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ORGANIZACIJA

Organizacija (Journal of Management, Informatics and Human Resources) is an interdisciplinary peer-reviewed journal which is open to contributions of high quality, from any perspective relevant to the organizational phenomena.

The journal is designed to encourage interest in all matters relating to organizational sciences and is intended to appeal to both the academic and professional community. In particular, journal publishes original articles that advance the empirical, theoretical, and methodological understanding of the theories and concepts of management and organization. The journal welcomes contributions from other scientific disciplines that encourage new conceptualizations in organizational theory and management practice.

We welcome different perspectives of analysis, including the organizations of various sizes and from various branches, units that constitute organizations, and the networks in which organizations are embedded.

Topics are drawn, but not limited to the following areas:

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Revija je zasnovana tako, da spodbuja zanimanje za različne vidike v zvezi z organizacijskimi vedami in je namenjena tako akademski kot strokovni skupnosti. Revija objavlja izvirne članke, ki spodbujajo empirično, teoretično in metodološko razumevanje teorij in konceptov managementa in organizacije. Pozdravljamo tudi prispevke iz drugih znanstvenih disciplin, ki spodbujajo nove koncepte v organizacijski teoriji in praksi. Objavljamo članke, ki analizirajo organiziranost z različnih vidikov, so usmerjeni na organizacije različnih velikosti in iz različnih sektorjev, na enote, ki sestavljajo organizacije, in na mreže, v katere so organizacije vpete.

Teme so pokrivajo predvsem naslednja področja:

- organizacijska teorija, upravljanje, razvoj in organizacijsko vedenje;
- management človeških virov (kot so organizacija in razvoj zaposlenih, vodenje, ustvarjanje vrednosti s pomočjo človeških virov, organizacijski pojavi na delovnem mestu itd.);
- vodstveni in podjetniški vidiki izobraževanja;
- poslovni informacijski sistemi (kot so digitalno poslovanje, sistemi za podporo odločanju, poslovna analitika itd.);
- podjetniški inženiring (npr. organizacijsko oblikovanje, upravljanje poslovnih procesov, paradigme preoblikovanja podjetij itd.);
- članki, ki analizirajo organizacijsko uspešnost in prizadevanja za izboljšanje le-te.

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Advancing Cultural Competence in Healthcare System: Insights on Barriers and Required Measures

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Background/Purpose: Cultural competence in the healthcare system is a crucial strategy to ensure the availability, accessibility, acceptability, and quality of healthcare services. However, literature on the systemic implementation of this concept in the Central and Eastern European region is scarce. The aim of our study is to present insights into the barriers to cultural competence and measures for its advancement in the Slovenian healthcare system.
Methods: We employed a qualitative methodology, conducting semi-structured interviews with professionals and experts in Slovenian healthcare system. Data was analysed by directed content analysis.
Results: The identified barriers to cultural competence and measures for its advancement pertained to several areas, including staffing, information for healthcare users, multidisciplinary and multi-level approaches, data collection and research, communication possibilities and skills, legislative foundation, flexibility of the healthcare system, quality standards, and educational efforts and policies.
Conclusions: In our study, we found that most barriers to cultural competence exist at the systemic and organizational level. Consequently, the measures identified to address these barriers should also be implemented at these levels. The first step towards achieving safer and more equitable healthcare services should involve incorporating the core principles of cultural competence into strategies and policies at both systemic and organizational levels of healthcare.

Keywords: *Cultural competency, Patient diversity, Obstacles, Strategies, Healthcare system*

1 Introduction

Cultural competence is an essential necessity in our globalized world, irrespective of industry, profession, or geographical location (Yousef, 2024). In healthcare, experts agree that cultural competence is crucial for the healthcare availability, accessibility, acceptability, and quality (Napier et al., 2017).

The concept has begun to develop in the seventies as a response to recognizing the influences of culture on health and on the vulnerability of certain population groups (Saha et al., 2008). Over the years, it has evolved into a multidimensional concept considered by many experts to be a key condition for achieving equality and quality in healthcare

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(Anderson et al., 2003; Napier et al., 2017; Constantinou et al., 2022).

First definition of cultural competence, applicable to healthcare organisation or a system, but also to an individual healthcare professional, was offered by Cross and colleagues in their scientific monograph of 1989 – this definition is still the most frequently cited (Jongen et al., 2018; Handtke et al., 2019). They proposed that cultural competence is a set of coherent behaviours, relationships, and principles present in the system, as well as in the organization or among practitioners, enabling effective functioning in intercultural situations (Cross et al., 1989). Betancourt and colleagues later defined health care system´s cultural competence as the ability of the system to provide care and adapt services to patients with different values, beliefs, and behaviours, thereby meeting patients' social, cultural, and linguistic needs (2002). Cultural competence is therefore an overarching term that includes both individual-level skills and characteristics of the organizational and/or systemic level of the healthcare system (Cai, 2016). For the purpose of this article, we have adopted the view as described by Constantinou et al (2022). They view it as an umbrella term, encompassing diversity competence, structural competence, intercultural communication, cultural awareness, cultural humility, cultural sensitivity, cultural empathy, and cultural intelligence. These concepts collectively capture the extensive scope of cultural competence, enabling effective, appropriate, and sensitive engagement in an understanding and reflexive manner, not only concerning ethnicity and cultural background but also gender, age, lifestyles, personal choices, and more. No other concept can comprehensively encompass all the skills and knowledge required for appropriately working with diverse patients (Constantinou et al., 2022).

Despite the important role of cultural competence in providing high-quality care and reducing social disparities in healthcare, this concept doesn't seem to be widely recognised as a strategy to improve health care accessibility and quality in the Central and Eastern European (CEE) region. A scoping review on cultural competence interventions in European healthcare has shown a significant lack of research especially in Mediterranean countries, compared to other parts of Europe, and has highlighted the need for increased focus and development of cultural competence (De-María et al., 2024). On the other hand, it has been shown that, for example in Slovenia, vulnerable and marginalized groups face many barriers to health as well as unequal and discriminatory health treatments (Lipovec Čebron & Huber, 2020). Similar findings where shown in the research, conducted in Slovenia, Croatia, Germany and Poland. In all four countries ethnic, national, cultural, and religious minorities, as well as migrants and foreigners, often encounter barriers to healthcare access due to factors, related to the lack of cultural competence (e.g. language barriers, presence of discrimination and discriminatory behaviours, inadequate cultural competence training) (Ramšak et al., 2023). These facts point to the importance of advancement of cultural competence in healthcare systems in the CEE region, but the literature related to the systemic implementation of this concept is scarce.

With our research we aimed to adress this gap in literature by examining the perspectives of Slovenian healthcare and cultural competence experts on the barriers to cultural competence, as well as on the measures for its advancement. We start by literature review on the importance and the characterisitcs of culturally competent health care systems, as well as on the barriers and interventions identified in the previous studies. This is followed by the methodology section, a summary of the results, and a discussion of our findings. Finally, conclusions and suggestions for future implementation and research directions are given.

2 Literature review

Healthcare systems are often marked by formal and informal barriers that affect the accessibility of healthcare services. These barriers can be legislative, communicative, organizational, financial, geographical, and physical (Chiarenza, 2012). Recent study from New Zealand identified barriers as attitudinal barriers (lack of culturally competent healthcare providers, discrimination by healthcare providers, personal, social, and cultural attributes) and structural barriers (policies and frameworks that regulated the accessibility of health services (Kanengoni-Nyatara, 2024). It has been shown that these barriers exist also in the CEE region (Ramšak et al., 2023). Not understanding and addressing these barriers have serious health implications and exacerbate healthcare disparities (Yong-Hing & Khosa, 2023).

Achieving equal access to healthcare services is a complex, ongoing challenge that demands a multifaceted strategy, involving policy reforms, public health initiatives, and cultural shifts within the healthcare system (Hickson, 2024). Cultural competence is a crucial skillset and mindset for delivering high-quality care and reducing social disparities in healthcare (Constantinou et al., 2022). It is based on understanding the barriers to equal access and on understanding the needs of the population it serves (Truong et al., 2014). A culturally competent healthcare system can offer equitable treatment to patients with varied values, beliefs, and behaviors, and can customize the delivery of care to align with patients' social, cultural, and linguistic needs. It contributes to safer, more efficient, timely, and patient-cantered healthcare (Betancourt et al., 2005), to improving health literacy, to reducing the vulnerability of minority groups (Powell, 2016) and may influence patient outcomes (Diamond et al., 2019; Schiaffino et al., 2020), even though the research on patient outcomes is limited (Chae et al., 2020). In culturally competent health-

care system, patients' negative healthcare encounters are reduced, adherence to medical advice is increased (Flynn et al., 2020), many communication misunderstandings are prevented and trust in healthcare professionals is increased (Paternotte et al., 2015; Flynn et al., 2020).

In previous times and continuing today, it was suggested that culturally competent system recognizes and acknowledges the importance of culture at all levels, assesses intercultural reactions, disseminates cultural related knowledge, and adapts services to specific culture-based needs (Cross et al., 1989; Yong-Hing & Khosa 2023). In the culturally competent system, there should also be an awareness that there are far more differences within individual cultural groups than among the groups themselves, and that differences are defined by many factors - not just ethnicity, but also age, region, education, and other influences (Engebretson et al., 2008).

Effecting changes towards cultural competence within the system necessitates a shift in organizational culture, with patient safety serving as the paramount guiding principle (Chassin & Loeb, 2013). Patient safety also encompasses cultural safety, wherein patients feel socially, spiritually, emotionally, and physically secure during their treatment. It underscores the dedication of healthcare personnel and institutions to foster an environment devoid of bias and inequality, ensuring that every patient feels embraced (Curtis et al., 2019). Regulatory bodies and health organizations should prioritize the incorporation of cultural competencies, mandating them to ensure regulations that are modern, fair, compassionate, and equitable for diverse populations. Consequently, comprehensive training on cultural competence, sensitivity, and diversity intelligence should be seamlessly integrated into all facets of the fitness-to-practice processes (Singh, 2023). However, the concept requires more than just culturally competent healthcare personnel; it must encompass the entire organization, which must be committed to effective diversity management (Rechel et al., 2013). Some of the most important barriers in the advancement of cultural competence in the healthcare system include organizational culture that does not prioritize cultural competence; staff attitudes that lack interest in diversity topics and tend to stereotype different groups; and a lack of information about the diversity of the population served by healthcare organizations (Taylor, 2005; Reese et al. 2017). Ramšak et al. (2023) identified significant challenges in providing diversity-responsive healthcare, including healthcare underfunding, language barriers, insufficient cultural training or interpersonal competencies, and lack of institutional support.

Strategies for the advancement of cultural competence are diverse. Experts warn against their inefficiency when fragmented approach is employed, focusing solely on one aspect in the healthcare system without clear consideration of their effects on other levels or their interconnections (Jongen et al., 2018). A scoping review of strategies for the advancement of cultural competence identified twenty strategies on four levels. Strategies on individual level included linguistic and/or cultural matching interventions, use of adapted written or visual material, and inclusion of families. Strategies on the organisational level included, but were not limited to, cultural competence training, integration of interpreter services and patient data collection and management. Strategies to implement culturally competent healthcare start with needs assessment and monitoring of organisational changes as well as creation of positions to monitor and supervise the process. Finally, strategies to provide access to culturally competent healthcare consist of integration of community health workers, user engagement, outreach methods and others (Handtke et al., 2019).

In Slovenia, there is a need for a deeper understanding of the healthcare system's relationship with population diversity and their needs. We must understand the perspective through our own "cultural lense" within the healthcare system. The aim of our research was therefore to examine the perspectives of Slovenian healthcare and cultural competence experts on the barriers to cultural competence, as well as on the measures for its advancement. The research was conducted as part of a broader doctoral thesis research, investigating various aspects of cultural competence in the Slovenian healthcare system. For purpose of this article, we have focused on two research questions, namely:

RQ1. What are the most significant barriers to cultural competence in the Slovenian healthcare system?

RQ2. What are the most important measures for advancing cultural competence in the Slovenian healthcare system?

3 Methodology

We employed a qualitative methodology, conducting semi-structured interviews on purposive sample - professionals from various levels of the healthcare system. In the field of cultural competence, qualitative methods are particularly suitable as they allow for a holistic view of social phenomena and sensitive data collection in natural settings (Bradshaw et al., 2017). The obtained results offer a complex description and interpretation of the discussed topic and often signal the need for action (Creswell, 2012). This methodology is also suitable at the national level, as demonstrated by Betancourt and colleagues in 2005, when they assessed the state, key perspectives, barriers, and trends in the development of cultural competence in the United States through interviews with experts (n = 37) (Betancourt et al., 2005).

We interviewed three different groups of healthcare system professionals and experts in Slovenia. Our first group consisted of key decision makers (KD) - representatives of various regulatory bodies of the healthcare sys-

tem, including Ministry of Health, National Public Health Institute, National Chambers of various healthcare professionals and others (n=14). Second group consisted of management of healthcare institutions (medical directors and head nurses of hospitals and healthcare centres - HM) (n=14), and our third group consisted of experts in the field of healthcare cultural competence (researchers and authors of scientific articles in this field - EX) (n=8). A total of 36 interviews were conducted.

The questionnaire for semi-structured interviews was informed by our research questions in consideration of the chosen data processing methodology - directed (deductive) content analysis. In this methodology, targeted questioning on predetermined topics is important. The questions therefore included targeted questions on barriers to cultural competence in the healthcare system and on the measures needed for its advancement (In your opinion, what are the most pressing barriers to advance cultural competence in the healthcare system? What are the necessary measures for the advancement of cultural competence?). Interviews also included questions related to the understanding and familiarity with the concept of cultural competence and other perspectives related to this field (for example: How do you assess the attitude and response of your work environment to the cultural diversity? How do you assess the need for cultural competence in your work environment, particularly in the Slovenian healthcare system? Do you believe that access to the healthcare system and within it is equal for everyone?) as well as questions on the specific indicators of cultural competence (for example: What are the opportunities for education in the field of cultural competence in your work environment? What measures to improve cultural competence have you taken/implemented in the last five years? Do you participate in initiatives to reduce cultural and language barriers - if so, which ones and in what way?).

All interviewees were briefed on the purpose and procedure of the study, as well as on the protection of personal data, and we obtained their written consent for the collection and processing of interview data. The interviews were recorded using the Voice Memos application. The average duration of each interview was 27.5 minutes. Interviews were transcribed and entered into the Atlas.ti application, version 8.4.4., where further data analysis took place.

Data was analysed by the directed (deductive) content analysis. We chose this methodology because it is recommended for extensive textual data (Pope et al., 2000), although despite its frequent use, there is relatively little literature available to assist researchers (Assarroudi et al., 2018). We conducted content analysis in steps, recommended by Elo and Kyngäs (2008). In the first, preparatory step, we have predetermined themes based on our research questions, prepared the manifested data and performed multiple readings of the data. In the second step, we have organised the data – all data, recognized as barriers to cultural competence and measures for its advancement, were assigned to these two predetermined themes. In the subsequent rounds, data was coded within those themes and sorted into categories. Our last step was devoted to the creation of the data report.

4 Results

4.1 Theme: Barriers to cultural competence

We have identified a total of 159 quotations, which we have assigned to 19 codes and 7 categories. Table 1 depicts identified categories and codes whereas the number of identified quotations according to the interview group in each category is depicted in Picture 1.

Table 1: Identified barriers to cultural competence

Category	Codes
Lack of time and personnel	Time constraints, Insufficient staff
Lack of information for users	Lack of simple language materials, Lack of materials on healthcare organisation and rights, Lack of foreign language materials
Lack of legislative foundation	Contradicting laws, Lack of regulation on Interpreters and Intercultural Mediators
Lack of multidisciplinary and multilevel approach	Lack of multidisciplinary cooperation, Lack of coordination among healthcare levels, Lack of national solutions
Lack of data	Inability to collect data, Insufficient research, Insufficient dissemination of available data
Lack of communication possibilities and skills	Poor communication skills, Linguistic barriers, Misunderstandings
Lack of technological and space resources	Digitalisation barriers, Outdated technology, Lack of space

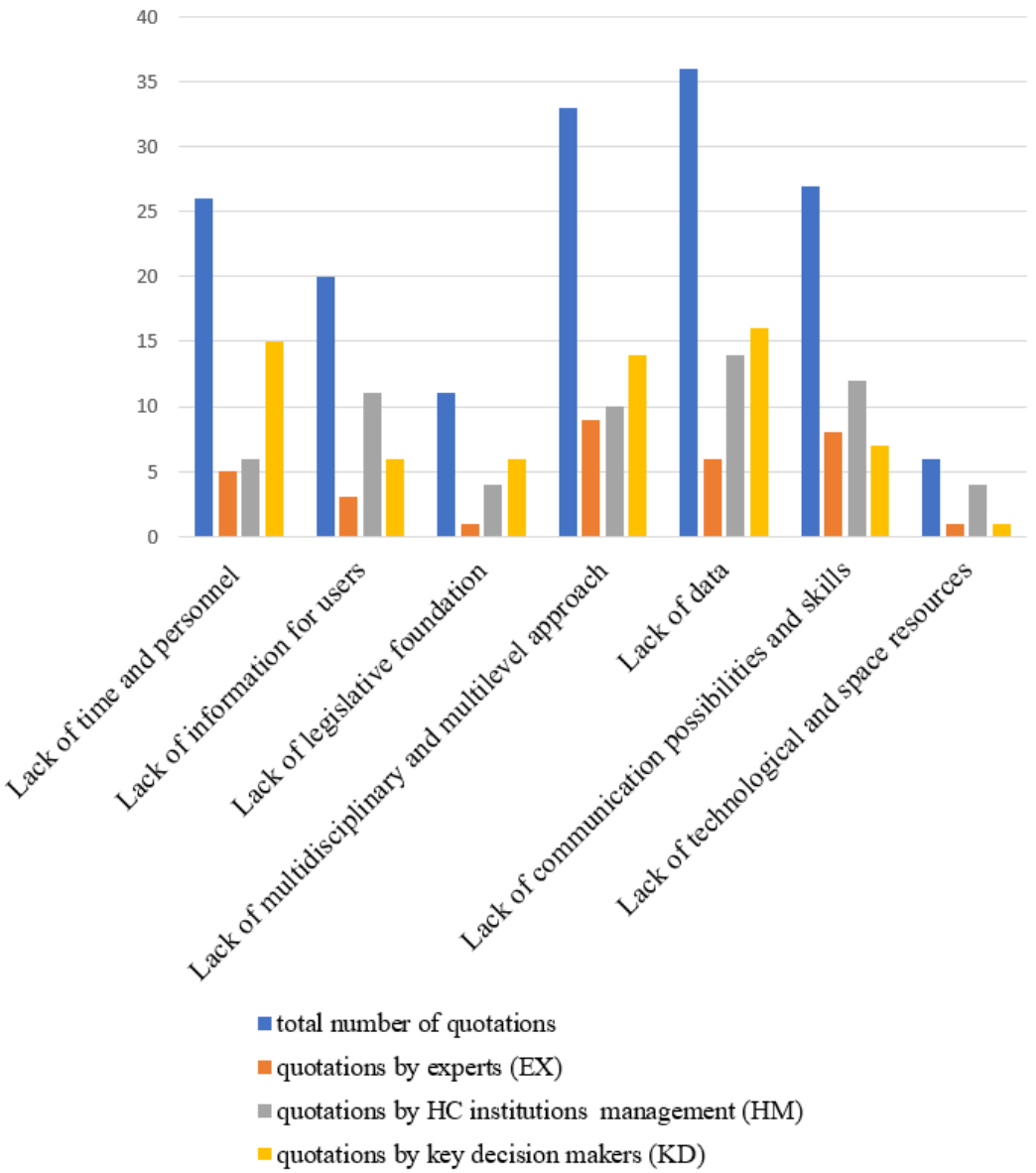

Figure 1: Barriers to cultural competence: number of quotations by category and interview group

The most frequently cited barrier to advancing cultural competence, particularly by key decision-makers and managers of healthcare institutions, was the lack of data. This was followed by the absence of a multidisciplinary and multilevel approach, a barrier most frequently highlighted by experts in comparison to other obstacles. Another significant barrier identified was the lack of communication possibilities and skills. This was followed by a lack of time and personnel, insufficient information available to healthcare users, and the absence of a legislative foundation. Additionally, the lack of technological and spatial resources was noted as a barrier, especially in data provided by managers of healthcare institutions. Representative quotations corresponding to each barrier category are presented in Table 2.

