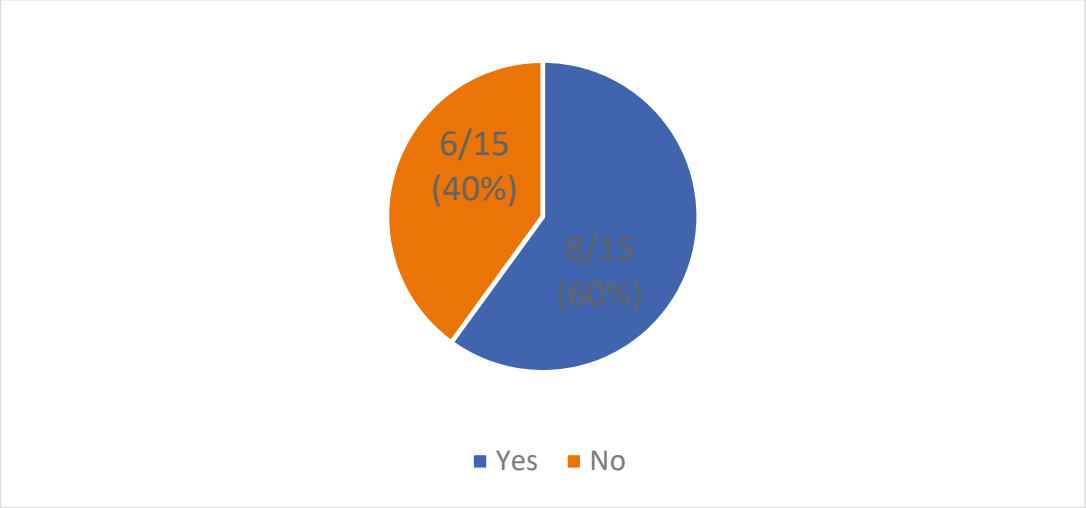

Figure A1. Respondents who had teleworked before.

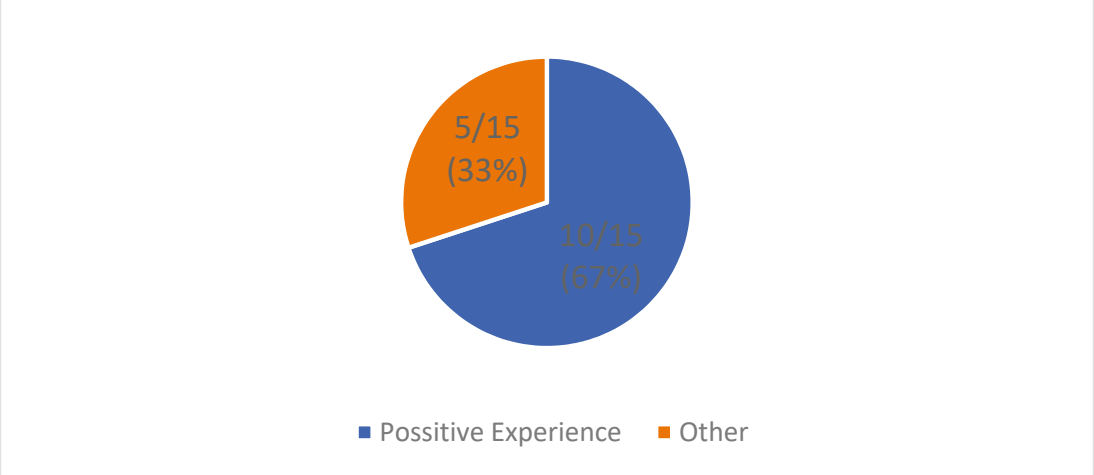

Figure A2. Experience of respondents while teleworking.