Table 2: Representative quotations of barriers to cultural competence in the Slovenian healthcare system

Category	**Representative quotations**
Lack of time and personnel	"It's hard for me to criticize or blame a doctor or nurse for not behaving culturally competent when they have 60 people waiting, when they're pressed for time, when they have to work 12 hours instead of 8 because there aren't enough nurses, when they have to go from night duty to the clinic. It's difficult, really difficult for healthcare workers to maintain an acceptable and high level under these circumstances." (EX-1)
Lack of information for users	"Lack of adequate information or information presented in a user-friendly manner. This emerges as one of the main barriers in all environments. The fact that they don't have the right information. Very basic information regarding the healthcare system, insurance, or what services the health centre or health promotion centre even provides...This really manifests as a pressing problem." (KD-8)
Lack of legislative foundation	"The Patient Rights Act states that you must provide care in the Slovenian language... on the other hand, you must ensure that they understand what you are saying. Here comes the conflict, and we have pointed this out, but as I said, there wasn't much receptiveness." (HM-10)
Lack of multidisciplinary and multilevel approach	"This is not part of a system, we are dealing with it or focusing on it only within a very narrow group of healthcare workers, mostly nurses... So, doctors are not reached. The first barrier that arises is that the decision-makers are doctors." (EX-5)
Lack of data	"Even if we look only at the population level, regarding the Statistical Office for collecting data, they are not allowed by law to collect data on religion, not even the Roma community, unless they themselves identify as Roma. Here, we actually don't have an accurate number unless we go into the field and ask them." (KD-8)
Lack of communication possibilities and skills	"What's lacking is adequate communication. We don't know how to communicate, neither with patients nor with each other. Even just for us to talk, communication... we're barefoot here. We don't have that. Communication is dismal. Even Slovenian-speaking communication." (KD-9)
Lack of technological and space resources	"And here we're not even talking about electronic matters, such as e-referrals and e-prescriptions, which are perceived as barriers from multiple perspectives, not just because of understanding but also due to access to the internet, to computers. That's one thing." (KD-8)

Table 3: Identified measures for advancement of cultural competence

Category	Code
Expansion of Human resources	Implementing staffing standards, Increasing the number of healthcare workers, Inclusion of other professionals in healthcare team
Policies and procedures	Policies on national level, Policies and procedures on healthcare organisation´ level
Linguistic measures	Use of interpreters and intercultural mediators, Availability of linguistically adjusted materials
Inclusion and advocacy	Inclusion of diverse groups in healthcare policy creation, Empowerment of healthcare workers to act as advocates
Sensibilisation and education	Measures in basic training, Continuing education measures, Training of stake holders and decision makers
Flexible organisation	Adjustment of service delivery, Adjustment of service location, Less bureaucracy
Research and data collection	Research initiatives, Data collection, National data dissemination
Implementation of Quality standards	Quality certification, Quality fostering culture
Improvement in clinical communication	Clinical communication basic education, Clinical communication ongoing training, Clinical communication standards

4.2 Theme: Measures for advancement of cultural competence

We have identified a total of 178 quotations, which we have assigned to 23 codes and 9 categories. Table 2 depicts identified categories and codes whereas the number of identified quotations according to the interview group in each category is depicted in Picture 2. Each category is accompanied by a representative quotation in Table 4.

Among the essential measures for fostering cultural competencies, we distinctly recognized substantial data highlighting the necessity for awareness-raising and educational efforts, especially in the data obtained from experts and key decision-makers. Data from managers of healthcare institutions indicates the importance of expanding human resources, measures related to inclusion of vulnerable groups and their advocacy, and linguistic measures, such as use of interpreters and availability of linguistically adjusted materials. Linguistic measures were also commonly cited by experts and key decision-makers. Other measures, such as integrating policies and procedures to support cultural competence, implementing quality standards, improving clinical communication, enhancing research and data collection, and increasing organizational flexibility, had similar overall frequencies of citations. Representative quotations corresponding to each measure category are presented in Table 2.

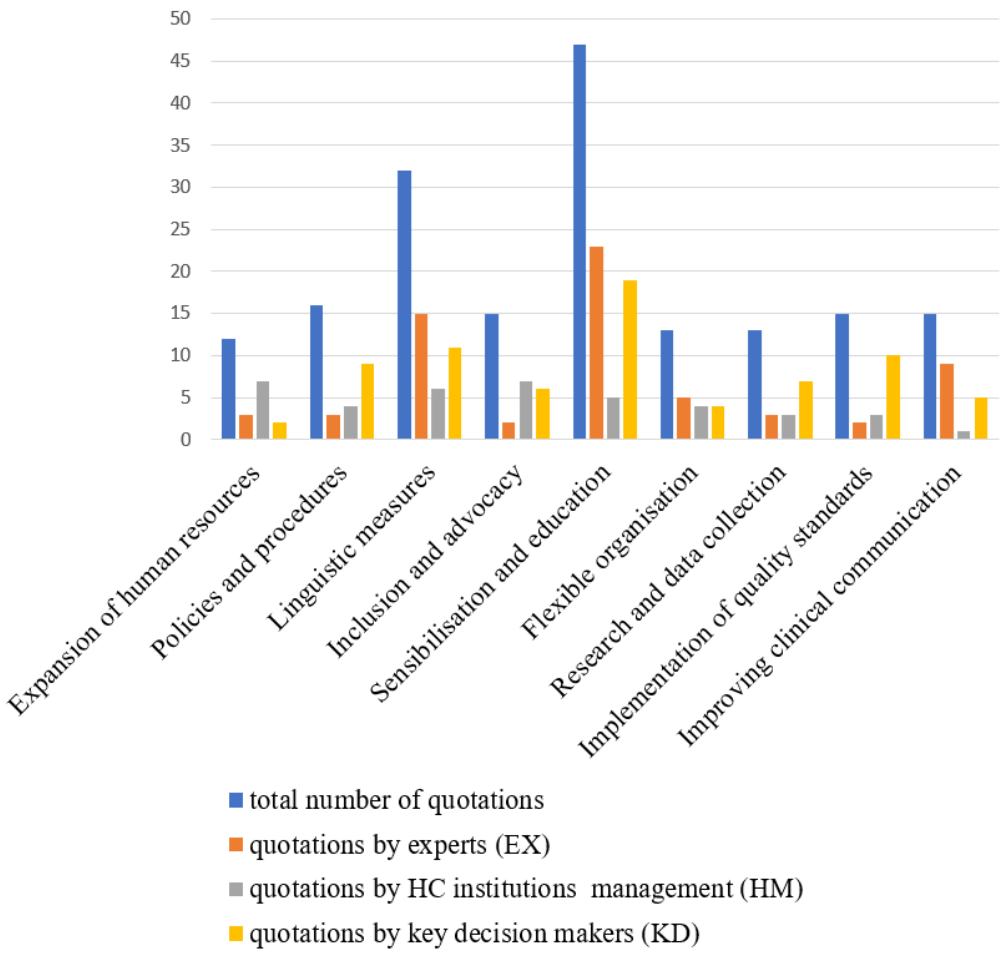

Figure 2: Measures to advance cultural competence: number of quotations by category and interview group

Table 4: Representative quotations of identified measures for advancement of cultural competence

Category	Representative Quotation
Expansion of Human resources	"I definitely see the greatest need in strengthening the workforce of the system. That's a fact." (KD-1)
Policies and procedures	"At the institutional level or even at the national level, it's time to address this very seriously, also as part of the strategy" (HM-2)
Linguistic measures	"We have very concrete needs for interpreters, which are notably lacking, let alone interpreters for healthcare needs. This is something that would help us to communicate at all." (EX-3)
Inclusion and advocacy	"Anyway, essential, I mean, very important is this inclusion because otherwise... Experts have their own prism, and we think we're doing the best, but with the best intentions, we're completely wrong." (EX-8)
Sensibilisation and education	"Firstly, it is necessary to establish an understanding, as we said earlier, that cultural dimensions even exist. Until healthcare workers are aware of this, they don't know that they have a need for intercultural competence." (EX-2)
Flexible organisation	"The flexibility of the healthcare system to allow healthcare workers some flexibility in terms of time organization at the clinic, and ultimately even for home visits, if necessary, would, of course, be very, very desirable." (EX-1)
Research and data collection	"In order to master this cultural competence, from my perspective, it would be necessary to first assess where we stand. To check where we are in Slovenia or in a particular hospital, what tools we have, what this cultural competence is, and based on that, start with education or training." (KD-2)
Implementation of Quality standards	"We only began to think about this when we embarked on obtaining this certification. That's when we really started to think about all these things." (HM-10)
Improvement in clinical communication	"Without a doubt, we really need to seriously start dealing with medical humanism and communication in healthcare. Someone should realize that this is currently among the most pressing issues, almost as much as waiting lists. By the way, I personally strongly believe that waiting lists in at least a third of cases are the result of poor communication." (EX-5)

5 Discussion

The essential condition for the cultural competence advancement is having sufficient information about the requirements and needs within the system, and often the problem lies precisely in the lack of available information. Our research indicates that lack of data related to diverse healthcare system users and their needs is an important barrier. None of the interviewees had data regarding vulnerable or other relevant groups residing in the institution's area of operation, the size of these communities, or their health-related characteristics.

Lack of data was justified in our research by inability to collect data due to legislative background of data collection, prohibiting inquiries about religion, ethnicity, social background, and similar characteristics. Indeed, European regulation on the protection of individuals with regard to the processing of personal data states that the processing of data revealing, among other, racial or ethnic origin, religious or philosophical beliefs, sex life or sexual orientation shall be prohibited (Regulation (EU) 2016/679, Article 9(1)). However, it is stipulated in the same article in paragraph 2 that this does not apply when processing is necessary for the purposes of preventive medicine, medical diagnosis, the provision of health or social care or management of health or social care systems and services. It is also allowed when there is a substantial public interest in the area of public health, such as for ensuring high standards of quality and safety of healthcare (Regulation (EU) 2016/679). Recommendations from the World Health Organization also indicate that collecting data on vulnerable groups and differences in their health outcomes compared to the general population is crucial for equality in healthcare (WHO, 2021). Carefully considered measures in this direction could therefore be possible and should be implemented. This observation was also acknowledged by our study participants, who identified researching and acquiring data relevant to vulnerable groups as an important measure.

However, several researchers emphasized that the focus of research and data collection should not be limited to vulnerable groups. More importantly, it should include an

examination of how the healthcare system and structural factors contribute to inequality (Kapilashrami et al., 2015; Hui et al., 2020) – addressing these issues is a key requirement for ensuring cultural safety (Curtis et al., 2019). In our research, this aspect was not identified; however, it is important to acknowledge it due to its growing recognition and significance.

Our findings revealed a notable barrier to achieving cultural competence in the healthcare system due to the absence of a multidisciplinary and multi-level approach. We have observed that there are many individual efforts to advance cultural competence on various levels, especially in primary care, but they are lacking connection and coordination. It has been shown in other research that culturally competent actions are often not systematically promoted through organizational contexts but are primarily supported by the individual efforts of staff members (Schenk et al., 2022). Fragmentation within healthcare systems can hinder coordinated efforts to address health disparities (Okolo et al., 2024), thus an effective approach necessitates a multidisciplinary and multi-level commitment (McCalman et al., 2017; Mews et al., 2018). It is therefore imperative that healthcare organizations, as well as regulatory bodies, ensure a coordinated and multidisciplinary approach in their efforts to advance cultural competence.

When discussing multidisciplinary commitment, the role of anthropologists in the advancement of cultural competence should not be neglected. Their advocacy for heightened focus on the socio-cultural aspects of health has been crucial to advancing cultural competencies within healthcare (Lipovec Čebron & Huber, 2020). Our research has shown that the inclusion of additional experts in the healthcare team is a crucial measure; however, the specific role of anthropologists was not acknowledged. We speculate that the role of anthropologists is not well understood by healthcare workers.

Integration of cultural competence into healthcare policies is another crucial step to advance cultural competence. This concept requires a foundation in the strategic documents of healthcare organizations to ensure responsiveness to the diverse needs of populations. It has been shown that values associated with population diversity must be clearly articulated, and leadership must support diversity and ensure that these values are reflected in practice (Okolo et al., 2024). One of the key values is also readiness and ability to adjust, or in other words, organizational flexibility, which was emphasized by our interviewees as an important measure. Flexibility is undoubtedly a crucial requirement for operating in the uncertain and evolving environment characteristic of healthcare (Kumar et al., 2018). With increasing diversity, it is required across all organizational levels, requiring close and constructive collaboration (Van Gool et al., 2017, Schenk et al., 2022).

Quality accreditation and quality fostering culture has also been identified in our research as an important measure for cultural competence advancement. Increased level of quality and safety can indeed be achieved thru these measures (Mitchell et al., 2020), however, quality certification must encompass issues related to diversity. Curtis et al recommend that evidence of cultural safety is a requirement for accreditation and ongoing certification (2019).

Our research has also identified lack of communication abilities and skills as an important barrier to cultural competence. It is well known that clear and effective communication between healthcare professionals and users is crucial for accessible, high-quality, and safe healthcare (Jongen et al., 2018) and is indeed closely linked to cultural competence (Henderson et al., 2018). Intercultural communication is among the skills that is increasingly required (Železnik et al., 2017). Key communication tasks for the purpose of cultural competence include understanding the patient's background, providing information, involving the patient in healthcare decisions, understanding the patient's beliefs and values, gaining the patient's trust, and providing appropriate support (Brown et al., 2016). Language barriers, which we have recognised in our research, can render all these tasks impossible or exceedingly difficult in practice. They may affect the outcome of the treatment, which is also valid for Slovenian healthcare (Ramšak et al., 2023). Primary responsibility for tackling these obstacles lay within the healthcare system (Škraban, 2020). From an organizational perspective, it is crucial to establish clear guidelines for integration of professional interpreters and intercultural mediators into healthcare practices (Lundin et al., 2018) - the necessity of this measure can be confirmed with our observations.

Our research indicates that enhancing overall clinical communication skills is as important as overcoming the language barriers. Patient rights advocates in Slovenia agree and emphasize the need to improve communication at all levels. They state that the cause of complaints often lies in unclear communication between the patient and the healthcare professional. According to the State Report on the Status of Patient Rights for the year 2019, advocates for patient rights highlight frequent grievances concerning patients' rights to information and involvement, underlining the pressing need for improved communication (Government of the Republic of Slovenia, 2020).

Linguistic measures identified in our study should also address the lack of linguistically adjusted information for diverse healthcare system users. It is essential that all health-related information is equally accessible to everyone. This entails not only more efficient dissemination of information to non-native speakers but also employing language that accommodates various levels of health literacy (Davidson et al., 2013). Furthermore, presenting information in a manner that mitigates the digital gap is crucial. The availability of internet access has influenced the distribution of influence and resources within society (Sparks, 2013). While global studies indicate a decline in

disparities in access to information based on ethnicity, discrepancies linked to socioeconomic status and especially older age are exacerbating (Hong & Cho, 2016; Mubarak & Suomi, 2022). Though it is important to employ health information technology in healthcare, it is also important to guarantee equitable access across diverse populations (Saeed & Masters, 2021).

Interview participants also emphasized the constraints of time and shortage of personnel in the healthcare system as obstacles to achieving cultural competence. Especially managers of healthcare institutions saw the expansion of human resources as an important measure. While the lack of personnel is a well-known fact in today's healthcare system across the world, acquiring cultural competence should not impose additional burdens on existing healthcare staff. Instead, this strategy can aid in retaining personnel (Delphin-Rittmon et al., 2013). There is, however, a notable paucity of literature examining the impact of cultural competence on the necessary staff ratio. Research in this area rather indicates that prioritizing the recruitment of personnel from diverse backgrounds is a critical measure, as it promotes culturally competent behaviors (Handtke et al., 2019; Schenk et al., 2022). Interestingly, our study did not identify having a culturally diverse workforce as a necessary measure.

We have, however, identified measures related to the inclusion and advocacy of diverse groups of healthcare users. In Slovenia, the involvement of not only vulnerable groups but users in general in the healthcare politics is relatively rare. An almost decade old study comparing user involvement in England, Slovenia, and Poland showed that the healthcare system in England was proactive in incorporating user opinions into healthcare policy, while users in Slovenia traditionally had a more passive role, and the concepts of genuine inclusion were still in their infancy (Lichon et al., 2015). Kavčič et al noted that in Slovenia, healthcare policies were primarily formulated by experts and decision-makers whereas users were not offered equitable partnership or influence on healthcare strategies (2015). In terms of cultural competence development, the inclusion of vulnerable groups, including those with cultural and linguistic diverse backgrounds, is a strategy of paramount importance (McCalman et al., 2017) – it has been proven, that cultural competence and effective consumer engagement are closely linked (Harrison, 2019).

Most important measure identified in our study was to increase cultural sensibility and provide education on the topics of diversity and cultural competence. The impact of cultural competence education in improving knowledge, attitudes, self-confidence, and skills among healthcare workers is supported by solid evidence (Jongen et al., 2018; Lin & Hsu, 2020). According to our results, education and awareness-raising activities should be strengthened at all systemic and organizational levels, as well as in intersecting systems (education, social welfare). It was somewhat surprising that in our research, the need for these measures were frequently found in the data obtained from experts and key decision makers, but less frequently from managers of healthcare institutions. Healthcare managers are namely responsible for cultivating a workforce capable of meeting the diverse needs of patient populations. This includes promoting diversity among healthcare personnel, providing ongoing training in cultural competence, and cultivating an inclusive environment (Okolo et al., 2024). Involving leadership and decision-makers in the educational efforts is the only way to achieve sustainable results (Weech-Maldonado et al., 2018).

5.1 Study limitations

We ensured the reliability of our results by adhering to recommendations applicable to qualitative research. In doing so, we relied on a plethora of scientific articles in the field of qualitative methodology and standards for reporting such research (Giacomini et al., 2000; O'Brien et al., 2014; Johnson et al., 2020). We have ensured the reliability through data saturation and triangulation, achieved by conducting semi-structured interviews with various groups of healthcare professionals and experts. We have also continuously adhered to the principle of reflexivity, which means that the researcher must constantly examine their own beliefs, assumptions, and biases, as well as their influence on data collection and interpretation of results (Johnson et al., 2020). Nevertheless, it cannot be denied that the characteristics of the researchers, including personal traits, qualifications, experiences, assumptions, and the like, can influence the study (O'Brien et al., 2014; Johnson et al., 2020). Further limitations relate to the fairly unknown concept of cultural competence in Slovenia, characterised by new terminology and large complexity of the field, potentially leading to varying understanding of the topic being explored.

6 Conclusion and recommendations

The cultural competence of the healthcare system is vital for attaining equality and quality in healthcare delivery. It also plays a crucial role in ensuring healthcare is safer, more effective, timely, and patient-centred. This concept is not an unreasonable expectation, as it aligns with fundamental human rights and principles of social justice that underpin modern society. Cultural competence, along with cultural humility, should be a standard requirement for every contemporary healthcare system. However, achieving it necessitates the integration of this concept across all levels and aspects of the system, requiring systematic and cohesive actions at the individual, team, organizational, and broader societal levels.

Our research has identified multiple barriers to cultural competence within the Slovenian healthcare system, with most of them occurring at the systemic and organizational level. Correspondingly, most of the identified measures to address these barriers must also be implemented at these levels. Isolated individual efforts and improvised solutions in this area are insufficient for enabling the healthcare system to successfully transition toward achieving comprehensive cultural competence. However, systemic and organizational measures can ensure that cultural competence becomes an integral part of the healthcare system.

We have demonstrated that majority of necessary measures have a solid evidence base. Nevertheless, studies on related topics mainly come from countries where cultural competence has been a known concept for decades, while our research is one of the few originating from South-Central Europe. We believe that the failure to recognize cultural competence as a crucial strategy for addressing healthcare inequalities in the studied geographical area may be a cause for concern. The first step towards achieving safer and more equitable healthcare services should involve incorporating the core principles of cultural competence—such as respect for diversity, adaptability, continuous education, and effective communication—into strategies and policies at both systemic and organizational levels. Subsequently, efforts should be made to address the barriers identified in our research and other related studies. These include lack of data and research in this area. Data concerning diverse groups or individuals in our region are notably scarce, not only regarding their needs and the obstacles they encounter within the healthcare system but also in terms of the magnitude of these issues and their consequences. Additionally, there is a lack of data on potential efforts and their effectiveness in addressing the needs of diverse populations. Future research should thus prioritize gathering additional locally sourced data to facilitate culturally specific solutions in advancing cultural competence.

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Spodbujanje napredka kulturne kompetentnosti v zdravstvenem sistemu: vpogledi v ovire in potrebne ukrepe

Namen: Kulturna kompetentnost v zdravstvenem sistemu je ključna strategija za zagotavljanje razpoložljivosti, dostopnosti, ustreznosti in kakovosti zdravstvenih storitev. Kljub temu je literatura o sistemski implementaciji tega koncepta v srednje- in vzhodnoevropski regiji skopa. Namen naše študije je predstaviti ovire pri spodbujanju kulturne kompetentnosti ter ukrepe za njen napredek v slovenskem zdravstvenem sistemu.
Metode: Uporabili smo kvalitativno metodologijo, pri čemer smo izvedli polstrukturirane intervjuje z zdravstvenimi strokovnjaki in poznavalci področja v slovenskem zdravstvenem sistemu. Podatke smo analizirali z usmerjeno vsebinsko analizo.
Rezultati: Ovire za zagotavljanje kulturne kompetentnosti in potrebne ukrepe za njen napredek smo zaznali na področjih, kot so zaposlovanje, informacije za uporabnike zdravstvenih storitev, multidisciplinarni in večstopenjski pristop, zbiranje podatkov in raziskovanje, možnosti in veščine komunikacije, zakonodajne podlage, fleksibilnost zdravstvenega sistema, standardi kakovosti, izobraževanje in strateške politike.
Zaključek: Naša študija je pokazala, da obstajajo na sistemski in organizacijski ravni v zdravstvu številne ovire za napredek kulturne kompetentnosti. Posledično je potrebno tudi ukrepe za spodbujanje napredka implementirati na teh ravneh. Prvi korak k doseganju bolj varnega in dostopnega zdravstva je vključitev temeljnih načel kulturne kompetentnosti v strategije in politike na sistemski in organizacijski ravni zdravstvenega sistema.

Ključne besede: *Kulturna kompetentnost, Raznolikost pacientov, Ovire, Strategije, Zdravstveni sistem*

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The Effect of Work-Family Conflict on the Impact of Role Overload on Turnover Intention and Job Satisfaction

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Purpose: This study aims to investigate how role overload and work-family conflict influence turnover intention and job satisfaction among public employees, providing insights for management practices to enhance employee well-being and organizational effectiveness.
Design/Methods: Quantitative data were collected from 390 public employees in the Central Anatolia region of Turkey. Structural equation modeling (SEM) was employed to analyze the relationships between role overload, work-family conflict, job satisfaction, and turnover intention.
Results: The study reveals that role overload positively influences work-family conflict, which in turn negatively impacts job satisfaction and increases turnover intention among public sector employees. Furthermore, job satisfaction is found to negatively affect turnover intention.
Conclusion: The findings highlight the importance of addressing role overload and work-family conflict to mitigate turnover intention and enhance job satisfaction among public employees. From a practical perspective, this study suggests that organizations should prioritize initiatives aimed at reducing role overload and managing work-family conflict to foster a positive work environment and retain talented employees. Socially, the study underscores the significance of supporting employees in balancing work and family responsibilities to promote their overall well-being and contribute to societal welfare.

Keywords: *Role overload, Work-family conflict, Turnover intention, Job satisfaction, Role conflict theory*

1 Introduction

The advent of information and communication technologies has brought about rapid and transformative changes in various aspects of organizational life in the current business world. Due to these developments, the expectations of employees in the business world have started to differentiate and the problems they perceive in this context have started to increase. In this context, the problems perceived by employees regarding role overload and work-family conflict have an important place in the literature (Bolino & Turnley, 2005; Judge & Colquitt, 2004).

When there is a discrepancy between the level of behavior required for a work position and the time and energy available to fulfill it, a form of conflict known as workplace role overload arises (Coverman, 1989; Pearson, 2008). The intertwining of work-life balance affects many people, especially employees (Michel et al., 2011).

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Work-family conflict undermines employee productivity and detrimentally affects job performance through its adverse impact on employees' job satisfaction (Johnson et al., 2005). In contemporary work environments, increasing demands in both professional and family spheres have made maintaining a harmonious work-life balance a challenging task. Individuals are tasked with the intricate juggling of multiple roles, necessitating the allocation of finite resources between their professional commitments and familial responsibilities (Fotiadis et al., 2019). Work-family conflict is seen as a source of stress for many employees (Haar, 2004). When the literature is analyzed, there is a decrease in employees' job satisfaction and an increase in turnover intentions (Haar, 2004; Saeed et al., 2014). Work-family conflict consists of time, strain, and behavior-based conflict dimensions. (Greenhaus & Beutell, 1985). Time-based conflict arises when the temporal commitments of one role interfere with the execution of activities associated with another role, while tension-based conflict manifests as emotional exhaustion resulting from reduced effectiveness in one role due to factors such as anxiety and stress caused by another role. Behavior-based conflict arises when behaviors that are appropriate for one role are ineffective in fulfilling the requirements of a secondary role (Greenhaus et al., 2006).

Factors that increase turnover intentions include irregular work schedules, lengthy vacations, a high workload, and low pay policies (Brien et al., 2015). Job satisfaction is a term used to describe how people feel and think about their jobs. Job satisfaction is indicated by positive and favorable feelings towards one's job. Unfavorable and negative attitudes toward work are signs of job discontent (Armstrong, 2006). Job satisfaction is a concept linked to the emotional well-being of employees, which influences many factors in various aspects, including overall job performance and turnover propensity (Rusbult et al., 1988). The primary objective of this study was to assess the influence of role overload on the relationship between work-family conflict and both job satisfaction and turnover intention. To achieve this aim, a survey technique was employed within the framework of quantitative methods. Again, structural equation modeling was used within the scope of the research and the effects between the variables were examined.

The research sample consisted of public employees in Turkey, particularly prison guards, police officers, and nurses. The selection of this sample is based on the fact that employees in this group are faced with excessive role load and job dissatisfaction. (Lambert et al., 2020; Stinglhamber et al., 2022). Although the relationship between these concepts has been examined in different studies, there are no studies in the literature in which these concepts are evaluated together. This situation is important for filling gaps in the literature.

2 Conceptual Framework

2.1 Role Overload

Role overload occurs when too many tasks are assigned or overcapacity is exceeded within a certain period of time (Alam & Asim, 2019; Brown et al., 2005). Role overload innovations cope with fixed deadlines, repetitive tasks, tasks requiring high attention and a lack of social support (Herrero et al., 2012). There are many workplace factors that cause role overload and these factors include some structural conditions. These include organizational dynamics such as mergers, downsizing and strict performance criteria, as well as cultural norms, technological advances, and the proliferation of information (Rodriguez et al., 2023). In addition, long working hours and night shifts can also contribute to role overload (Kuschel, 2015). Three different types of role stressors are described in relation to role overload in the literature; role ambiguity, overload, and conflict (Tordera et al., 2008). Role overload, defined as role conflict, role ambiguity, and the expectation of the role holder to perform a variety of role behaviors in a very short period, all of which may be abstractly incompatible with each other (Van Sell et al., 1981), is one of the three forms of work stressors in various organizational contexts (Chiu et al., 2015). Role overload can cause stress, anxiety, and exhaustion, which can negatively impact performance (Hecht, 2001; Park & Jang, 2017). When excessive role overload occurs, employees' job satisfaction decreases (Dodanwala et al., 2022; Pearson, 2008). This situation is also negative for employees.

2.2 Work-Family Conflict

In contemporary society, the changing dynamics of both the work and family fields require most employees to orientate and reconcile their obligations in both areas (Obrenovic et al., 2020). Work-family conflict is a type of inter-role incompatibility in which the demands imposed by work and family conflict are inherently incompatible in various dimensions (Greenhaus & Beutell, 1985). The consequences of such conflict extend beyond the individual, affecting physical and psychological health, attitudes, and performance in both the work and family domains (Amstad et al., 2011). The bidirectional relationship between work and family conflict explains that work-related stressors such as low self-efficacy or too much workload negatively affect the "work" dimension, while family-related stressors such as parental dependency or family conflicts destabilize the "family" domain (Liu et al., 2019). Furthermore, the relationship between employee happiness and productivity is becoming increasingly recognized by organizations, which are consequently paying greater attention

to the family aspects of employees' lives and are actively involved in resolving work-family conflicts (Obrenovic et al., 2020). Organizational support for work-family balance has been found to correlate with higher levels of job performance and improved mental health among individuals. This, in turn, promotes greater satisfaction and allows for more efficient work engagement (Fitzpatrick et al., 2012).

2.3 Turnover Intention

With the acceleration of globalization and internationalization movements, it is of great importance for businesses to increase their competitive capabilities to achieve sustainable growth and development. In this context, attracting and retaining talent has become an important concept for organizations (Nadiri & Tanova, 2010). In this context, the continuity of employees and the absence of thoughts of leaving the job is an important factor. Although businesses want to keep their employees within their organization, employees may have the intention to leave their jobs. Turnover intention is the probability that an employee will voluntarily leave his or her job in the foreseeable future (Cho & Lewis, 2012). Employee turnover refers to the phenomenon of employees voluntarily leaving the organization (Aman-Ullah et al., 2022). However, the literature shows that an employee's choice to leave a company is expensive for both the employee and the organization. While high turnover intentions are a concern for most managers, the cost to management of failing to retain trained and effective employees is also high. (Carmeli & Weisberg, 2006; Sjöberg & Sverke, 2000). In this context, employees who are dissatisfied with their current jobs tend to be quit and look for another job (Mobley et al., 1978).

2.4 Job Satisfaction

Despite the long-standing and extensive research on job satisfaction, the use of this concept is still widely used to explain workplace behaviors (Bezdrob & Šunje, 2021). The concept of job satisfaction is generally defined as a pleasant emotional state, and it is an important determinant of evaluations of the work environment (Soomro et al., 2018). An alternative conceptualization of job satisfaction is that it may be defined as the favorable evolution of employees' emotional well-being resulting from their professional engagement (Özkan et al., 2020). Moorman (1993) approached job satisfaction as both cognitive and effective. Affective job satisfaction is generally accepted as a positive emotional evaluation. From a cognitive perspective, job satisfaction can be viewed as a cognitive appraisal that involves a logical and rational assessment of the working environment. It encompasses a blend of favorable and unfavorable emotions experienced by employees toward their occupation and exhibits a strong correlation with an individual's workplace conduct (Newstrom, 2007). Job satisfaction is a multidimensional concept that refers to an employee's evaluation and attitude towards various aspects of job content and work environment (Zhang et al., 2020). According to another definition, job satisfaction is a concept that shows the subjective feelings of employees about the psychological and physiological dimensions of their work environment, that is, the degree to which employees like their jobs (Yang et al., 2023). Additionally, it constitutes a cluster of attributes capable of fostering not only the emotional well-being of employees but also influencing other work-related attitudes and modifications in performance (Soomro et al., 2018).

3 Theoretical Background and Hypothesis Development

3.1 Nexus of Role Overload and Work-Family Conflict

The notions of work and family serve as fundamental constructs in life, playing pivotal roles in fostering stability and preserving equilibrium (Dodanwala et al., 2022). Work-family conflict can be understood as a form of conflict where the demands and responsibilities originating from the work and family domains are inherently discordant (Greenhaus & Beutell, 1985). In other words, employees' commitment to their jobs prevents them from participating in their work and family life. Recent studies have focused on the effects of job characteristics on families (Karimi, 2008; Panda et al., 2022; Tran, 2023). Work-family conflict can lead to burnout, low performance, and discontent in home life, among other work- and family-related effects (Gurbuz et al., 2012). It is anticipated that instances of work-family conflict will increase in cases where the workload of employees exceeds their capacities (Ahmad, 2010). When employees face situations such as excessive workloads, they are forced to work more overtime to fulfill their responsibilities, and the time they can spare for their families decreases. In addition, a high workload forces employees to work faster than their normal pace, which causes them to become physically tired (Dodanwala & Shrestha, 2021). Previous research has indicated that role overload correlates positively with work-family conflict (Ahmad, 2010; Bolino & Turnley, 2005; Dodanwala et al., 2022; Duxbury et al., 2021; Gurbuz et al., 2012). In this context, the following hypothesis was reached by virtue of the studies in the literature:

Hypothesis 1: Role overload has a positive effect on work-family conflict.

3.2 Nexus of Work-Family Conflict and Job Satisfaction

Work and family are two fundamental aspects of human life. Those who attempt to achieve a balance between work and family frequently find themselves in a state of conflict between their families and careers. Employees who are exposed to work-family conflict are likely to experience negative consequences such as stress. Stress causes negative individual and organizational behaviors in the workplace. These negative behaviors include decreased productivity, decreased performance, employees' indifferent behaviors toward the organization and colleagues, and avoidance of responsibility. (Fairbrother & Warn, 2003). Employees' motivation and job satisfaction can be negatively affected by stress and fatigue associated with excessive workload. This situation causes employees to experience stress and unhappiness by feeling that they cannot meet the expectations of the employer when they must fulfill their duties within a certain period or undertake tasks outside their areas of expertise. In contrast, Zhao and Namasivayam (2012) posited that individuals operating within demanding work environments are inclined to contemplate the interplay between their professional and familial domains, consequently experiencing diminished levels of job satisfaction. Buonocore and Russo (2012) found that work-family conflict negatively affected job satisfaction, in line with the data collected from nurses. Many authors have concluded in their studies that work-family conflict negatively affects job satisfaction (Choi et al., 2018; Kalliath & Kalliath, 2013; Mittal & Bhakar, 2018; Perrewe et al., 1999). The following hypothesis was established in this context based on the investigations in the literature:

Hypothesis 2: Work-family conflict has a negative effect on job satisfaction.

3.3 Nexus of Work-Family Conflict and Turnover Intention

The concepts of work and family are shaped as opposing elements. Contemporary workplaces are characterized by extended work hours, abbreviated vacation intervals, and heightened levels of competition (Aboobaker & Edward, 2020). Elimination of problems related to work-family conflict is effective in increasing employees' commitment to their organizations, making them more active and productive, and thus reducing turnover intention rates (Allen & Armstrong, 2006). Turnover intention is defined as an employee's conscious intention to leave the workplace because of negative conditions, such as excessive workload, burnout, and low job satisfaction (Tett & Meyer, 1993; Ding & Lyu, 2023). Thus, turnover intention may appear as a reaction to conflict between employees' work and family life goals (Bajaba et al., 2022). Employees' changing organizations lead to the disclosure of confidential information belonging to the organization, which in turn causes businesses to lose their competitive advantage and reduce their profit share. Conversely, work-family conflicts give rise to adverse outcomes, including diminished job satisfaction, increased absenteeism, and escalated employee turnover (Blomme et al., 2010). In addition, high turnover intention imposes excessive costs on businesses (Long et al., 2016). When the related literature is examined, it is concluded that work-family conflict positively affects turnover intention (Anderson et al., 2002; Rasheed et al., 2018; Wang et al., 2017). The following hypothesis was established in this context since the investigations in the literature.

Hypothesis 3: Work-family conflict has a positive effect on turnover intention.

3.4 Nexus Between Job Satisfaction and Turnover Intention

The most valuable resource in a corporation is its workforce. Worker job satisfaction has a significant impact on the intention to leave an organization (Alam & Asim, 2019; Mobley et al., 1978). Ensuring job satisfaction reduces employee turnover intention. When employees are not satisfied with their jobs, their turnover intentions are supported (Pinnington et al., 2023). Previous studies have determined that turnover intention leads to undesirable costs for organizations in terms of organizational structure, loss of information, costs, and training (Charles-Leija et al., 2023). Numerous studies have confirmed that job satisfaction is inversely correlated with turnover intention (Amah, 2009; Chen et al., 2004; Dole & Schroeder, 2001; Naidoo, 2018). The following hypothesis was established in this context since the investigations in the literature:

Hypothesis 4: Job satisfaction has a negative effect on turnover intention.

3.5 Theoretical Framework of the Research

Role conflict is a theory of work and family conflict that he has many roles in his life, and that he has different tasks and duties in various settings. responsibilities (Liu & You, 2019). In other words, role conflict theory suggests that if a worker has more roles, the possibility of pressure and burden of performing these roles will rise (Linzer et al., 2002). At the same time, following the conservation of resources theory (Hobfoll, 1989), people's energy and resources are limited and when individuals use their resources in one area (e.g. work), there is a scarcity of resources in another area (e.g. family), increasing the like-

lihood of conflict. Theoretical frameworks such as role conflict theory and conservation of resources (COR) theory offer valuable insights into the assessment of stressors and coping mechanisms associated with occupations such as police officers, nurses and prison guards. Role conflict theory suggests that psychological disorders arise when individuals encounter incompatible expectations within their professional roles. This is thought to be a common phenomenon, particularly among nurses and police officers, who experience high levels of role conflict. Nurses are exposed to role incompatibility through increased anxiety and depressive symptoms due to the nature of their professional environment (Hosseini & Homayuni, 2022). This theory describes the motivations behind certain social behaviours exhibited by individuals, the ways in which individuals assess the costs and benefits of relationships, and the strategies used to maintain balance and fairness in interpersonal interactions by understanding exchange, reciprocity, norms and trust (Jabeen & Isakovic, 2018). Social Exchange Theory suggests that employees are constantly involved in reciprocal interactions within both their professional and familial spheres. These interactions are governed by an evaluative process, where employees weigh the perceived rewards and costs associated with various facets of their lives. Key dimensions under consideration include work-family balance, role overload, job satisfaction, and turnover intention. The perceived alignment or imbalance between the benefits and drawbacks in each of these domains plays a pivotal role in shaping employees' overall levels of engagement in their work (Krishnakumar, 2024).

On the other hand, according to the social exchange theory employees respond to conditions that are supported by their organizations (e.g. work-family balance practices). If they think that their organizations do not support work-family balance, they may react with less commitment (Ribeiro et al., 2023). This may lead to turnover or a decrease in employee satisfaction.