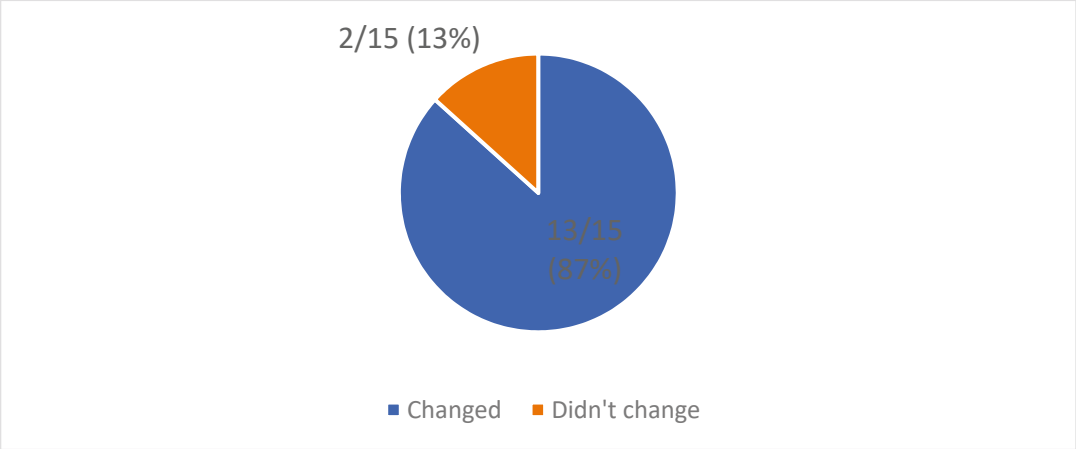

Figure A3. Alteration of activities during telework.

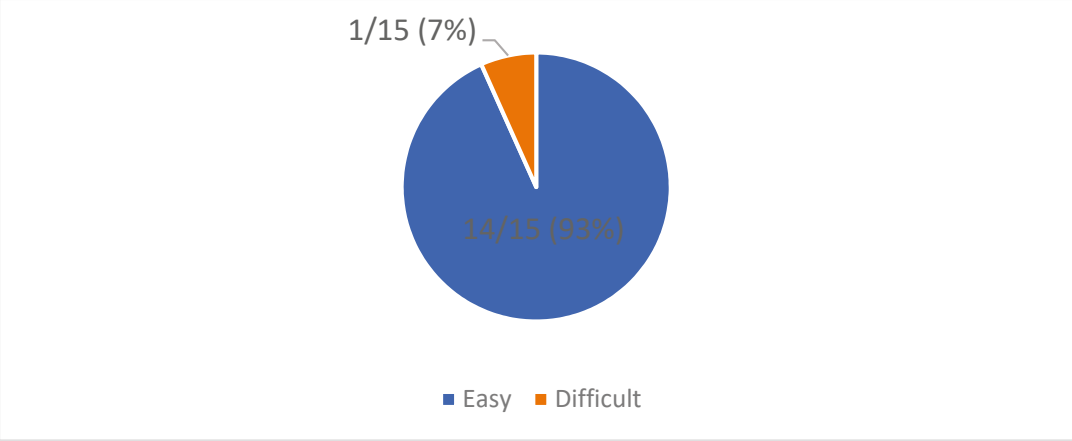

Figure A4. Ease of adapting to the new way of working.

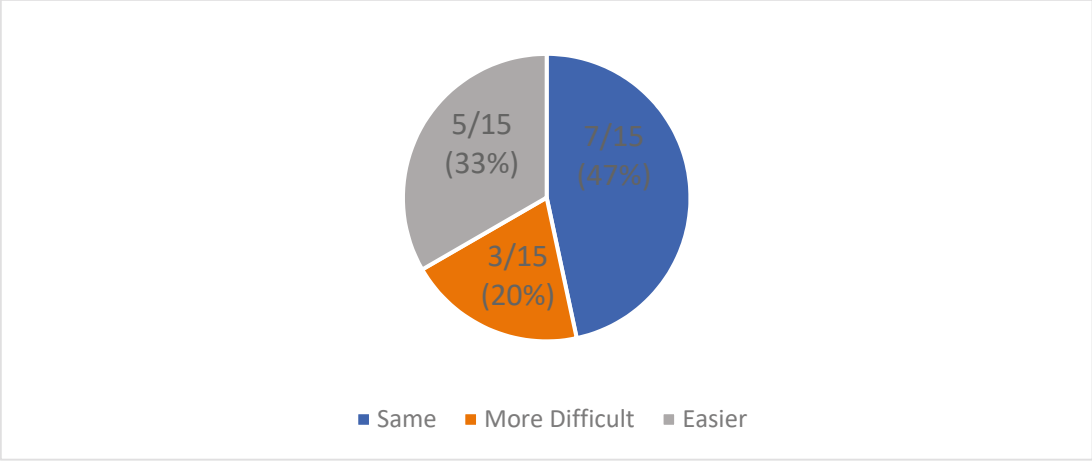

Figure A5. Difficulty fulfilling daily tasks.