Table 1: Demographic variables

Variables		n	%
Gender	Male	240	61.5
	Female	150	38.5
Age	20-30	114	29.2
	31-40	168	43.1
	41-50	49	20.3
	51 and over	29	7.4
Marital Status	Married	271	69.5
	Single	119	30.5
Educational Status	High School	64	16.4
	Bachelor's Degree	280	71.8
	Postgraduate	41	10.5
	Doctoral Degree	5	1.3
Total Work Experience	0-1 Year	28	7.2
	2-5 Years	146	37.4
	6-15 Years	144	36.9
	16 Years and over	72	18.5
Position	Prison officer	116	29.7
	Police officer	108	27.7
	Nurse	130	33.4
	Other officers	36	9.2
Total		**390**	**100.0**

4 Materials and Method

4.1 Sample

This study employed structural equation modelling to uncover the relationships between the variables under investigation. Additionally, correlation and explanatory factor analyses were performed. Furthermore, the construct validity of the variables was examined by analyzing the AVE and CR values.

In this study, a questionnaire was used as the quantitative method. The data were collected from public employees (especially prison officer, police officers, and nurses) in Central Anatolia, Turkey. This sample was selected because the three groups mentioned above work in a stressful way because of excessive role overload, and their intention to leave their jobs is frequently expressed. The population of the study consists of about 5 million public employees in Turkey. Of these, 225,000 are nurses, 350,000 are police officers and 55,000 are correction officers (Presidency of Strategy and Budget, 2023). According to Ahmed (2024), 384 people are sufficient for the sample of the study at 95% confidence interval. In this context, data were collected from 390 people in this study. In this context, 403 people were reached, and 13 people were excluded from the scope after the extreme values were checked. The analyses were conducted on the remaining 390 people. The demographic variables of the 390 participants are shown in Table 1.

As shown in Table 1, 240 participants were male (61.5%). The age range with the highest number of participants was 31-40 years (43.1%). In terms of marital status, the highest number of participants were married with 271 (69.5%). In terms of education, a bachelor's degree graduate came to the forefront with 280 participants. In terms of total work experience, the highest participation is 2-5 years (37.4%). Finally, in terms of position, all participants were civil servants in the public sector, and the highest participation was from nurses, with 130 participants (29.7%).

4.2 Procedures and Measurements

The measurement model analysis was conducted using structural equation modelling (SEM) through IBM's AMOS v24.0 software. AMOS software is ideal for factor-based models and provides new insights from the data by detecting complex patterns (Sarstedt et al., 2016). The survey method was the primary approach for data collection in this study. Scale statements were asked of the participants using a Likert scale (5-point Likert scale ranging from 1=Never Agree to 5=Strongly Agree was used). The relevant scales were taken from those previously used in other studies and were applied to participants in the Turkish language. The work-family conflict (WFC) and the role overload (RO) scales were translated into Turkish by two academicians who are experts in their fields. After the necessary analyses (explanatory and confirmatory factor analysis), a pilot study was conducted and the two scales were used in the study. For the other two scales, ready-made Turkish forms were used. The scales used are as follows:

The work-family conflict (WFC) scale consists of 10 statements. This measure was developed and employed by Haslam et al. (2014). The scale comprises statements that measure work and family conflicts. A sample statement is as follows: "My work prevents me from spending enough quality time with my family."

The role overload (RO) scale consists of five statements. Alam (2016) created and employed this measure. The scale consists of statements related to the heavy workload that employees face. Example statement: "I often have difficult tasks".

The job satisfaction (JS) scale consists of five statements. This measure was created and employed by Judge et al. (1998) and adapted to Turkish by Keser and Bilir (2019). The scale includes statements that measure employee job satisfaction. Sample statement: "I am quite satisfied with my current job."

The turnover intention (TI) scale consists of four statements. This measure was created and employed by Rosin and Korabik (1991) and adapted to Turkish by Tanrıöver (2005). On the scale, there are statements that measure employees' intentions to quit their jobs. Sample statement: "I am actively looking for a new job."

5 Results

5.1 Descriptive Statistics

This section presents the descriptive statistics of the variables under examination. The Average Variance Extracted (AVE) for convergent validity, composite reliability (CR) for composite reliability, Cronbach's α for reliability of the scales, Kaiser-Mayer-Olkin (KMO) values, and exploratory factor analysis (EFA) values were analyzed for the factor structures of the variables. Cronbach's α, composite reliability coefficient (CR) ≥0.70 and average variance explained (AVE) ≥0.50 (Fornell & Larcker, 1981; Hair et al., 2010; Rejikumar et al., 2019). In this context, the results regarding demographic information are presented in Table 2.

According to Table 2, four variables were considered within the scope of this study. The first is the role overload variable, which consists of a single dimension. There were five items in the variable, and the items had values between 0.884 and 0.765. The Cronbach's α value of the variable was 0.894, and the KMO value was 0.870. The value obtained were good. The second variable is work-family conflict. The variable has 10 items, with values between 0.836 and 0.545. The Cronbach's α value of the variable

was 0.939, and the KMO value was 0.924.

These values were quite high. The third variable used is the job satisfaction variable, which consists of a single dimension. There were five items in the variable, and the items had values between 0.895 and 0.784. The Cronbach's α value of the variable was 0.868, and the KMO value was 0.847.

The values obtained were good. Finally, the last variable analysed is the intention to quit the job, which also consists of a single dimension. There were four items in the variable and the items had values between 0.906 and 0.743. The Cronbach's alpha value of the variable was 0.857 and the KMO value was 0.818. The condition CR>AVE was fulfilled for all variables. On the other hand, the values obtained were good. Therefore, we considered it appropriate to use these variables in this study.

5.2 Correlation Analysis

Correlation analysis was used to determine the strength and nature of the relationship between the two variables. Table 3 displays the correlations between the variables in this context.

According to Table 3, the highest correlation is between TI and JS (r=-0.785, p=0.01). In other words, an increase in job satisfaction corresponds to a reduction in the turnover intention of the organization. The lowest correlation was observed between JS and RO (r=-0.614, p=0.01). It is imperative to note that, to ensure the validity of the square root of AVE, the absolute value of the correlation must exceed that of the inter-correlation (Sarstedt et al., 2014). In general, there is a high correlation between the variables and the values of AVE are higher than the corre-

Table 2: Demographic findings of the study

Scales	Sub-dimensions	Variables	EFA	AVE	CR	Values
Role Overload (RO)	One Dimension	RO1	0,892	0.705	0.923	Cronbach's α= 0.910 KMO= 0.875 Barlett Sph. Testi = 1271,178 Total Variance = %73.622
		RO2	0,856			
		RO3	0,848			
		RO4	0,873			
		RO5	0,819			
Work-Family Conflict (WFC)	One Dimension	WFC1	0,845	0.667	0.952	Cronbach's α= 0.944 KMO= 0.929 Barlett Sph. Testi = 3237,118 Total Variance = %66.679
		WFC2	0,869			
		WFC3	0,816			
		WFC4	0,847			
		WFC5	0,833			
		FWC6	0,818			
		FWC7	0,778			
		FWC8	0,781			
		FWC9	0,834			
		FWC10	0,737			
Job Satisfaction (JS)	One Dimension	JS1	0,792	0.711	0.925	Cronbach's α= 0.898 KMO= 0.852 Barlett Sph. Testi = 1184.657 Total Variance = %71.121
		JS2	0,873			
		JS3	0,814			
		JS4	0,892			
		JS5	0,842			
Turnover Intention (TI)	One Dimension	TI1	0,914	0.743	0.920	Cronbach's α= 0.885 KMO= 0.824 Barlett Sph. Testi = 911.637 Total Variance = %74.348
		TI2	0,891			
		TI3	0,877			
		TI4	0,759			

sponding rows and columns. In this way, divergent validity is also assured.

5.3 Measurement Model

Within the framework of this study, analyses were conducted using the SPSS 29.0 and Amos 24.0 software packages. Exploratory factor analysis (EFA) was employed to validate the factor structures of the dimensions examined in this study. Confirmatory factor analysis (CFA) was applied to verify the research model. Cronbach's alpha (CA) was analyzed to measure the validity of the dimensions and average variance extracted (AVE) and Composite Reliability (CR) values for internal consistency.

Within the scope of this study, a research model covering all four dimensions is proposed. The hypotheses and the research model of this study are shown in Figure 1.

Table 3: Discriminant validity and correlations

n=390		RO	WFC	JS	TI
RO[1]	Pearson Correlation	*0,858**			
	Sig. (2-tailed)	0.000			
WFC[2]	Pearson Correlation	0.695**	*0,817**		
	Sig. (2-tailed)	0.000			
JS[3]	Pearson Correlation	-0.614**	-0.714**	*0,843**	
	Sig. (2-tailed)	0.000	0.000		
TI[4]	Pearson Correlation	0.624**	0.709**	-0.785**	*0,862**
	Sig. (2-tailed)	0.000	0.000	0.000	

* Square root of AVE.
**Correlation is significant at the 0.01 level (2-tailed).
1-Role overload, 2-Work-family conflict; 3. Job satisfaction; 4. Turnover intention

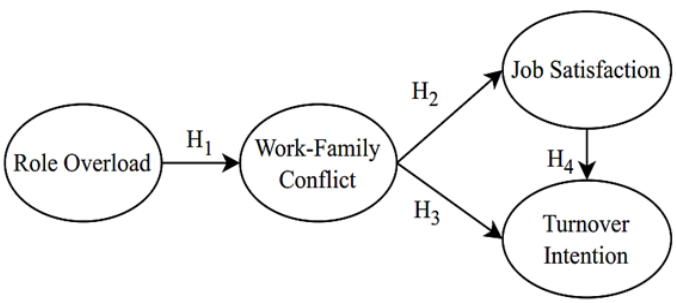

Figure 1: Research model

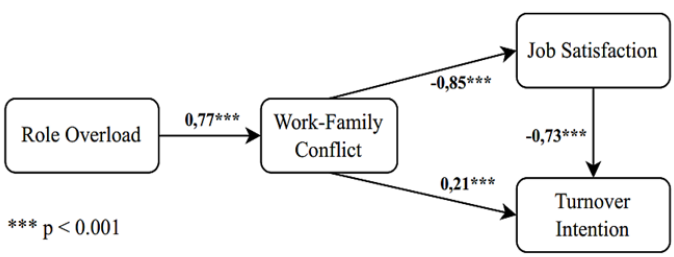

Figure 2: Structural equation modeling results with standardized coefficients

According to Figure 1, role overload affects work-family conflict (H1). Work-family conflict affects job satisfaction and turnover intention (H2 and H3). Job satisfaction affected turnover intention (H4). The results of all hypotheses are presented in the following section.

5.4 Testing the Hypothesis

This section presents the testing and verification of the hypotheses. Accordingly, all hypotheses were tested using structural equation modeling. According to the results of structural equation modeling, the fit indices of the model were as follows: CMIN/DF (2.427), NFI (0.931), CFI (0.958), TLI (0.952), GFI (0.895), RMSEA (0.061), and SRMR (0.040). According to these results, the model generally showed an excellent fit. The results of the structural equation model analysis are shown in Figure 2.

Figure 2 shows the results of structural equation modeling with the standardized coefficients. Hypothesis H1, RO has a positive effect on WFC, was accepted *(β=0.77, p<0.001)*. Accordingly, an increase in RO has a significant and positive effect on WFC and increases work-family conflict, which in turn has a negative effect on employees.

Another hypothesis, H2, which states that WFC has a negative effect on JS, was accepted *(β=-0.85, p<0.001)*. In this case, the WFC faced by working individuals affects their JS status and causes them to be unhappy and not enjoy their work.

In the third hypothesis, H3, the statement that WFC has a positive effect on TI was accepted *(β=0.21, p<0.001).* Accordingly, employees who are exposed to WFC at an increasing rate experience TI and enter a process leading to resignation.

In the last hypothesis, H4, the statement that JS has a negative effect on TI was accepted *(β=-0.73, p<0.001)*. According to this situation, the higher the job satisfaction of the employees, the greater the decrease in their turnover intention. According to the results of the analyses, all hypotheses in the model are accepted.

6 Discussion

In this study, the interplay between role overload, work-family conflict, turnover intention, and job satisfaction among public employees in the Central Anatolia region of Turkey was explored using quantitative methods and structural equation modeling. The findings revealed several important insights into the dynamics of these variables.

Previous studies (Bajaba et al., 2022; Cortese et al., 2010; Darrat et al., 2010; Deng et al., 2018; Gao et al., 2012; Gilboa et al., 2008; Grandey et al., 2005; Jensen et al, 2011; Jia & Li, 2021; Kalliath & Kalliath, 2013; Lambert et al., 2020; Matthews et al., 2013; Pathardikar et al., 2023; Ribeiro et al., 2023; Terry & Woo, 2020; Vickovic & Morrow, 2020; Viegas & Henriques, 2021; Zito et al., 2019) the relationships among role overload, work-family conflict, job satisfaction, and turnover intention were examined, but no study has used these variables together.

The first hypothesis, that RO has a positive effect on WFC, was accepted because of the analyses. There are other results supporting this hypothesis in the literature (Adebayo, 2006; Dodanwala et al., 2022). This suggests that when employees are burdened with excessive responsibilities and tasks in the workplace, they are more likely to experience conflict between their work and family roles. This finding aligns with existing literature on the relationship between workload and work-life balance.

Another hypothesis, that WFC has a negative effect on JS, is also accepted. Similar results have been reported in the literature (Baş & Güney, 2022; Lu et al., 2017). This suggests that employees have difficulty in balancing work and family responsibilities and that this is a problem that needs to be addressed.

The third hypothesis, that WFC has a positive effect on TI, was accepted. As WFC increases, TI also increases. In other words, workers' intents to leave rise in tandem with the degradation of their work-family life balance. This finding emphasizes the importance of addressing work-family conflict in the workplace to reduce turnover intentions. Similar negative effects have been found in the literature (Anderson et al., 2002; Liu & You, 2019; Lu et al., 2017; Rasheed et al., 2018; Wang et al., 2017).

In the final hypothesis, it was confirmed that JS exerts a negative influence on TI. This is consistent with the well-established understanding that satisfied employees are less likely to seek alternative employment opportunities. Therefore, organizations that prioritize employee satisfaction are likely to experience lower turnover rates and greater employee retention. Meta-analyses have consistently underscored job satisfaction as one of the principal precursors to TI (Choi & Kim, 2016; Özkan et al., 2020). In this context, (Tett & Meyer, 1993) stated that among other factors affecting turnover intention, job satisfaction has the most negative effect on turnover intention. JS has a direct and negative effect on turnover intention (Han & Jekel, 2010; Lu et al., 2017; Tziner et al., 2015). JS and TI are significantly and inversely related, indicating a strong direct relationship. Consequently, all hypotheses developed because the examined variables are corroborated and accepted.

7 Conclusion

Several key findings emerged from the analyses carried out in this study. First, a significant and positive association was observed between excessive role overload and work-family conflict. Second, it was established that

work-family conflict exerts a negative impact on job satisfaction. Additionally, work-family conflict was found to have a positive effect on turnover intention. Lastly, job satisfaction was revealed to have a negative influence on turnover intention. The results were also significant according to role conflict theory, conservation of resources theory, and social exchange theory on which the study was based. Consequently, all hypotheses were considered significant and accepted. In summary, the role overload experienced by public sector employees initiates work-family conflict, which subsequently reduces job satisfaction and increases turnover intentions. Furthermore, an increase in job satisfaction among public employees is associated with a reduction in turnover intention. Employees who experience role overload may encounter difficulties in achieving a balance between their work and family lives. Organizations and managers must pay attention to this situation. Happy employees may also have high productivity. Hence, an equitable distribution of work among employees can alleviate the burden of role overload, thereby facilitating the achievement of work-family balance. Conversely, the presence of detrimental factors such as role overload and work-family conflict are likely to engender job dissatisfaction among employees and disrupt the harmonious functioning of the organization. (Kelly et al., 2011). Again, unfavorable situations may create pressure on employees and lead them to intention to quit, which is the thought before leaving the job. In this case, a high employee turnover rate and a loss of the labor force may result.

Our study has certain limitations and offers opportunities for future research Primarily because the research was conducted only among public sector employees in Turkey, the results may not be directly extrapolated to other industries or countries. Nevertheless, it is assumed that the variables addressed may also be experienced in other sectors or countries. Second, collecting data in a single period may cause method bias. Finally, the fact that the sample of the research covers only public sector employees is seen as a limitation of the research. Finally, in future studies, it is recommended that comparisons be made by selecting different sectors as a sample. It is thought that improving the working hours of the employees, improving their wages, and providing more career development opportunities for them will enable them to reduce their stress, concentrate more on their work, feel more satisfied, and thus reduce their intention to leave the job.

8 Policy Recommendations

Reducing role overload and work-family conflict in public sector organizations requires a multifaceted approach that integrates organizational policies, human resource management (HRM) practices and individual support mechanisms. The implementation of flexible working arrangements, such as special leave benefit schemes, and HR practices that enhance resilience can reduce workload and work intensity, as evidenced by the reported satisfaction of civil servants in South Korea (Kim et al., 2024). Furthermore, the creation of a constructive organizational atmosphere integrated with transformational leadership practices contributes to the reduction of burnout among public sector employees, which is believed to increase overall well-being and service quality (Green et al., 2014).

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Vpliv konflikta med delom in družino na razmerje med preobremenjenostjo z vlogami ter namero po menjavi zaposlitve in zadovoljstvom pri delu

Namen: Namen raziskave je preučiti, kako preobremenjenost z vlogami in konflikt med delom in družino vplivata na namero po menjavi zaposlitve in zadovoljstvo pri delu pri zaposlenih v javnem sektorju. Cilj je prispevati k boljšemu razumevanju dejavnikov, ki vplivajo na dobrobit zaposlenih, ter podati smernice za upravljavske prakse, ki izboljšujejo organizacijsko učinkovitost.
Metodologija: Kvantitativni podatki so bili zbrani pri 390 zaposlenih v javnem sektorju v regiji Osrednje Anatolije v Turčiji. Za analizo relacij med preobremenjenostjo z vlogami, konfliktom med delom in družino, zadovoljstvom pri delu in namero po menjavi zaposlitve je bila uporabljena metoda strukturnega enačbenega modeliranja (SEM).
Rezultati: Rezultati kažejo, da preobremenjenost z vlogami pozitivno vpliva na konflikt med delom in družino, kar posledično negativno vpliva na zadovoljstvo pri delu in povečuje namero po menjavi zaposlitve. Poleg tega se je izkazalo, da višja raven zadovoljstva pri delu statistično značilno zmanjšuje namero po menjavi zaposlitve.
Sklep: Ugotovitve poudarjajo pomen celovitega upravljanja delovnih obremenitev in usklajevanja poklicnega ter zasebnega življenja. Organizacije naj dajejo prednost ukrepom za zmanjševanje preobremenjenosti in obvladovanje konflikta med delom in družino, saj to prispeva k večjemu zadovoljstvu zaposlenih in znižanju fluktuacije kadrov. Z družbenega vidika raziskava opozarja na pomen podpore zaposlenim pri usklajevanju delovnih in družinskih obveznosti, saj to prispeva k njihovemu celostnemu blagostanju in družbeni koheziji.

Ključne besede: *Preobremenjenost z vlogami, Konflikt med delom in družino, Namera po menjavi zaposlitve, Zadovoljstvo pri delu, Teorija konflikta med vlogami*

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The Influence of Benefits and Trust on Consumers' Attitudes towards Artificial Intelligence: The Moderating Role of Threats

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Background/Purpose: This article explores consumers' perception of the benefits of intelligent service robots (ISR) in the purchasing process, their trust in artificial intelligence (AI), their perception of AI-related threats, and the impact of these variables on consumer attitudes toward AI. Additionally, the study examines the moderating effect of perceived AI-related threats on the relationship between perceived benefits and trust on one side and the formation of consumer attitudes toward AI on the other.
Methods: The research was conducted in the first half of 2024 on a judgmental sample of 224 employed consumers in the Republic of Slovenia. Data were collected through a structured online questionnaire. For the empirical analysis, a non-parametric approach using SEM-PLS modelling was applied to examine relationships between the studied research constructs.
Results: The findings indicate that perceived benefits of ISR have a strong and positive impact on consumer attitudes toward AI, while perceived AI-related threats strongly and negatively influence these attitudes. Moreover, the results reveal that perceived AI-related threats significantly and negatively moderate the effect of consumers' perceived trust in AI on the formation of their attitudes toward AI.
Conclusion: The results of this study contribute significantly to the theoretical understanding of employed consumers' attitudes toward AI. They also provide practical implications for companies in developing predictive models of consumer behaviour and defining effective marketing strategies to encourage AI adoption in the purchasing process.