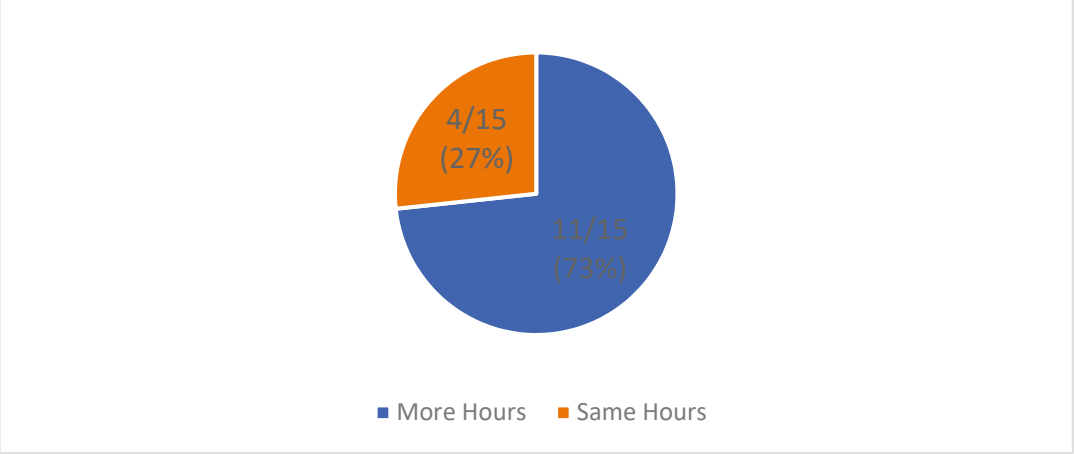

Figure A6. Hours worked during telework.

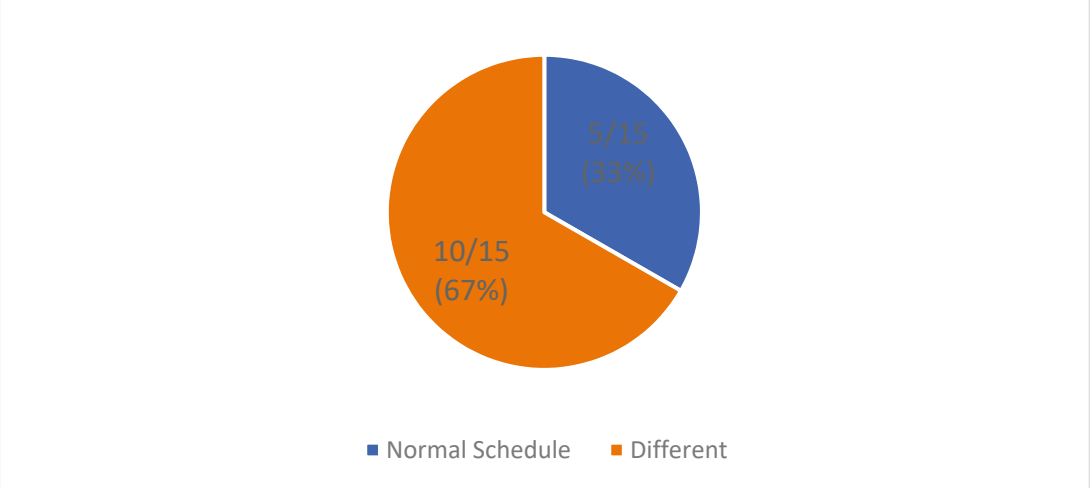

Figure A7. Working schedule during teleworking.

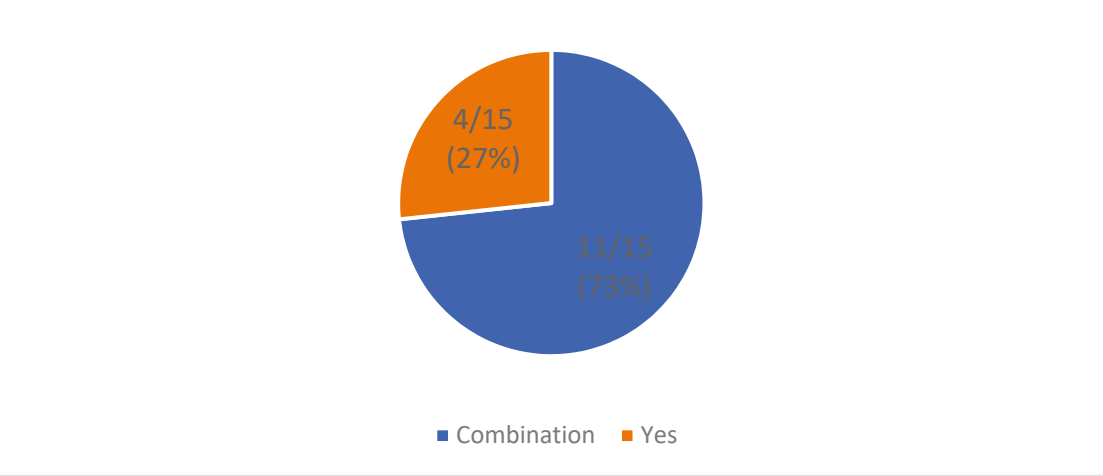

Figure A8. Respondents who prefer teleworking to on-site work.