Keywords: *Artificial intelligence (AI), Consumer attitudes, Perceived AI-related threats, Perceived benefits of intelligent service robots (ISR), Perceived consumer trust*

JEL Classification: M21, M31

1 Introduction

Artificial intelligence (AI) refers to technologies capable of performing tasks that typically require human intelligence (Stein et al., 2024), such as visual perception, speech recognition, decision-making, and natural language processing. AI systems are designed to learn from experience and improve over time using algorithms and statistical models (Ahmad et al., 2023; Russell & Norvig, 2010). Consequently, AI has a transformative impact on how we live and work (Lockey et al., 2021), enhancing efficiency, accuracy, and decision-making.

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AI has numerous applications across various fields and industries, including healthcare, finance, retail, transportation, education, and marketing (Cavallo, 2019; Cao, 2022; Bughin et al., 2018; Bharadiya, 2023; Özüdoğru & Cakir, 2021; Huang & Rust, 2018).

The marketing industry, in particular, has widely adopted AI, streamlining various market exchange processes such as customer segmentation and personalized advertising. AI can analyse customer data to identify behavioural patterns and provide personalized recommendations and advertisements based on customer preferences and purchase history (Basha, 2023). It supports the evolution of marketing toward automated, data-driven value creation, optimizing operations by automating tasks and enabling precise marketing strategies (Kirova & Boneva, 2024; Martinez-Lopez & Casillas, 2013). Additionally, it enhances product and service customization by analysing consumer purchases and interests (Trawnih et al., 2022; Shank et al., 2019).

AI is transforming the way companies interact with customers, leading to improved customer experiences and satisfaction. AI technologies, such as chatbots, virtual assistants, and predictive analytics, offer numerous benefits to consumers by enhancing service quality, personalizing experiences, and increasing purchasing efficiency (Aksu & Sener, 2024; Trawnih et al., 2022; Xu et al., 2021). As a result, the rapid adoption of AI is reshaping the consumer buying process and significantly influencing consumer behaviour, including attitudes toward AI (Mendez-Suarez et al., 2024).

Recent research indicates that AI has a significant impact on consumer trust (Chi & Vu, 2022). Studies have observed a positive relationship between empathetic AI responses and consumer trust, as they improve communication quality between AI systems and consumers, fostering AI acceptance as a service agent (Chi & Vu, 2022; Huang & Rust, 2018). Previous research has primarily focused on factors such as transparency, explainability, accuracy, reliability, automation, anthropomorphism, and mass data extraction as key antecedents and challenges of trust in AI technology (Lockey et al., 2021; Hasan et al., 2021; Zarifis & Cheng, 2022). However, there is a lack of detailed research examining consumer trust and the benefits of AI as key factors influencing consumer attitudes toward AI.

On the other hand, the adoption of AI technologies has raised concerns regarding privacy, security, and job displacement (Mirbabaie et al., 2022). Therefore, it is essential to understand consumers' perceived experiences with AI, both in the buying process and in general, as these perceptions shape their attitudes toward AI and influence their willingness to engage with AI technologies (Kieslich et al., 2021). Negative attitudes toward AI may lead to skepticism regarding its capabilities, concerns about potential risks and ethical implications, and ultimately, reduced adoption (Ikkatai et al., 2022). Additionally, some consumers exhibit significant hesitation and fear toward autonomous systems (Hinks, 2020).

We argue that consumer attitudes toward AI technologies are a crucial factor strongly influencing behavioural patterns and the willingness to adopt AI in the buying process. While consumers recognize the benefits of AI and trust its capabilities, they also perceive potential threats, such as job displacement, changes in work tasks, ethical and security dilemmas, and other possible negative consequences of AI implementation in different environments. However, research exploring this "dual role" of consumers—both recognizing the advantages and perceiving threats of AI—remains limited.

This study contributes to the theoretical understanding of consumer attitudes toward AI and the factors influencing their formation by focusing on employed consumers. This approach provides a more comprehensive assessment of attitudes toward AI, exploring the interplay between the perceived benefits of AI in the purchasing process, general trust in AI, and perceived risks of AI both in the purchasing process and the workplace.

To address the identified gaps in the literature, we formulated the following research questions:

(a) How do the potential benefits of AI for consumers, consumer trust in AI, and perceived threats of AI influence consumer attitudes toward AI?

(b) Do perceived threats moderate the relationship between perceived benefits, trust, and consumer attitudes toward AI?

Furthermore, the findings of this research are expected to provide valuable insights for policymakers and companies, helping them design and market AI-based products and services that address consumer concerns and preferences, mitigate perceived threats, and overcome adoption barriers to improve consumer attitudes toward AI.

2 Literature Review and Hypothesis Development

2.1 Consumers' benefits of AI

To fully exploit the economic and societal advantages of AI technologies, it is vital for companies to comprehend and quantify their benefits for consumers (Ahmad et al., 2023) in order to know how do they feel about their AI products to market them better (Haleem et al., 2022). Perceived benefits are beliefs about the positive outcomes associated with a cognitive, affective or behaviour response of consumers to a real or perceived threat (Chandon et al., 2000; Liu et al., 2012). Grewal et. al (2021) suggest that realized and anticipated benefits of AI for consumers based on customized offers achieved through data-led personalization, optimization, and innovation.

According to the majority of researchers, there are a few benefits of AI for consumers: enhances decision-making and problem solving (Sivarajah et al., 2017; Topol, 2019; Bastani et al., 2021; Chen et al., 2019), increases efficiency and productivity, customization (Grewal et al., 2021) as well as enhances consumers' experience (Trawnih et al., 2024), which is relating to the interactions between the consumer and the company during the consumer' journey, and encompasses multiple dimensions: emotional, cognitive, behavioural, sensorial, and social (Puntoni et al., 2021; Lemon and Verhoef, 2016; Brakus et al., 2009).

From the marketing point of view, last mentioned benefit of AI, i.e. enhanced consumer experience, significantly reshapes exchanging processes by enhancing customer engagement through interaction and increasing efficiency (Xu et al., 2021). By analysing customer data, AI can create a detailed profile of each consumer and use this information to provide customized recommendations and offers (Kadambi et al., 2018). The data capture experience provides benefits to consumers because it can make them feel as if they are served by the AI: the provision of personal data allows consumers access to customized services, information, and entertainment, often for free (Puntoni et al., 2021).

Consumers in buying process often face with intelligent customer service robots (i.e. chatbots and virtual assistants), which can significantly influence their experience with AI. Chatbots are automated software programs that can simulate conversation with human users. They can be used to provide customer support, answer common questions, and provide recommendations. Virtual assistants are similar to chatbots but are designed to provide more personalized assistance to users (Jenkins, 2021) by offering quick and efficient support and reducing wait times. They can also be available 24/7, providing consumers with access to support outside of regular business hours.

Consequently, companies can improve consumer satisfaction and loyalty, leading to increased revenue and consumer retention. Chatbots and virtual assistants can also reduce the need for human support staff, leading to cost savings for companies. Predictive analytics can be used to identify trends and patterns in consumer behaviour, which can be used to develop targeted marketing campaigns and identify new opportunities for growth (Mariani et al., 2023).

Despite of a number of researches on specific elements of consumers' benefits of AI, and factors through which we can explain cognitive, affective and behavioural reactions of consumers in relation to implementation of AI technology, there is still a research gap.

To fill this gap, our research tries to contribute to more comprehensive insight into different viewpoints of consumers' benefits of specific manifestation of AI (i.e. intelligent consumer service robots), and a potential impact of these benefits on consumers' attitudes towards AI.

Suggested by Gao et al. (2022), potential consumers' stimuli of AI can fall into five groups: perceived interactivity of consumers, perceived personalization of consumers, consumers' engagement, consumers' value co-creation, and consumers' ability readiness. In our opinion, first four groups of stimuli, suggested by Gao et al. (2022), have the characteristics of consumers' benefits of AI as well.

Perceived interactivity and personalization are two of the most critical stimuli, with the former relating to consumers' subjective assessment of their interaction with AI technology overall (Scardamalia and Bereiter, 2014; Gao et al., 2022) and the latter relating to the potential of AI technology to provide consumers with customized and personalized services (Neuhofer et al., 2015; Gao et al., 2022). AI based devices with high levels of interactivity not only enable consumers to engage, but also provide them with opportunities to share information and emotional support with others (Roy et al., 2019; Gao et al., 2022). In addition to these, high levels of personalized offerings provide consumers with customized suggestions or solutions through algorithmic analysis to satisfy their personal preferences and needs (Heer, 2019; Gao et al. 2022).

Consumers engagement is mental state of consumers who are creating experiences with a company in a specific service relationship (Brodie et al., 2011). AI systems are only useful if consumers recognize the suggestions provided by AI before they can accept the AI itself (Gao et al., 2022).

Among the actors involved in the value co-creation process, consumers have been identified as a particularly significant contributor that companies can effectively exploit (Tran and Vu, 2021). According to Zhang and Chen (2008), companies focus on co-creation with consumers can help to gain new competences, and to achieve a more competitive advantage for them. On the other side, consumers' cooperation with companies and their empowerment in process of creating a new product (AI technology) influence their level of perceived benefits, received from the AI, and their level of satisfaction as well.

In our opinion such framework can offer a good starting point to hypothesize:

Hypothesis 1: Consumers' perceived benefits of intelligent consumer service robots (ICSRs) have a positive and significant effect on consumers' attitudes towards AI technology.

2.2 Consumers' trust in AI

Although there is no universally accepted scholarly definition of this concept, we can define trust as 'a belief by one party in a relationship that the other party will not act against his or her interests, where this belief is held without undue doubt or suspicion and in the absence of detailed information about the actions of the other party'

(Tomkins, 2001; Laaksonen et al., 2008). One party may trust the other party's benevolence (a belief that on party acts in the interests of the other), honesty (a belief that the other party's word is reliable and credible), and competence (a belief that the other party has the necessary expertise to per-form as required) (Buttle, 2010).

Therefore, trust is a vital aspect of consumers' behaviour, influencing the attitudes and decision-making processes of consumers towards products and services (Rousseau et al., 1998) and is linked to consumers' expectation of services provided by companies (Chi and Vu, 2022), namely the two components of trust are the intention to accept vulnerability based on positive expectations of consumers (Lockey et al., 2021).

In the context of AI, trust can be defined as the willingness of individuals to rely on AI systems and accept their recommendations or decisions. Trust in AI can be influenced by various factors, including the perceived reliability, competence, and ethical standards of the system and its operators (Mayer et al., 1995). Deeper understanding of consumers' trust based on AI system features to consumers' motivation and responses has yet to be reached. From this perspective, consumers' trust in AI is defined as a common ground of belief from consumers to AI devices (Chi and Vu, 2022).

As AI technologies are increasingly integrated into various aspects of daily life, the importance of trust in AI is growing (Wang et al., 2019). Trust plays a crucial role in ensuring the safe and effective use of AI, as well as promoting public acceptance of these technologies. Some researchers have shown that consumers are more likely to adopt and use new technologies when they trust the technology and its providers (Riegelsberger et al., 2003). On the other hand, lack of trust in technology can lead to resistance and reluctance to use it. Therefore, building and maintaining trust is essential for the successful adoption and integration of AI technologies into every day' buying processes of consumers (Komiak and Benbasat, 2006).

However, building trust in AI is not always easy, as AI systems often operate in complex and opaque ways, making it difficult for consumers to understand how decisions are made (Lu et al., 2025). Additionally, concerns about privacy, security, and bias can erode trust in AI systems (Kaplan and Haenlein, 2019). As a result, there is a need for greater transparency and accountability in AI systems to increase trust and confidence in their use (European Commission, 2020).

Another challenge to building trust in AI is the lack of regulation and standardization in the industry. As AI technologies continue to evolve and develop, there is a need for clear guidelines and standards to ensure the ethical and responsible use of AI. This will not only help build trust among consumers but also promote innovation and growth in the industry (Floridi et al., 2018).

The adoption of new technologies by the public is strongly influenced by the level of trust that individuals have in those technologies (Siau and Wang, 2018). This is especially true for AI technologies, which are often viewed as complex and potentially dangerous. Research has shown that trust is a key factor in the adoption of AI technologies, and that lack of trust can be a significant barrier to adoption (Hasan et al., 2021; Venkatesh et al., 2003).

One of the main reasons why trust is important for the adoption of new technologies is that it reduces uncertainty and perceived risk. When individuals are uncertain about the potential risks and benefits of a new technology, they may be hesitant to adopt it. Trust helps to reduce this uncertainty by providing individuals with a sense of confidence that the technology will perform as expected and that their personal information will be protected (Zarifis and Cheng, 2022; Morgan and Hunt, 1994).

Another important factor in the role of trust in the adoption of AI technologies is the social influence of trust. Consumers are often influenced by the opinions and behaviours of others when making decisions about new technologies. If individuals perceive that others trust a new technology, they are more likely to adopt it themselves. On the other hand, if there is a lack of trust in a new technology, this can lead to a negative perception and reduced adoption (Lockey et al., 2021; Luhmann, 1988).

In our opinion, trust plays a crucial role in consumers' adoption of AI technologies. To promote the adoption of AI, it is important for developers of AI and policymakers to prioritize building trust with the consumers by addressing concerns related to transparency, ethics, and security. By building trust, AI technologies can be adopted more widely and effectively, leading to their potential benefits and positive consumers' attitudes towards AI. Hence, our hypothesis is proposed as follows:

Hypothesis 2: Consumers' trust in AI has a positive and significant effect on consumers' attitudes towards AI technology.

2.3 Consumers' perceived threats of AI

Consumers as general public (outside the buying process) show, despite of perceived benefits of AI, some considerable restraint when it comes to the broad societal diffusion of AI applications that might even border on actual fear of such technology (Kieslich et al., 2021; Hinks, 2020; McClure, 2018; Liang, 2017). Understanding both, benefits and threats, enables companies a more comprehensive approach to threats assessment (Ahmad et al., 2023; Tepylo et al., 2023). If companies' know how people feel about their AI products, they can market them better (Ahmad et al., 2023; Haleem et al., 2022).

There are numerous articles discussing the threats of AI tools for general public. The majority of researchers define the following reasons of threats: job displacement

(Mirbabaie et al., 2022), economic inequality (Brynjolfsson and McAfee, 2014), ethical and legal reasons (Huang et al., 2023; Wach et al., 2023; Kieslich et al., 2021), lack of transparency (Jones, 2018), potential for different types of bias (Buolamwini and Gebru, 2018), and risk of potential misuse and abuse (Tufekci, 2018).

AI has the potential to automate many tasks that are currently performed by humans, which may lead to job loss and unemployment. Recent research has suggested that up to 47% of US jobs are at risk of automation in the next few decades (Frey and Osborne, 2017). While some new jobs may be created by the development of AI, the displacement of jobs is likely to have a significant impact on the labour market and may disproportionately affect low-skilled workers and those in industries that are most susceptible to automation, such as manufacturing and transportation (Mirbabaie et al., 2022; Autor, 2015).

The displacement of jobs can also lead to economic inequality. Those who are most impacted by job loss may not have the skills or resources to adapt to new jobs or industries, which can lead to long-term unemployment and reduced income. This may exacerbate existing economic inequalities and create a widening gap between the rich and poor (Brynjolfsson and McAfee, 2014). In addition, the development of AI may create a new class of "winner-takes-all" industries, where a few companies and individuals benefit greatly from the advances in AI technology, while others are left behind (Brynjolfsson and McAfee, 2014).

As AI technology continues to advance, there are growing concerns about its ethical and legal implications. One of the main ethical concerns surrounding AI is the potential for the technology to be used in ways that violate privacy and human rights. Facial recognition technology has been criticized for its potential use in mass surveillance and tracking of individuals without their consent (Huang et al., 2023; Wach et al., 2023; Kieslich et al., 2021; Crawford and Calo, 2016). The possibility for AI to be prejudiced or racist is yet another ethical worry. Because AI systems are trained on historical data, they may learn and perpetuate existing biases and inequalities. This might result in unfairness in the recruiting, financing, and criminal justice systems.

In addition, the lack of diversity in the tech industry may contribute to biased AI systems, as the people designing and developing these systems may not represent the diversity of the population they are intended to serve (O'Neil, 2016). There are also legal concerns surrounding AI, particularly in the area of liability. As AI systems become more autonomous and make decisions that impact human lives, questions arise about who is responsible if something goes wrong (Mirbabaie et al., 2022; Calo, 2015).

One of the major challenges with AI systems is their lack of transparency and potential for bias. AI systems can be very complex, and it can be difficult to understand how they make decisions. This lack of transparency can make it difficult to identify errors or biases in the system, which can have significant consequences (Jones, 2018).

One way in which bias can manifest in AI systems is through biased data. AI systems learn from the data they are trained on, and if that data is biased, the system can learn to make biased decisions. Specifically, if a facial recognition system is trained on a dataset that is predominantly male and white, the system may not perform as well on images of women or people with darker skin tones. This can have serious implications for areas such as law enforcement or hiring decisions (Buolamwini and Gebru, 2018). In addition to biased data, AI systems can also perpetuate and amplify existing social biases. If an AI system is trained on data that reflects existing gender or racial biases, the system may learn to perpetuate these biases in its decisions. This can lead to discrimination and exacerbate existing inequalities (O'Neil, 2016).

While AI has the potential to bring significant benefits to consumers, there is also a risk of potential misuse and abuse. This can occur in a variety of ways, such as the use of AI for malicious purposes (cyberattacks or the spread of misinformation) (Ye et al., 2016), or the unintended consequences of AI systems (perpetuation of biases or the amplification of harmful behaviours) (O'Neil, 2016). This can lead to discriminatory outcomes, such as biased hiring decisions or the denial of access to services for certain groups of people. AI systems can amplify harmful behaviours, such as the spread of hate speech or the promotion of extremist content, by prioritizing engagement over accuracy or truth (Tufekci, 2018).

According to some previous researches, threats of AI are at first processed cognitively (Kieslich et al., 2021; Witte, 1992) and, therefore, can shape consumers' attitudes towards AI. Consequently, we hypothesize:

Hypothesis 3: Consumers' perceived threats of AI have a negative and significant effect on consumers' attitudes towards AI technology.

2.4 Consumers' Attitudes towards AI

According to Eagly and Chaiken (1993), attitudes are described as "evaluative judgments about objects, people, or events that are expressed by positive or negative affect, cognition, or behaviour". Positive, negative, or neutral attitudes as evaluations can be communicated with affective, cognitive, and behavioural reactions (Fishbein and Ajzen, 1975).

There are a number of factors that affect how attitudes are formed, i.e. personal beliefs, social influence, as well as cognitive processes, such as perception and learning. Personal beliefs refer to an individual's thoughts and convictions about an object or issue. Experiences, socializa-

tion, and media exposure can all have an impact on these beliefs (Ajzen and Fishbein, 1980). Social influence refers to the impact that others have on individual's attitudes and behaviour. It can take many forms, including conformity, social comparison, and persuasion (Cialdini and Goldstein, 2004). In order to make sense of their surroundings, people organize and interpret sensory data through a process known as perception. Contrarily, learning describes the process by which people pick up new facts and understanding about a subject. Both, perception and learning can shape an individual's attitudes towards an object or issue (Petty and Cacioppo, 1986).