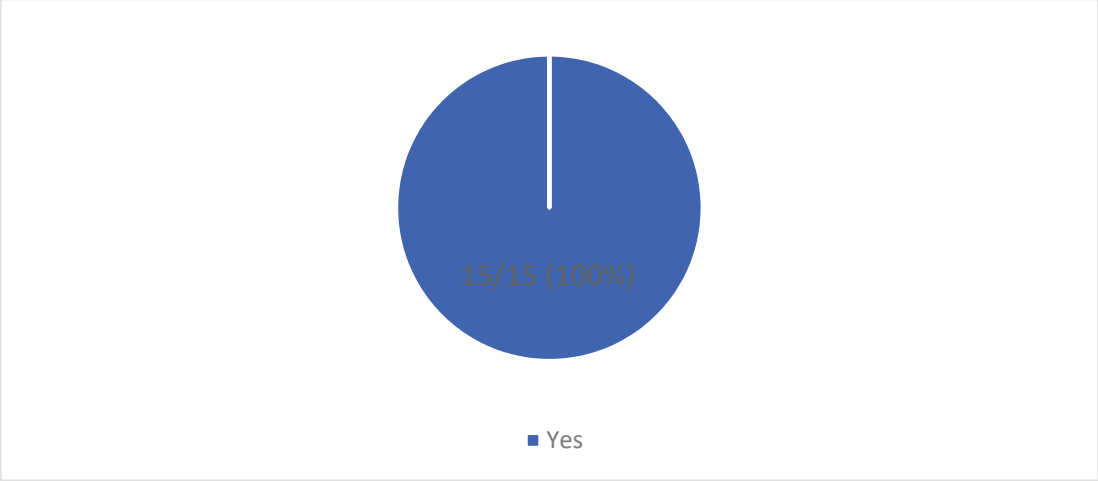

Figure A9. Willing to take advantage of teleworking in the future.

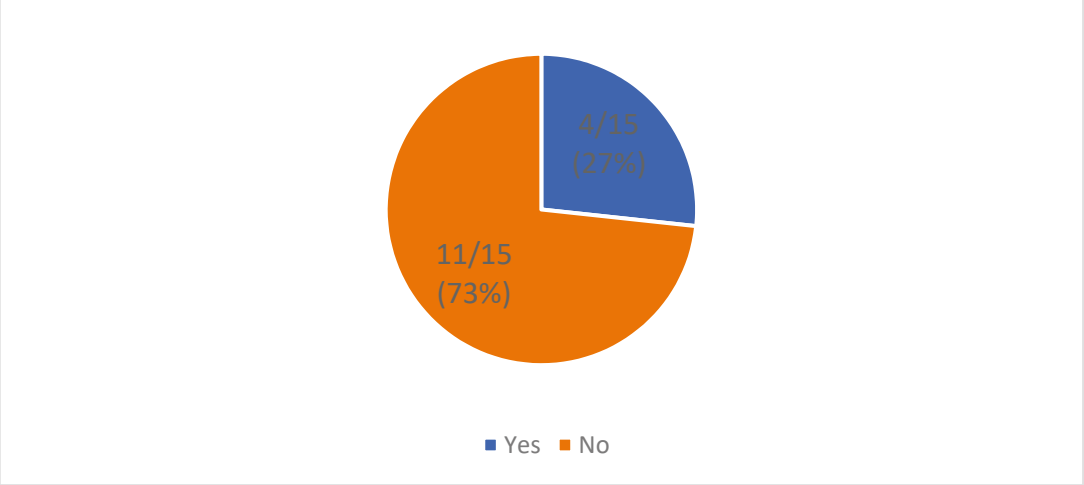

Figure A10. Intention to telework permanently.

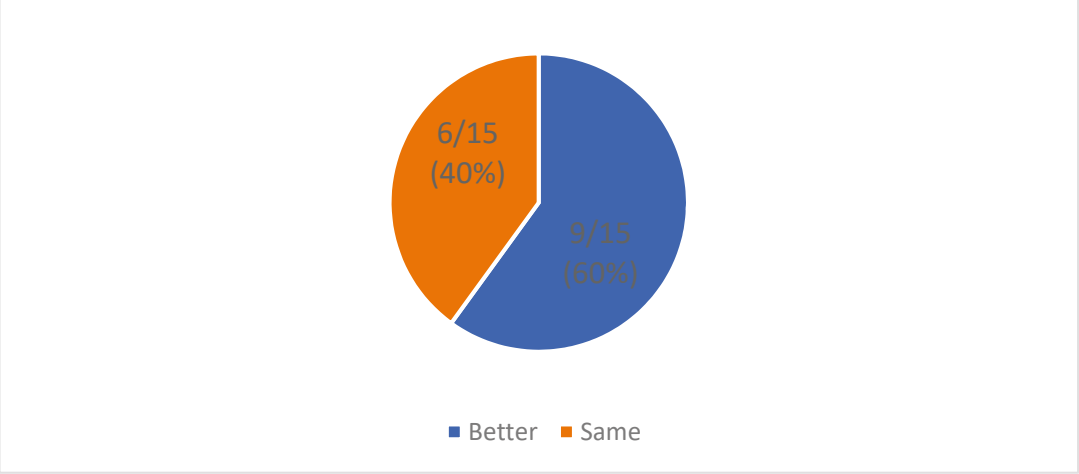

Figure A11. Performance of duties during telework.

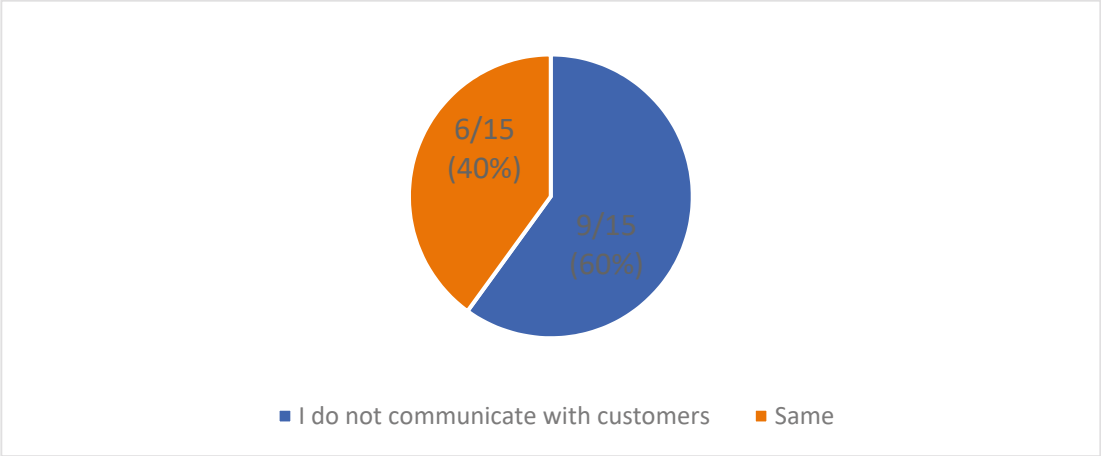

Figure A12. Communication with customers during telework.

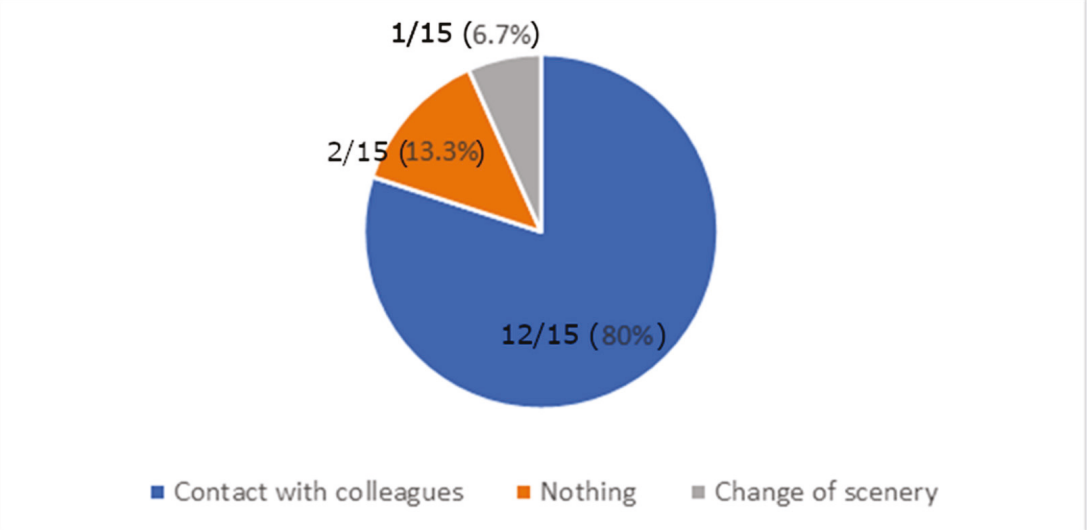

Figure A13. What respondents missed most while working remotely.