To successfully design, develop, launch, communicate, and promote new AI-intensive products, companies must first understand their consumers' attitudes towards AI, as current consumer perceptions appear to be divided (Mendez-Suarez et al., 2024). It is essential to understand consumers' views on AI; thus, reducing perceived risks, enhancing potential benefits, strengthen their trust, and diminish perceived threats. Consumers with more favourable attitudes towards AI are more likely to hold positive views of AI and more receptive attitude toward AI in marketing communications (Lobera et. Al., 2020; Chen et al., 2022; Mendez-Suarez et al., 2024).

Several theoretical frameworks have been proposed to explain how individuals form attitudes towards new technologies such as AI. Technology Acceptance Model (TAM) developed by Davis (1989) posits that perceived usefulness and perceived ease of use are the primary determinants of an individual's intention to use a technology. This model has been used to study public attitudes towards a wide range of technologies, including AI (Venkatesh et al., 2003).

Another relevant theoretical framework is the Social Cognitive Theory (SCT) developed by Bandura (1986). According to SCT, individuals learn attitudes and behaviours through observation and modelling of others, as well as through their own experiences (Bandura, 1986). In the context of AI, SCT could be applied to understand how individuals form attitudes towards AI based on their exposure to AI technologies and their perceptions of AI in the media.

The Technology Risk Framework (TRF) developed by Slovic (1999) is another relevant framework. The TRF suggests that public attitudes towards technologies are influenced by three main factors: dread risk, unknown risk, and personal control. Dread risk refers to the perceived potential for a technology to cause catastrophic harm, unknown risk refers to uncertainties surrounding the technology, and personal control refers to the perceived ability of an individual to control the risks associated with the technology (Slovic, 1999).

Attitude-Behavioural Intention (ABI) model developed by Moon and Kim (2001) suggests that attitudes towards AI are influenced by perceived usefulness, perceived ease of use, and perceived risks associated with AI. These attitudes, in turn, influence an individual's intention to use or not use AI.

Another relevant model is the Cognitive-Affective-Conative (CAC) model proposed by Cacioppo et al. (2007). This model suggests that attitudes towards AI are formed through cognitive (i.e. beliefs about AI), affective (i.e. emotions towards AI), and conative (i.e. behavioural processes). This model has been used to study attitudes of individuals towards a range of technologies, including AI (Kraus, 2017; Stein et al. 2024).

While theoretical frameworks and models provide a useful starting point for understanding consumers' attitudes towards AI, empirical studies are necessary to gain a more comprehensive and nuanced understanding of these attitudes. Nevertheless, a growing body of research has explored consumers' attitudes towards AI, examining factors such as trust, risk perception, benefits, drawbacks, and ethical considerations, there are still gaps and limitations in the literature that need to be addressed, if we investigate consumers' attitudes towards AI. Therefore, it seems to be a good platform for empirical research.

2.5 The moderating role of consumers' perceived threats of AI

In order to get comprehensive insight into consumers' attitudes towards AI as a consequence of their perceived benefits of AI and perceived trust in AI, it is of great importance not to overlook consumers' perceived threats of AI. Although consumers evaluate specified benefits of AI and develop a particular level of trust in it during the buying process, they inevitable face different threats of AI in every day' life, which are not necessarily derived as a consequence of their interaction and experiences in the buying process. Such threats can arise as a result of different factors, as for example: personal opinion, their readiness to adopt AI devices, and a huge number of influences from external environment (i.e. social, economic, cultural, technological, educational etc.).

Therefore, we posit that consumers' perceived threats of AI may moderate, i.e. effect strength of the impact of consumers' potential benefits of AI and consumers' perceived trust in AI. Thus, our study proposes:

Hypothesis 4: Consumers' perceived threats of AI negatively and significantly moderates the effect of consumers' perceived benefits of AI on consumers' attitudes towards AI.

Hypothesis 5: Consumers' perceived threats of AI negatively and significantly moderates the effect of consumers' perceived trust in AI on consumers' attitudes towards AI.

3 Research Methodology and Results

3.1 Sample and collection of data

The data for the empirical research was collected through a highly structured online questionnaire from January 2024 to June 2024. The respondents were employed consumers aged 18 to 64 in the Republic of Slovenia who had used intelligent consumer service robots (ICSRs) in their purchasing process.

In the first step, the questionnaire was distributed to a convenient sample of 600 respondents, using filter questions regarding their age range, employment status, and experience with ICSRs in the purchasing process. In the second step, a non-random judgmental sampling method was applied to select valid responses based on the required respondent parameters for our research. Among the received questionnaires, 224 were deemed valid.

A chi-square test of early and late respondents showed no significant differences ($p > 0.05$) in gender, age, years of employment, or monthly income. Therefore, the possibility of non-response bias was ruled out. The characteristics of the respondents in terms of gender, age, years of employment, and monthly income are presented in Table 1.

3.2 Analysis of data

The research is quantitative using non-parametric approach to SEM-PLS modelling of relations between the main research constructs: consumers' perceived benefits of ICSRs, consumers' perceived trust in AI, and consumers' perceived threats of AI as independent research constructs on one side, as well as consumers' attitudes towards AI as dependent research construct. In addition to these, the moderating impact of consumers' perceived threats of AI was analysed. Figure 1 shows to us the conceptual framework developed.

Table 1: Respondents' demographic characteristics

Criteria	Frequency	%
Gender		
Male	123	54,9
Female	101	45,1
Age		
18 – 24 years old	58	25,9
25 – 34 years old	76	33,9
35 – 49 years old	72	32,1
50 – 64 years old	18	8,1
Working years		
Below 3 years	37	16,5
3 – 5 years	55	24,6
5 – 10 years	51	22,8
Above 10 years	81	36,1
Monthly income		
Below 1000 euro	39	17,4
1000 – 1500 euro	78	34,8
1501 – 2000 euro	67	29,9
Above 2000 euro	40	17,9

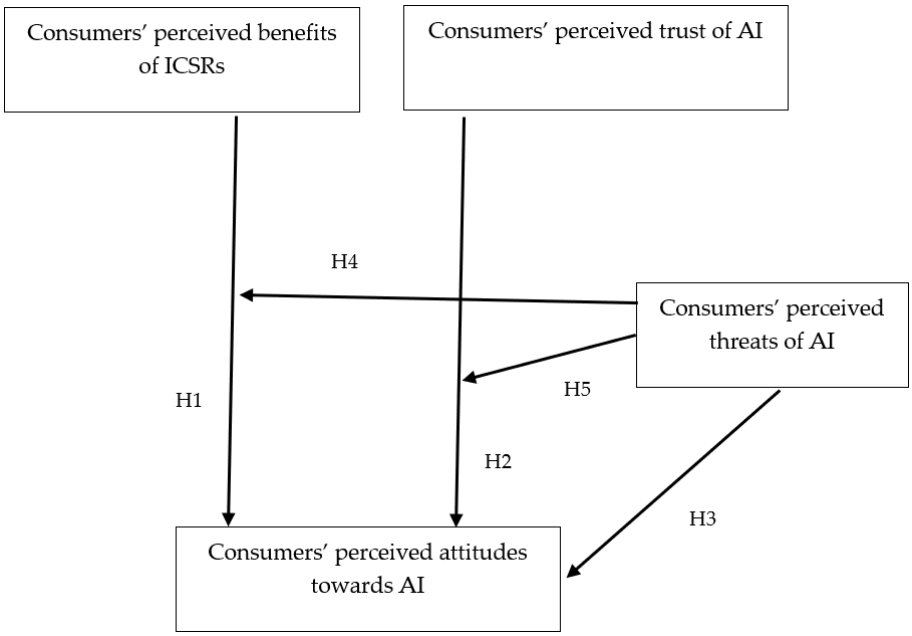

Figure 1: Conceptual framework

3.2.1 Measurement model

All the items for main constructs that we have used in our empirical study have been collected by the relevant authors, who empirically investigated the constructs analysed in our research, and have been measured by five-point Likert scale (5 – strongly agree to 1 – strongly disagree).

The items of consumers' perceived benefits of intelligence consumer service robots (ICSRs) scale were generated by literature reviews. Finally, we derived from S-O-R framework, suggested by Jacoby (2002), Koo and Ju (2010) and modified by Gao et al. (2022), which covers different aspects of possible consumers' stimuli appearing as possible consumers' benefits. They act as external stimuli (S), can affect consumers' internal cognitions and emotions (O), and eventually drive their behaviour responses (R). According to such comprehensive definition, perceived consumers' benefits of intelligent consumer service robots (ICSRs) may fall into four groups of benefits: perceived interactivity, perceived personalization, customer engagement, and value co-creation (Gao et al., 2022) with 19 items.

Consumers' perceived trust in AI have been measured by six items, which are validated by Pelau et al. (2021) and implemented by Chi and Vu (2022), who have investigated the impact of anthropomorphism, empathy response, and interaction on the customer trust in AI. Therefore, such measurement may fit our research objectives too.

The items for measuring consumers' perceived threats of AI, adapted for our empirical research, derived from psychometric instrument to measure threats, suggested and conducted by Ahmad et al. (2023) and encompass 14 items.

Consumers' attitudes towards AI have been measured by ATTARI-12 Scale of attitudes, suggested by Stein et al. (2024), which incorporates 12 items with the psychological trichotomy of cognition, emotion, and behaviour as the main components of attitude as well as captures both positive and negative aspects of the attitude towards AI. Therefore, by opinion of the authors, it eliminates some weaknesses of other known scales for attitudes measurement, i.e. General Attitudes Towards Artificial Intelligence Scale – GAAIS (Schepman and Rodway, 2020), the Attitudes Towards Artificial Intelligence Scale – ATAI (Sindermann et al., 2020), AI Anxiety Scale – AIAS (Wang and Wang, 2019), and the Threats of Artificial Intelligence Scale – TAI (Kieslich et al., 2021).

First of all, we tested the convergent validity of research constructs using item loadings, Cronbach alpha coefficient (CA), average variance extracted (AVE), and composite reliability (CR).

The results of PLS analysis show to us that all research constructs and items indicated satisfactory average variance extracted (AVE), Cronbach's alpha coefficient (CA), composite reliability (CR) and item loadings (all loadings are higher than 0.65 for the sample size n = 224). Therefore, we can conclude that they demonstrate overall satisfactory

discriminant validity and reliability and satisfactory convergent validity. Detail list of all construct items, means, standard deviations, Cronbach's alpha, AVE as well as CR values and item loadings are provided in table 2.

The validity of research constructs in our reflective measurement model and individual items was tested also by exploratory factor analysis in order to estimate the convergent validity. All items of our research constructs possess main item loadings above 0.65, while side loadings are below 0.3 (Fornell and Larcker, 1981). According to such results, we can conclude that convergent validity is satisfactory.

In addition to these, we tested the research constructs and items by HTMT criterion (Hetrotrait-Monotrait) to assess discriminant validity and indicate the research constructs' correlations, which is suggested by Henseler et al. (2015) and Kline (2015). The results in the table 3 show to us that the criterion for discriminant validity for all research constructs is achieved, because all values are lower than 0.85.

Table 2: Construct items, means (M), standard deviations (SD), Cronbach's alpha (CA), average variance extraction (AVE), composite reliability (CR), and item loadings

Research Constructs	Items	M	SD	Item loadings	CA	CR	AVE
Consumers' perceived benefits of ICSRs		2.88	0.80		0.71	0.85	0.66
	CPB1	2.31	0.73	0.81			
	CPB2	3.85	0.76	0.86			
	CPB3	3.90	0.85	0.84			
	CPB4	2.21	0.71	0.79			
	CPB5	3.08	0.66	0.77			
	CPB6	2.14	0.89	0.75			
	CPB7	2.87	0.45	0.67			
	CPB8	3.18	0.76	0.68			
	CPB9	2.06	0.64	0.66			
	CPB10	4.02	1.05	0.78			
	CPB11	3.15	0.78	0.69			
	CPB12	2.85	0.62	0.81			
	CPB13	2.76	0.89	0.74			
	CPB14	3.10	0.98	0.68			
	CPB15	2.23	0.56	0.71			
	CPB16	2.06	1.04	0.72			
	CPB17	2.89	1.19	0.66			
	CPB18	3.15	0.93	0.71			
	CPB19	2.85	0.65	0.79			
Consumers' perceived trust in AI		3.96	0.75		0.68	0.73	0.66
	CPT1	4.05	0.60	0.71			
	CPT2	4.14	0.71	0.67			
	CPT3	3.65	0.75	0.66			
	CPT4	4.17	0.79	0.68			
	CPT5	3.90	0.94	0.69			
	CPT6	3.86	0.72	0.79			

Table 2: Construct items, means (M), standard deviations (SD), Cronbach's alpha (CA), average variance extraction (AVE), composite reliability (CR), and item loadings (continue)

Research Constructs	Items	M	SD	Item loadings	CA	CR	AVE
Consumers' perceived threats of AI		3.50	0.85		0.81	0.85	0.77
	CPTH1	3.61	1.13	0.74			
	CPTH2	4.05	1.39	0.66			
	CPTH3	3.55	0.92	0.67			
	CPTH4	4.08	0.95	0.73			
	CPTH5	4.16	0.69	0.69			
	CPTH6	4.03	0.77	0.70			
	CPTH7	3.78	0.62	0.68			
	CPTH8	3.32	0.96	0.79			
	CPTH9	3.09	0.74	0.67			
	CPTH10	2.92	1.13	0.84			
	CPTH11	3.01	0.60	0.74			
	CPTH12	3.45	0.73	0.78			
	CPTH13	2.88	0.61	0.67			
	CPTH14	3.14	0.71	0.66			
Consumers' attitudes towards AI		3.75	0.77		0.77	0.89	0.85
	CA1	4.03	0.78	0.71			
	CA2	4.15	0.82	0.73			
	CA3	3.87	0.75	0.69			
	CA4	3.94	0.63	0.72			
	CA5	3.85	0.96	0.79			
	CA6	4.06	0.88	0.78			
	CA7	3.67	0.65	0.67			
	CA8	3.05	0.89	0.66			
	CA9	3.15	0.92	0.66			
	CA10	4.02	0.77	0.81			
	CA11	3.55	0.62	0.82			
	CA12	3.67	0.61	0.67			

Table 3: HTMT ratio for discriminant validity assessment

Research constructs	1	2	3	4
1 Consumers' perceived benefits of ICSRs				
2 Consumers' perceived trust in AI	0.812			
3 Consumers' attitudes towards AI	0.797	0.774		
4 Consumers' perceived threats of AI	0.841	0.816	0.825	

3.2.2 Structural Research Model Assessment and Results

In the next step of our analysis we tested the structural research model, which is derived from the measurement model explained in the previous step, and tested research hypotheses. Suggested by Hair et al. (2018), we had to assess the proportion of variance explained in order to determine the accuracy of the model's predictions. In our research, the structural model explains 27% of the variance of consumers' attitudes towards AI ($R2 = 0.27$). Next, the Stone-Geisser cross-validated redundancy (Q2) was calculated, which gives us the information about the quality of model prediction. Because in our study $Q2 = 0.81$, the perceived result fits the recommended range between 0 and 1. Thus, we can confirm the predictive relevance of our research.

In the table 4, we present the results of hypotheses testing, including path coefficients (β), t-value, p-value, and final results.

The results in table 4 reveal that the impact of consumers' perceived benefits of ICSRs on consumers' attitudes towards AI is positive and statistically significant, while the consumers' perceived trust in AI has a positive but statistically non-significant impact on consumers' attitudes towards AI. In addition to these, the impact of consumers' perceived threats of AI on consumers' attitudes towards AI is negatively and statistically significant. Therefore, we can confirm the research hypotheses H1 and H3, but we cannot support the research hypothesis H2.

The results of moderation effect of consumers' perceived threats of AI on the impact of consumers' perceived benefits of AI on consumers' attitudes towards AI is not significant. On the other hand, the consumers' perceived threats of AI significantly moderate the impact of consumers' perceived trust in AI on consumers' attitudes towards AI. Therefore, we can confirm research hypothesis H5, while the research hypothesis H4 is not supported.

4 Discussion

4.1 Theoretical and managerial implications

In a world shaped by AI that are supposed to make human life safer, healthier, and more convenient, it is important to understand how people (and particularly consumers) evaluate the very notion of AI – and to identify factors that account for notable variance in this regard (Stein et el., 2024). Therefore, their perception of AI become of great importance. Thus, a comprehensive insight in their attitudes (i.e. cognitive, affective, and behavioural component) towards AI significantly contribute to the knowledge of how do they feel and what are their possible reactions (usage of AI in buying processes as well in general in every day' life).

This research has provided comprehensive insights into the multifaceted landscape of consumers' attitudes towards AI and factors that shape these attitudes. It constructs an integrated analysis framework and research model of three independent research constructs to measure their impact on consumers' attitudes towards AI, during which we explored a moderating influence one of them. The research, therefore, systematically expands the analyses of factors and their multi-collinearity that influence consumers' attitudes towards AI in previous studies. In addition to this, the implementation of specific measurement framework for individual research constructs, based on previous studies and used for other purposes, strongly supported our research objectives and added to the value of our empirical study.

The study researched five fundamental hypotheses, providing a deep understanding of the complex relations between consumers' perception of benefits of ICSRs, trust in AI, threats of AI, and, consequently, their attitudes towards AI. In our opinion, the key findings of our research may significantly contribute to the highly growing field of consumers' perception of AI.

Table 4: Hypotheses testing results

Research hypotheses		β	t-value	p-value	Results
H1	Benefits - Attitudes	0.39	1.64	<0,001	Supported
H2	Trust - Attitudes	0.08	3.23	>0,01	Not-Supported
H3	Threats - Attitudes	- 0.38	2.81	<0.001	Supported
H4	Benefits - Threats - Attitudes	- 0.09	0.87	>0.01	Not supported
H5	Trust - Threats - Attitudes	- 0.22	2.35	<0,01	Supported

Although a huge number of previous researches investigated the role of different research constructs and variables, including benefits and trust, influence customers in the process of shaping their attitudes towards AI (Lobera et al., 2020; Stein et al., 2024; Bergdahl et al., 2023; Gerlich, 2023; Sartori and Bocca, 2023; Aksu and Sener, 2024), there is no previous research that has been focused on moderating role of consumers' perceived threats of AI and their inter-relations with consumers' perceived benefits and trust, which may shape their attitudes towards AI.

In line with our hypothesis H3, it has been affirmed that consumers, who perceive AI as a threat, manifest more negative attitudes towards AI. Our research showed a significantly negative correlation ($\beta = -0.39$, $p < 0.001$) between their concerns about AI threats and their attitudes towards AI. This fact underlines the importance of dealing with consumers concern regarding how AI might affect different fields of their life, as it is essential for encouraging more positive attitude.

However, according to our hypothesis H4, it is important to emphasize that a negative influence of perceived threats of AI does not reduce a positive and strong relation between consumers' perceived benefits of a specific tool of AI (ICSRs), and their attitudes towards AI ($\beta = 0.045$, $p < 0.001$). This finding held particular relevance for chief marketing officers of companies, who care for their AI technology in buying processes as they shed light on the possible negative influences of consumers' perceived threats of AI on their AI adoption. Thus, companies, which enable a use of AI technology for consumers in their process of selling, should strengthen a bundle of benefits of AI perceived by consumers, because perceived benefits, despite of possible threats, significantly impact consumers' attitudes towards AI.