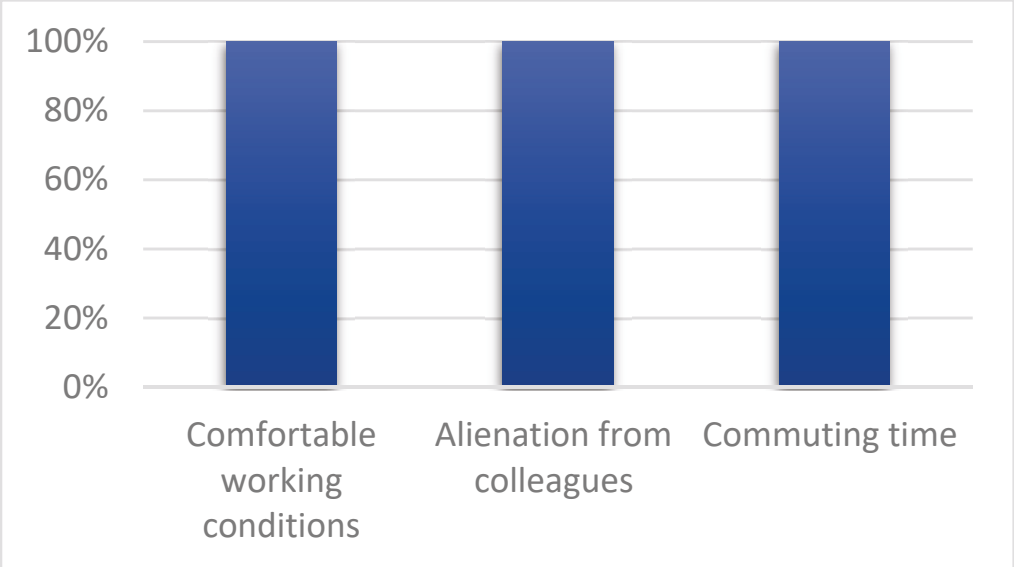

Figure A14. Best and worst feature of teleworking.

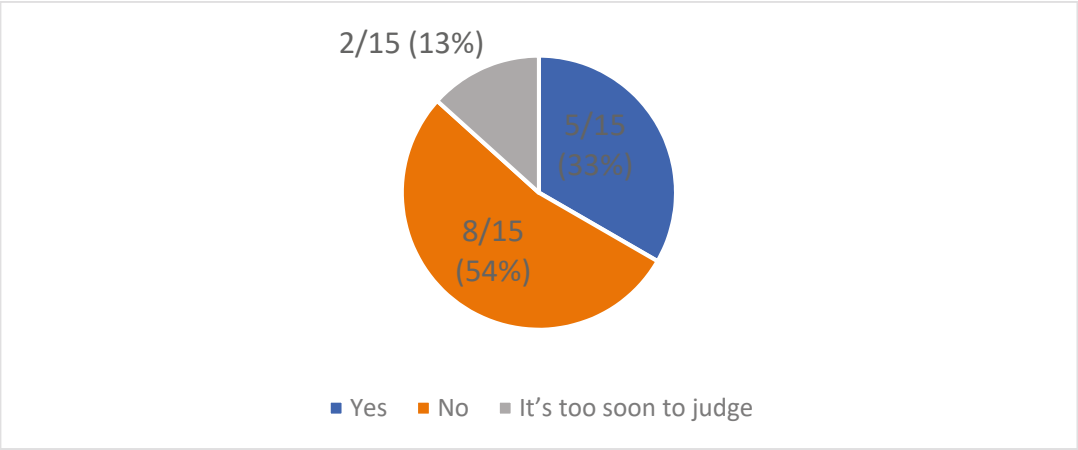

Figure A15. Participants worried about their professional future after the crisis.

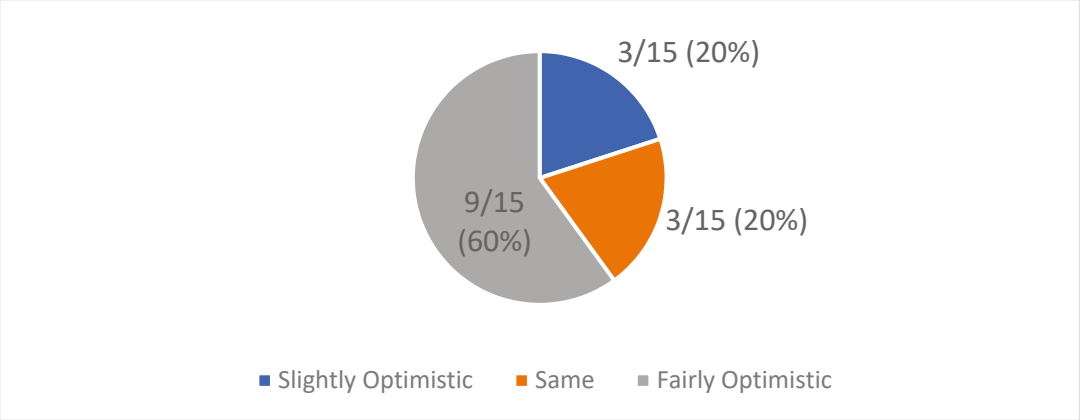

Figure A16. Participants' optimism for their professional future after the crisis.