By examining the impact of consumers' perceived trust on their attitudes towards AI (hypothesis H2), the research offers a comprehensive understanding of consumers' perceived threats as a moderator (hypothesis H5). Namely, there exists statistically non-significant positive impact of consumers' perceived trust on their attitudes towards AI ($\beta = 0.10$). However, consumers' perceived threats of AI statistically significantly and negatively moderate the relationship between consumers' perceived trust and their attitudes towards AI ($\beta = -0.22$, $p < 0.01$). The results, obviously, have shown that AI providers should take into the consideration an important negative role of consumers' perceived threats in shaping their attitudes of AI and try to eliminate an influence of such threats in consumers' perception. Consequently, AI developers and policymakers should focus on specific threats perceived by consumers and adopt personalized approaches to effectively address them.

In addition to these, the results of our research enable companies to better understand all three components of the customers' attitude towards AI in the exchange process (i.e. cognitive, affective and behavioural component). Consumers' experiences improved through AI-driven marketing activities can enhance effectiveness and efficiency of exchange processes between the companies and consumers. Hence, knowledge about the factors which influence customers' attitude may support the companies in the process of establishing predictive models of consumers' behaviour, defining efficient marketing strategy aimed to encouraging adoption of AI technology in buying process (Hicham et al., 2023; Verma et al. 2021).

4.2 Research limitations and directions for future research

Despite its contributions to understanding consumers' attitudes towards AI, this research has several limitations. Firstly, the study focused only on non-random judgmental sample of consumers who use AI-related product (i.e. intelligent consumer service robots), which may introduce sample bias and not fully represent the broader population. The reliability of results depends on respondents providing honest and consistent answers, but self-reported data can be influenced by social desirability bias and limited understanding of AI concepts. Second, since data for both endogenous and exogenous research constructs were collected from the same respondents in the same location at the same time, there is a potential for research bias, such as common method bias (MacKenzie and Podsakoff, 2012). Third, the study was conducted over a limited period, affecting the depth of data collection and analysis. A more extensive study with a larger and more diverse sample size could provide deeper insights. Solely relying on surveys might benefit from including other methods like interviews or focus groups to enhance findings. Limited demographic information about respondents may hinder analysis of how factors such as age, gender, income, and working years influence attitudes toward AI. Finally, the rapidly evolving field of AI means consumers' perceptions may change over time, and this research represents a snapshot of their answers at a particular moment. These limitations should be considered when interpreting the findings.

Considering these limitations, future research in this field can benefit from the following suggestions: longitudinal studies which should track changes in consumers' attitudes over time to identify evolving trends and shifts as AI technology progresses; cross-cultural studies by examining AI attitudes across different cultures can reveal unique concerns and expectations as well as offering a more nuanced understanding of global perceptions; in-depth qualitative research, such as interviews and focus groups in combination with quantitative surveys will help uncover the deeper reasons behind consumers' attitudes that surveys alone might miss; contextual analysis with investigating how various applications and contexts of

AI impact consumers' responses can provide insights into specific areas of concern.

Analysing consumers' attitudes toward AI applications in different industries will help address sector-specific concerns.

Furthermore, some ethical considerations should be considered, because research into the ethical aspects of AI, including the development of ethical frameworks, is essential for responsible AI development. Exploring factors that contribute to trust in AI, such as transparency and accountability, can guide the creation of more trustworthy AI systems. As AI technology continues to evolve, understanding and shaping consumers' attitudes remains an ongoing process. Following the suggested areas for future research and addressing individual concerns and ethical issues can help provide clearer and more balanced perspectives on AI. This approach aims to benefit both the industry and society. As AI impacts various aspects of life, establishing a transparent and responsible relationship between AI and the public (not only consumers in buying process) is crucial. This research offers foundational insights that can guide future developments and improve the integration of AI into society.

4.3 Conclusion

Understanding consumer attitudes towards AI is crucial for several reasons. First, it helps companies tailor their products and services to meet consumer expectations. The perceived benefits of AI, such as increased efficiency and personalized experiences, play a significant role in shaping these attitudes. Consumers who recognize the advantages of AI are more likely to embrace it in their daily lives. However, the level of trust that consumers have in AI technologies can significantly influence their acceptance. Building this trust requires transparency, accountability, and ethical considerations by AI developers.

Moreover, consumers' perceived threats associated with AI cannot be overlooked. Concerns about privacy and data security often deter individuals from fully adopting AI solutions. It is essential for companies to address these threats through clear communication and robust security measures. The balance between perceived benefits and threats they recognize ultimately determines consumer sentiment. Companies need to ensure that their AI applications enhance user experience without compromising personal safety.

Finally, understanding consumer attitudes also enables policymakers to create regulations that protect users. By listening to consumer concerns, regulations can enhance trust in AI technologies, setting the groundwork for wider adoption. Therefore, comprehensively understanding consumer perceptions of AI—its benefits and threats, and the importance of trust—is essential for successful integration into society. This understanding ultimately drives innovation while ensuring that AI development remains aligned with public values and expectations.

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Vpliv koristi in zaupanja na stališča porabnikov do umetne inteligence: moderacijska vloga nevarnosti

Ozadje/Namen: V članku raziskujemo porabnikovo zaznavanje koristi inteligentnih storitvenih robotov (ISR) v nakupnem procesu, zaupanje porabnikov v umetno inteligenco (UI), njihovo zaznavanje nevarnosti UI in vpliv omenjenih spremenljivk na porabnikova stališča do UI. V okviru raziskave nas je med drugim zanimalo, kakšen je moderacijski učinek porabnikovih zaznanih nevarnosti UI na odnos med omenjenimi koristmi in zaupanjem na eni strani ter oblikovanjem porabnikovih stališč do UI na drugi strani.
Metode: Raziskava je bila izvedena v prvi polovici leta 2024 na namernem vzorcu 224 zaposlenih porabnikov v Republiki Sloveniji. Podatki so bili pridobljeni s strukturiranim spletnim vprašalnikom. V okviru empirične analize smo uporabili neparametrični pristop z SEM-PLS modeliranjem odnosov med proučevanimi raziskovalnimi konstrukti.
Rezultati: Ugotovili smo, da zaznane koristi ISR močno in pozitivno vplivajo na stališča porabnikov do UI, medtem ko zaznane nevarnosti v zvezi z UI na stališča do UI vplivajo močno negativno. Rezultati raziskave pa so še pokazali, da zaznane nevarnosti v zvezi z UI pri porabnikih statistično pomembno in negativno moderirajo vpliv zaznanega zaupanja porabnikov v UI na oblikovanje njihovih stališč do UI.
Zaključek: Rezultati naše raziskave predstavljajo pomemben prispevek k teoriji na področju proučevanja stališč zaposlenih porabnikov do UI, predstavljajo možno podporo podjetjem v njihovem procesu oblikovanja napovedovalnih modelov vedenja porabnikov ter omogočajo učinkovitejše opredeljevanje ustreznih marketinških strategij za spodbujanje porabnikov pri njihovem sprejemanju UI tehnologije v procesu nakupa.

Ključne besede: *Umetna inteligenca (UI), Stališča porabnikov, Zaznane nevarnosti UI, Zaznane koristi porabnikov do inteligentnih storitvenih robotov (ISR), Zaznano zaupanje porabnikov*

JEL klasifikacija: M21, M31

Appendix: Scales of measurement

Consumers' perceived benefits of intelligent consumer service robots-ICSRs (5-point Likert scale ranging from strongly agree - 5 to strongly disagree - 1)

Perceived interactivity

ICSRs can accurately provide me with the information I need.

When I encounter a problem, ISR can provide me with a solution.

ICSRs can effectively collect consumer feedback.

ICSRs can effectively promote two-way communication with a seller.

Perceived personalization

ICSRs store my preferences and offer me extra services based on my preferences.

ICSRs do a pretty good job guessing what kinds of things I might want and making suggestions.

ICSRs know what I want.

ICSR setup can be personalized to my needs.

The service provided by ICSRs is customized exactly to my question.

Consumers' engagement

I feel like I can be myself when using ICSRs.

The things I did with the ICSRs are in line with what I really wanted to do.

Using ICSRs has become a part of my daily consumption.

I think I have a strong emotional connection with ICSRs.

Value co-creation

I actively responded to the questions of the ICSRs so that the company can understand my needs.

I participated in the solicitation or evaluation of new product/service ideas proposed by the ICSRs.

I participated in the experience or promotion of new products recommended by the ICSRs.

I actively gave feedback about my experience, questions, improvement suggestions to the ICSRs.

I actively recommended that others use ICSRs to purchase products/services.

I actively help other consumers solve their problems.

Consumers' perceived trust in AI (5-point Likert scale ranging from strongly agree - 5 to strongly disagree - 1)

I trust that AI will take care of me.

I trust that people are safe when interacting with AI.

I trust that AI will deliver the best services.

I trust that AI will recommend the best services for my needs and demands.

I trust that AI will offer more efficient services than human beings.

I trust that AI will offer a modern look to service firms.

Consumers' perceived threats of AI (5-point Likert scale ranging from strongly agree - 5 to strongly disagree - 1)

AI causes a lack of human interaction.

AI causes some legal issue problems.

AI decreases creativity and critical thinking.

AI tools do not replace classical off-line buying process.

AI causes some security concerns.

AI causes some technical issue problems.

AI causes over-reliance on technology.

AI causes some ethical dilemmas.

Use of AI tools requires constantly need for Internet.

Difficulty in handling complex task in buying process.

Risk of acquire inaccurate / incorrect or biased information.

Over-detailed, redundant, excessive content.

Using AI tools will reduce some skills and abilities of person who use it.

I see AI tools as a threat to human ethics.

Consumers' attitudes towards AI (5-point Likert scale ranging from strongly agree - 5 to strongly disagree - 1)

AI will make the world a better place. (Cognitive)

I have strong positive emotions about AI. (Affective)

I want to use technologies that rely on AI. (Behavioural)

AI has more advantages than disadvantages. (Cognitive)

I look forward to future AI developments. (Affective)
AI offers solutions to many world problems. (Cognitive)
I prefer technologies that feature AI. (Behavioural)
I am not afraid of AI. (Affective)
I would rather choose a technology with AI than one without it. (Behavioural)
AI solves problems rather than creates them. (Cognitive)
When I think about AI, I have mostly positive feelings. (Affective)
I would not avoid technologies that are based on AI. (Behavioural)

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Dynamic Capabilities and Environmental Performance of High-Tech SMEs in Pakistan – The Role of Eco-Innovation and Female Executives

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Background/Purpose: This study examines the relationship between dynamic capabilities (DCs) and environmental performance (EP) in high-tech SMEs in Pakistan, focusing on the key dimensions of sensing, seizing, and reconfiguration. Additionally, it explores the mediating role of environmental innovation (EI) and the moderating effect of female leadership on this relationship.

Methods: A quantitative research approach was employed, using a structured questionnaire distributed among male and female Chief Executive Officers (CEOs), senior management personnel, and executives in high-tech SMEs. Data were analysed using structural equation modelling (SEM) to assess the relationships between DCs, environmental innovation, and environmental performance.

Results: The findings indicate that seizing capabilities significantly enhances environmental performance, with a one-point increase leading to a 0.282-point improvement. Similarly, reconfiguration contributes positively, with a one-point increase resulting in a 0.227-point improvement. Both process innovation (path coefficient = 0.384, p = 0.001) and product innovation (path coefficient = 0.157, p = 0.043) positively influence environmental performance. However, female leadership did not exhibit a significant direct effect on environmental performance. Notably, female moderators negatively impacted the relationship between process innovation and environmental performance (-0.328), suggesting that in lower hierarchical positions, female inclusion may reduce the effectiveness of process innovation in achieving sustainability goals.

Conclusions: The study provides empirical evidence on the role of dynamic capabilities and environmental innovation in enhancing sustainability in high-tech SMEs. It highlights the need for firms to strengthen their seizing and reconfiguration capabilities to improve environmental performance. Additionally, eco-innovation should be encouraged, and gender diversity in leadership should be strategically considered when designing innovation and sustainability strategies. These findings offer valuable insights for policymakers and industry practitioners aiming to foster sustainable business practices in high-tech SMEs in Pakistan.

Keywords: *Dynamic capabilities, Environmental performance, High-Tech SMEs, Eco-Innovation, Female leadership*

1 Introduction

The increasing urgency of environmental sustainability has prompted organisations across industries to integrate eco-innovation and sustainability-driven strategies into their operations. Sustainable business practices are crucial to long-term success as companies strive to align their strategic goals with environmental and social respon-

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sibilities (Esty & Winston, 2009; Lubin & Esty, 2010). The dynamic business environment demands that organisations develop capabilities to sense and respond to external pressures, including regulatory changes, consumer preferences, and technological advancements (Teece, 2007). In this regard, dynamic capabilities (DCs) serve as a critical theoretical framework, explaining how organisations can adapt, innovate, and remain competitive while pursuing environmental sustainability (Eisenhardt & Martin, 2000; Zollo & Winter, 2002).

Despite growing scholarly interest in dynamic capabilities and their role in fostering environmental performance (Reyes-Santiago et al., 2019; Dangelico & Pontrandolfo, 2015), empirical research remains limited in certain geographical contexts. Specifically, there is a lack of research investigating the impact of the three primary dimensions of dynamic capabilities—sensing, seizing, and reconfiguration—on environmental performance in emerging economies such as Pakistan (Eikelenboom & de Jong, 2019). This study aims to bridge this gap by examining how high-tech small and medium-sized enterprises (SMEs) in Pakistan leverage dynamic capabilities to enhance their environmental performance.

Additionally, eco-innovation has been identified as a potential mediator between dynamic capabilities and environmental performance, as organisations that embrace innovation-driven environmental strategies tend to achieve superior sustainability outcomes (Costantini et al., 2017; Arranz et al., 2020). However, the moderating role of female leadership in this relationship remains underexplored. Research suggests that gender diversity in leadership can influence corporate social responsibility and environmental sustainability efforts (Glass et al., 2016; Liu et al., 2022). This study investigates whether female executives strengthen or weaken the connection between dynamic capabilities, eco-innovation, and environmental performance.

This study contributes to the growing body of literature on dynamic capabilities and environmental performance by providing empirical evidence from the high-tech sector in Pakistan. The research employs a quantitative methodology using structured questionnaires, allowing for statistical analysis of the relationships among dynamic capabilities, eco-innovation, and environmental performance. The findings offer valuable implications for businesses and policymakers, emphasising the need for strategic investments in eco-innovation and dynamic capabilities while considering the influence of gender diversity in leadership.

Next, we present the theoretical background that underpins our study. We explore a variety of topics that are essential for understanding the framework and context of our research.

Dynamic Capabilities and Environmental Performance

The dynamic capabilities framework, introduced by Teece et al. (1997), posits that organisations achieve and sustain competitive advantage by continuously adapting and reconfiguring their resources in response to changing environmental conditions. Dynamic capabilities consist of three core elements: sensing opportunities, seizing them, and reconfiguring organisational resources to maintain competitiveness (Teece, 2007). Scholars argue that these capabilities enable organisations to pursue environmental sustainability, facilitating eco-innovation integration into business strategies (Helfat & Peteraf, 2003; Buzzao & Rizzi, 2021).

Empirical studies suggest that organisations with well-developed dynamic capabilities are more likely to engage in proactive environmental strategies, thereby improving their environmental performance (Eikelenboom & de Jong, 2019). Specifically, sensing allows organisations to identify market trends and regulatory changes related to sustainability, seizing enables them to capitalise on eco-friendly innovations, and reconfiguration ensures continuous adaptation to new environmental challenges (Reyes-Santiago et al., 2019). This study explores how these three dimensions of dynamic capabilities impact environmental performance within high-tech SMEs in Pakistan.

Eco-Innovation as a Mediator

Eco-innovation refers to developing and implementing new products, services, or business practices that reduce environmental impact while maintaining economic viability (Dangelico et al., 2017; Qi et al., 2013). Scholars emphasise that eco-innovation is a crucial mechanism through which dynamic capabilities contribute to environmental performance (Costantini et al., 2017). Firms that integrate eco-innovation into their business models can achieve greater resource efficiency, regulatory compliance, and competitive differentiation (Arranz et al., 2020).

Recent research highlights the mediating role of eco-innovation in linking dynamic capabilities to environmental outcomes. For instance, organisations that effectively sense environmental challenges are more likely to invest in eco-innovation, enhancing their environmental performance (Cai & Li, 2018). Similarly, organisations with strong reconfiguration capabilities can align technological advancements with sustainability goals, providing more substantial environmental benefits (Dangelico et al., 2017). This study examines whether eco-innovation mediates the relationship between dynamic capabilities and environmental performance in high-tech SMEs.

The Moderating Role of Female Leadership

The role of female leadership in corporate sustainability has gained significant attention in recent years (Post et al., 2011; Liu et al., 2022). Research suggests that female executives prioritise ethical considerations, corporate social responsibility, and environmental initiatives more than their male counterparts (Glass et al., 2016). However, the extent to which female leadership moderates the impact of dynamic capabilities on environmental performance remains largely unexplored.

Studies indicate that gender-diverse leadership teams are more likely to adopt sustainability-oriented strategies, foster innovation, and drive long-term environmental goals (Boulouta, 2013; García-Granero et al., 2018). However, some scholars argue that structural and cultural barriers may limit the effectiveness of female executives in shaping environmental performance outcomes (Eagly & Johannesen-Schmidt, 2001). This study investigates whether female executives moderate the relationship between dynamic capabilities and environmental performance, particularly through the lens of eco-innovation.

Dynamic Capabilities, Eco-Innovation, and Environmental Performance: Hypotheses Development

This section delves into the development of hypotheses, drawing upon existing literature and theoretical frameworks to examine the relationships between dynamic capabilities, eco-innovation, environmental performance, and the moderating role of female executives.

Dynamic Capabilities and Environmental Performance

Dynamic capabilities are crucial for navigating the complexities of sustainability in a rapidly changing environment (Arend, 2014; O'Neil & Usbasaran, 2016). They provide firms the adaptive flexibility needed for continuous modifications and improvements (Arend, 2014; Chen & Chang, 2013). Research has shown a positive link between dynamic capabilities and firm performance, including profitability (Drnevich & Kriauciunas, 2011; Protogerou et al., 2011). However, the relationship between dynamic capabilities and environmental performance is less clear-cut. Some studies indicate a positive association (Mousavi et al., 2018), while others suggest a negative or ambivalent impact (Protogerou et al., 2011; Akhtar et al., 2020).

Drawing on the Resource-Based View (RBV), which emphasises the importance of valuable, rare, inimitable, and non-substitutable (VRIN) resources for achieving competitive advantage (Peteraf & Barney, 2003), this study posits that dynamic capabilities, as a specific type of capability, can enhance a firm's environmental performance. Therefore, the first hypothesis is:

H1: Dynamic capabilities positively impact a firm's environmental performance in high-tech SMEs in Pakistan.

Dynamic Capabilities and Eco-Innovation

Eco-innovation, encompassing environmentally sustainable products and practices (Teece, 2007), has been positively linked to dynamic capabilities in several studies (Dangelico et al., 2017; Moroni et al., 2022; Zhou et al., 2018). Dynamic capabilities enable firms to sense, seize, and reconfigure resources to address environmental concerns and foster eco-innovation (Teece, 2007; Tseng & Lee, 2014). The RBV, extended to include the natural environment (Cheng et al., 2014), suggests that eco-innovation can be viewed as a distinctive green capability developed through various resources. Eco-innovation is increasingly recognised as a crucial driver of economic growth and sustainable development (Baird et al., 2014; Aydıner et al., 2018).

Building on these findings, this study proposes:

H2: Dynamic capabilities positively impact eco-innovation in high-tech SMEs in Pakistan.

Eco-Innovation and Environmental Performance

Eco-innovation, aimed at mitigating environmental damage (Costantini, 2017), has been shown to positively influence environmental performance (Küçükoğlu & Pinar, 2015; Cai & Li, 2018; Fernando & Wah, 2017). It can lead to a "double externality" by reducing environmental impacts and generating knowledge spillovers (Cai & Li, 2018). Eco-innovation is a key strategy for addressing environmental challenges and gaining a competitive advantage (Yurdakul & Kazan, 2020).