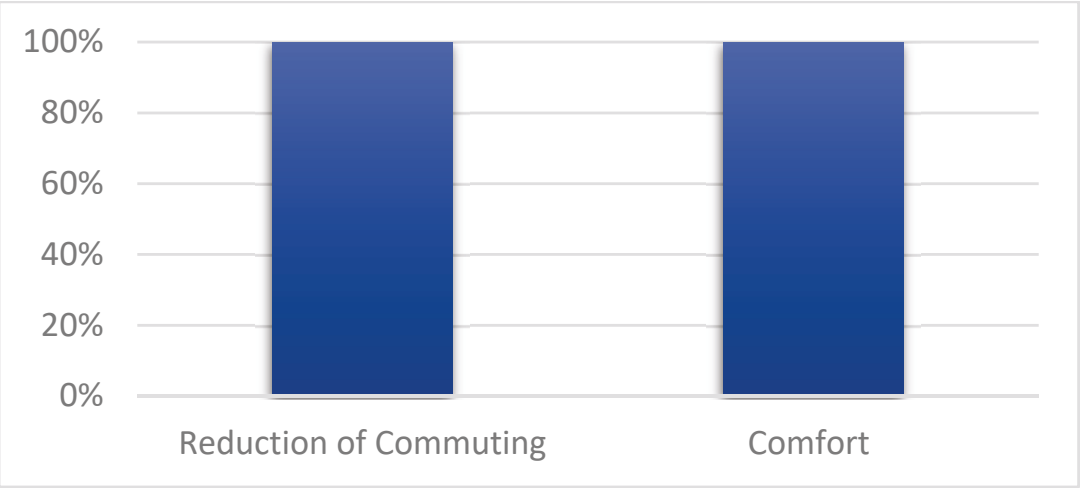

Figure A17. Main benefits of working remotely for a period of time in the future.

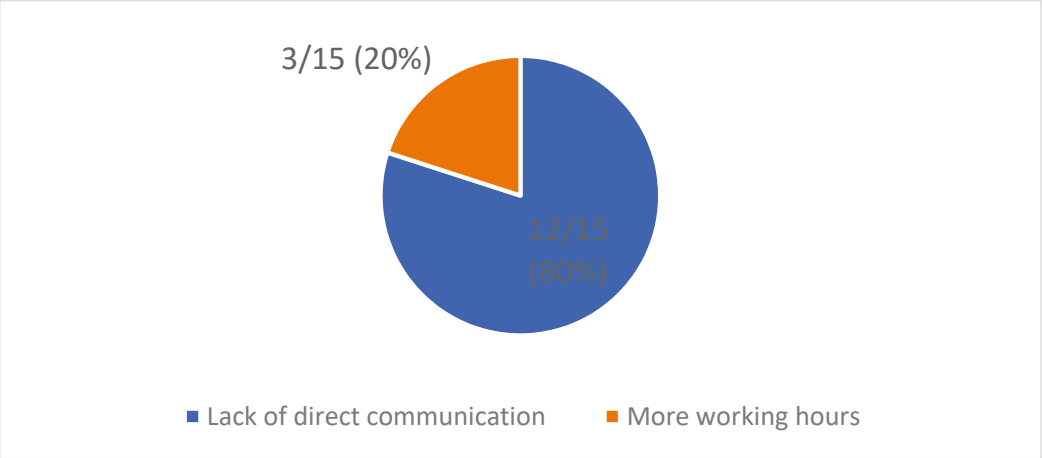

Figure A18. Main disadvantages of working remotely in the future.

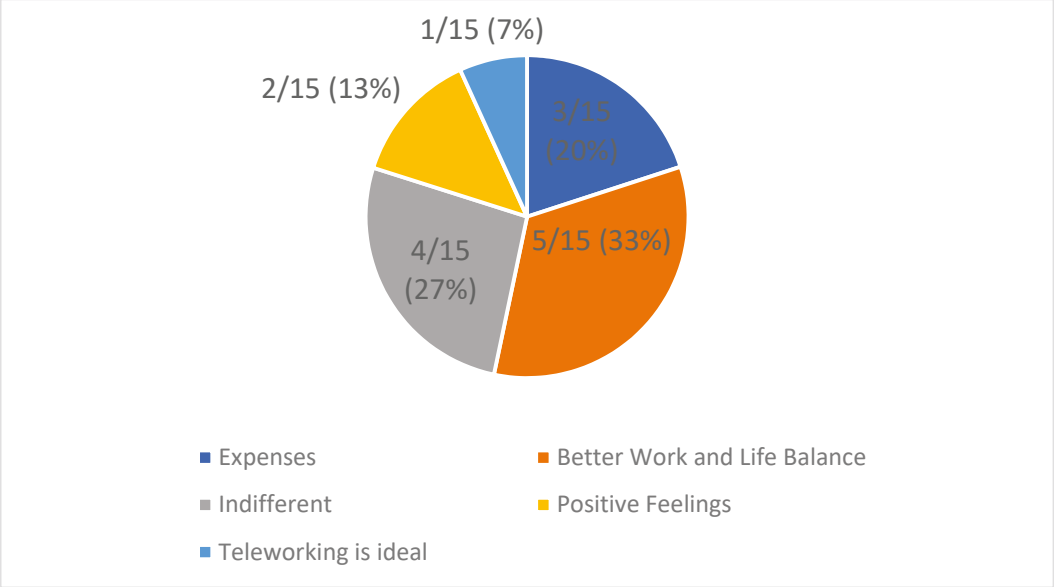

Figure A19. What comes to mind when thinking about teleworking.

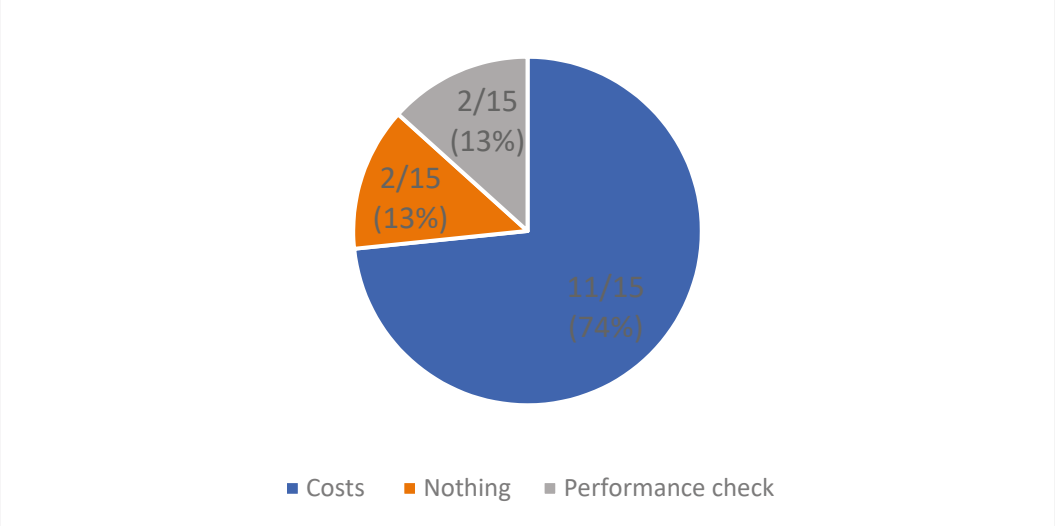

Figure A20. Facilitating conditions for teleworking in the future.

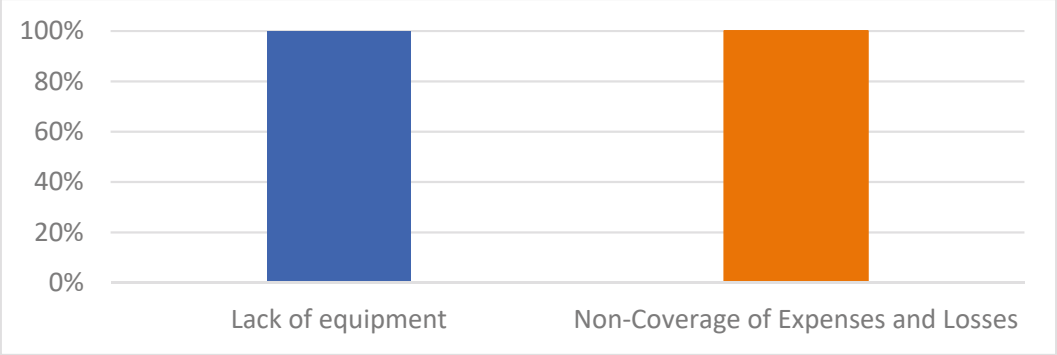

Figure A21. Deterrents for adopting telework in the future.

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