This study hypothesises that eco-innovation mediates the relationship between dynamic capabilities and environmental performance:

H3: Eco-innovation mediates the relationship between dynamic capabilities and the environmental performance of high-tech companies in Pakistan.

Female Executives as Moderators

Research suggests a potential link between female executives and environmental performance (Tran & Pham, 2020; Post et al., 2011). Upper Echelon Theory posits that executives' backgrounds, including gender, influence their strategic decisions (Hambrick & Mason, 1984; Hambrick, 2007). Studies have shown that female leaders are more concerned with ethics, social responsibility, and environmental sustainability (Eagly & Johannesen-Schmidt, 2001; Boulouta, 2013).

This study proposes that female executives play a moderating role in the relationship between dynamic capabilities and environmental performance, both directly and indirectly, through eco-innovation:

H4: The presence of female executives plays a moderating role in the relationship between dynamic capabilities, eco-innovation, and environmental performance of firms in high-tech SMEs in Pakistan.

These hypotheses will be tested using quantitative data collected from high-tech SMEs in Pakistan. The findings will contribute to a better understanding of how dynamic capabilities, eco-innovation, and female leadership can enhance environmental performance and drive sustainable competitive advantage.

This study integrates DC, RBV, and eco-innovation frameworks to examine their impact on environmental performance, contributing to sustainability discourse in high-tech SMEs.

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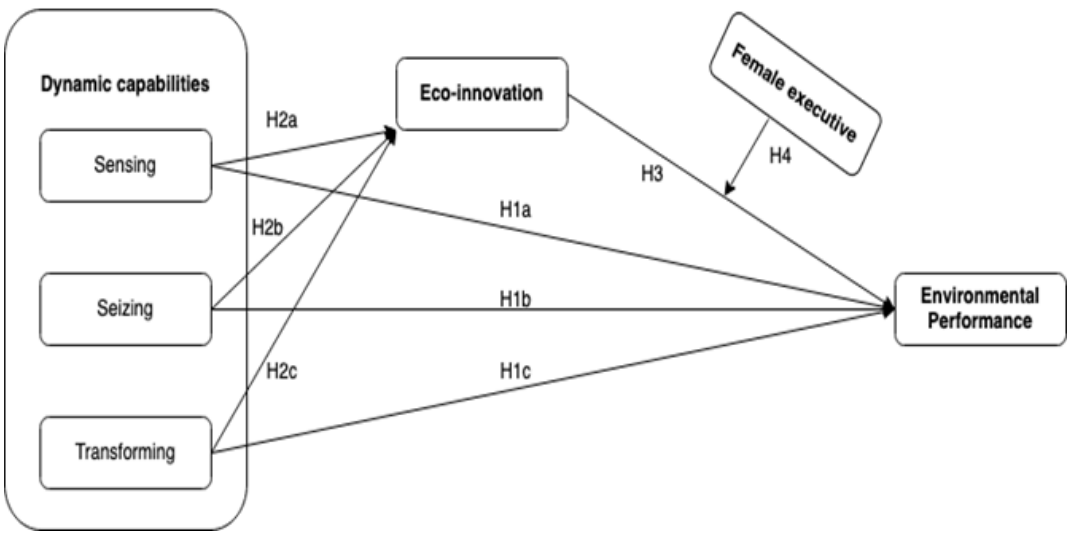

Figure 1: Theoretical framework

Table 1: Table illustrating the hypothesis number and its relevant testing theory

Hypothesis	Testing Theory
H1	Resource-based View
H2	Resource-based View
H3	Resource-based View
H4	Upper Echelon

Research Methodology

This study employs a quantitative research approach to investigate the relationship between dynamic capabilities, eco-innovation, and environmental performance in high-tech SMEs in Pakistan. This approach is chosen because it can test hypotheses, establish cause-and-effect relationships, and make predictions based on numerical data (Johnson & Christensen, 2014). The quantitative approach allows for the collection of precise, structured, and validated data, enabling the analysis of statistical relationships and the generalisation of findings to a broader population (Almeida et al., 2017).

The research is guided by a positivist philosophy, which emphasises objectivity, measurement, and the testing of hypotheses through quantitative data analysis (Creswell & Creswell, 2005). This aligns with the study's focus on collecting numerical data through questionnaires and analysing it using statistical techniques to draw objective conclusions.

Sampling Technique

A stratified sampling technique ensures that the sample adequately represents the population of interest. This technique involves dividing the population into smaller groups based on specific characteristics and randomly selecting participants from each group (Sharma, 2017). In this study, the population consists of high-tech SMEs in Pakistan. The sample is stratified based on firm size and industry sub-sector to ensure representation across different types of high-tech firms. The final sample size for this study is 117 firms. The respondents who completed the questionnaires were primarily mid- to senior-level managers involved in strategic decision-making, innovation, or sustainability roles. Among the 117 companies, the total number of individual respondents was 234, as multiple executives from the same firm participated in some cases. Of the respondents, 63% were male and 37% were female. Specifically, 18 women were identified as holding positions at the highest level of company executives, including CEO, Director, or Head of Department. Meanwhile, 39 women were in lower-level executive or managerial positions, including operations, finance, or innovation management.

Measurements

The study utilises established scales and measures from the existing literature to assess the key constructs:

- **Dynamic Capabilities:** Measured using a 5-point Likert scale, capturing the three dimensions of sensing, seizing, and reconfiguration (Zhou et al., 2019). Items assess the frequency of environmental scanning, observation of changes in values and lifestyles, participation in professional activities, adoption of best practices, development of new business methods, reaction to environmental changes, renewal of business processes, identification of new ways to achieve objectives, implementation of new management methods, and the use of existing resources in new ways (Nieves & Haller, 2014; Jantunen et al., 2018; Wilden et al., 2013).
- **Eco-Innovation:** Measured using a 5-point Likert scale, capturing both product and process eco-innovation (Barriga et al., 2022; García-Granero et al., 2018). Items assess the development of new eco-products through technologies for recycling and decomposition, innovative updates to manufacturing processes to meet environmental standards, reduction of chemical waste, waste minimisation, and recycling of waste, water, and materials.
- **Environmental Performance:** Measured using a 5-point Likert scale, capturing various aspects of environmental performance (Barriga et al., 2022). Items assess the decrease in consumption of hazardous materials, reduction in environmental accidents, improvement of the environmental situation, reduction in air emissions, and reduction of solid waste.

Research Analysis Tool

Structural Equation Modeling (SEM) is employed to analyse the collected data. SEM is a powerful statistical technique that allows for examining multiple variables simultaneously, considering their interdependencies (McDonald & Ho, 2002). It enables the assessment of measurement properties, the construction of latent variables, and the testing of theoretical models (Byrne, 2016; Becker et al., 2012; Hair et al., 2014). SEM is particularly well-suited for this study as it allows for examining mediating and moderating effects, helping to identify the mechanisms through which dynamic capabilities influence environmental performance and the role of eco-innovation and female executives in this relationship.

SEM is chosen for this study because it provides a comprehensive framework for analysing complex relationships between multiple variables, ensuring the rigour and validity of the analysis. SEM will enable a thorough examination of the hypotheses and contribute to a deeper understanding of the complex interplay between dynamic capabilities, eco-innovation, female leadership, and environmental performance in the high-tech industry.

Data Analysis

This chapter presents the data analysis collected through the quantitative research methodology described in the previous chapter. The analysis examines dynamic capabilities' direct and indirect effects on environmental performance, with eco-innovation as a mediator and female executives as a moderator. The analysis uses Structural Equation Modeling (SEM) with the Smart-PLS software.

Structural Equation Modeling (SEM)

SEM is a powerful statistical technique widely used in social and behavioural sciences to analyse complex relationships between multiple variables (Gana & Broc, 2019). It allows for examining direct and indirect effects and mediating and moderating variables, making it well-suited for this study (Hox & Bechger, 1999; Rahman et al., 2015).

This study employs Partial Least Squares-SEM (PLS-SEM), a variance-based SEM approach suitable for estimating complex cause-effect relationship models with latent variables (Hair et al., 2014; Sarstedt et al., 2021). PLS-SEM consists of two sub-models: the measurement model, which defines the relationships between observed variables and latent constructs, and the structural model, which specifies the relationships between the latent constructs (Hossan et al., 2020).

Mediating Role of Eco-Innovation

The analysis examines the mediating effect of eco-innovation on the relationship between dynamic capabilities and environmental performance. Full mediation occurs when the direct effect of dynamic capabilities on environmental performance is not significant, but the indirect effect through eco-innovation is significant. Partial mediation occurs when both the direct and indirect effects are significant (Ballen & Salehi, 2021).

The PLS-SEM analysis reveals the following:

- **Direct Effects:** Sensing does not significantly impact environmental performance (β=0.116, P=0.346). However, seizing (β=0.282, P=0.015) and reconfiguration (β=0.227, P=0.045) significantly positively affect environmental performance.
- **Indirect Effects:** The analysis will further examine the indirect effects of dynamic capabilities on environmental performance through eco-innovation, considering both product and process dimensions of eco-innovation.

These findings suggest that while sensing alone may not directly contribute to environmental performance, the ability to seize opportunities and reconfigure resources plays a crucial role in enhancing environmental outcomes. The subsequent analysis will delve deeper into the mediating role of eco-innovation and the moderating influence of female executives to provide a more comprehensive understanding of these relationships.

The previous model (Figure 5.1) examines the direct impact of Dynamic capabilities on Environmental Performance, and we called this the naïve model. Nevertheless, adding Eco-innovation as a mediating variable, which Product Innovation and Process Innovation represent, has changed the impact of dynamic capabilities on Environmental Performance. Results in Table 5.2 show the impact of dynamic capabilities on Environmental Performance after adding the mediating variable.

Table 2: The impact of dynamic capabilities on environmental performance. (Niamat, R using PLS-SEM)

Impact	Coefficient	P values
Reconfiguration -> Environmental Performance	0.227	0.045
Seizing -> Environmental Performance	0.282	0.015
Sensing -> Environmental Performance	0.116	0.346

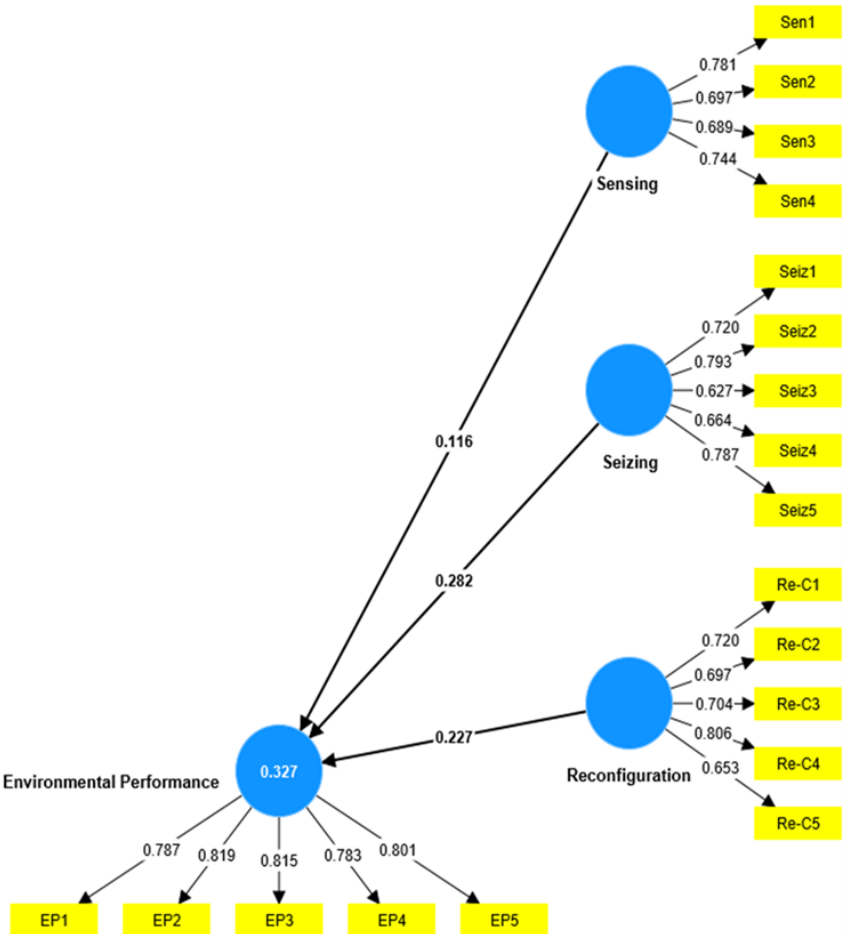

Figure 2: The mediating role of Eco-innovation. (Niamat, R using PLS-SEM)

Table 3: The impact of dynamic capabilities on Environmental Performance through Eco-innovation. (Niamat, R using PLS-SEM)

Impact	Path coefficients	P-value
Process -> Environmental Performance	0.384	0.001
Product -> Environmental Performance	0.157	0.043
Reconfiguration -> Environmental Performance	0.127	0.084
Reconfiguration -> Process	0.191	0.078
Reconfiguration -> Product	0.024	0.862
Seizing -> Environmental Performance	0.091	0.019
Seizing -> Process	0.364	0.003
Seizing -> Product	0.342	0.030
Sensing -> Environmental Performance	0.042	0.313
Sensing -> Process	0.217	0.047
Sensing -> Product	0.006	0.972

Process and Environmental Performance:

The relationship between Process and Environmental Performance becomes significant with a path coefficient of 0.384 and a p-value of 0.001. This indicates that Process innovation now has a significant positive impact on Environmental Performance.

Product and Environmental Performance:

The relationship between Product innovation and Environmental Performance is also significant, with a path coefficient of 0.157 and a p-value of 0.043. This suggests that Product innovation has a positive effect on Environmental Performance.

Reconfiguration and Environmental Performance:

While the path coefficient for Reconfiguration to Environmental Performance remains positive (0.127), it is no longer statistically significant at the conventional significance level (p=0.084).

Seizing and Environmental Performance:

The relationship between Seizing and Environmental Performance is weaker and marginally significant (β=0.091, P=0.019).

Sensing and Environmental Performance:

The relationship between Sensing and Environmental Performance remains non-significant (β=0.042, P=0.313).

Table 04 shows the impact of dynamic capabilities on environmental performance, mediated by eco-innovation, after including control variables. The statistical analysis results indicated that the p-value for the relation between Sensing and Environmental Performance was 0.146. Similarly, the p-value for the relationship between Seizing and Environmental Performance was 0.003. Lastly, the p-value for the relationship between Reconfiguration and Environmental Performance was determined to be 0.168. Based on the data, the dimensions of sensing and reconfiguration do not have a statistically significant effect on environmental performance. However, seizing only has a significant and indirect impact on environmental performance.

Table 4: The impact of dynamic capabilities on environmental performance, mediated by eco-innovation with control variables. (Niamat, R using PLS-SEM)

Impact	Total effects	P values
Process -> Environmental Performance	0.417	0.000
Product -> Environmental Performance	0.124	0.112
Reconfiguration -> Environmental Performance	0.217	0.057
Reconfiguration -> Process	0.191	0.077
Reconfiguration -> Product	0.026	0.850
Seizing -> Environmental Performance	0.288	0.015
Seizing -> Process	0.365	0.003
Seizing -> Product	0.340	0.031
Sensing -> Environmental Performance	0.148	0.239
Sensing -> Process	0.215	0.049
Sensing -> Product	0.007	0.967

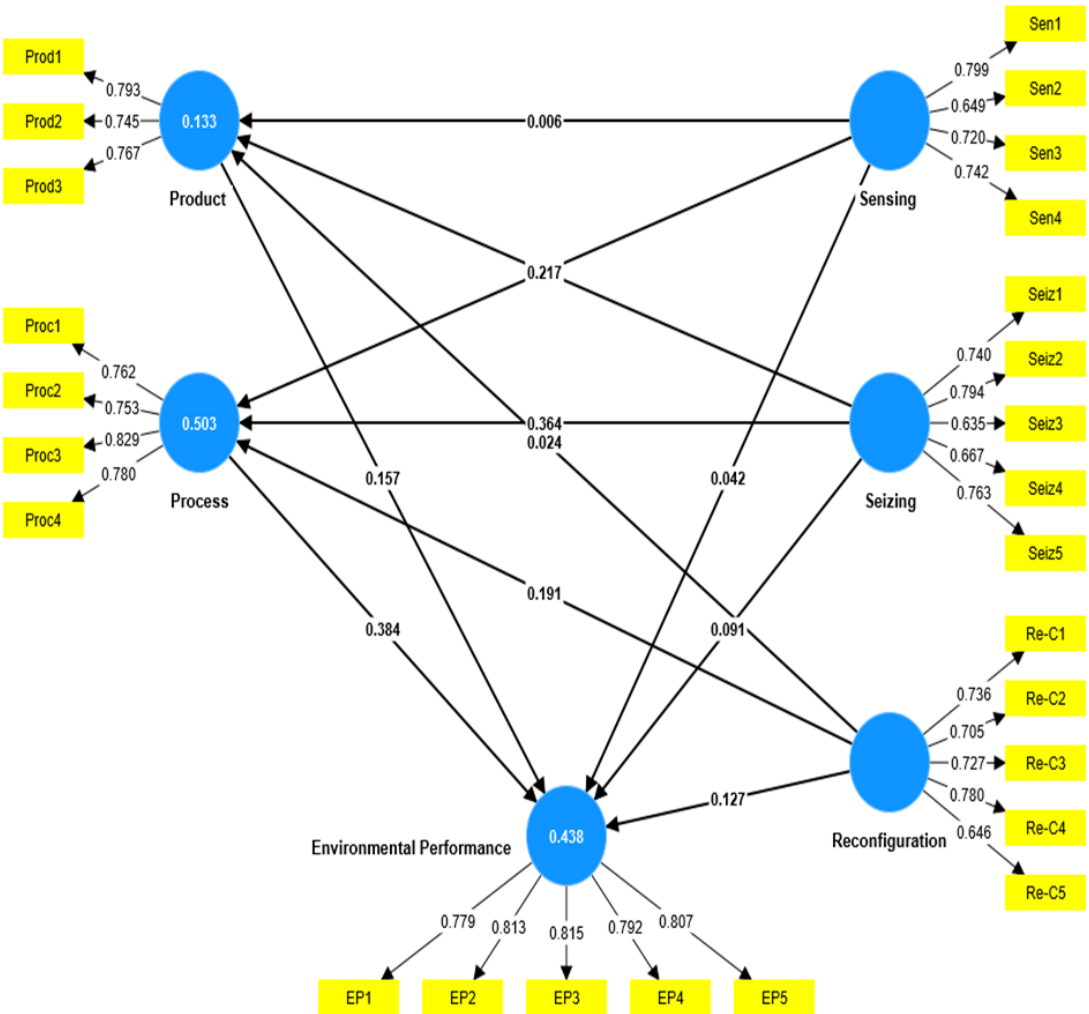

Figure 3: The impact of dynamic capabilities on Environmental Performance through Eco-innovation. (Niamat, R using PLS-SEM)

SEM analysis; the moderating of the female executives on dynamic capabilities and environmental performance.

A moderating effect is caused by a variable (Female) whose variation influences the relationship between an independent and dependent variable. We have an independent variable (dynamic capabilities), a dependent variable (environmental performance), and a moderator (female executives). This section examines the moderating role of female presence on different relationships that affect environmental performance; the following equations examine these relationships.

The following equation represents the naïve model, where Environmental performance is affected by the explanatory variable, the dynamic capabilities, and the Female variable, which represents the existence of females in the High-Tech sector.

$$EP_i = \alpha + \beta_1 DC_i + \gamma\, Female_i + \varepsilon_i \quad (1)$$

Table 05 model (1) shows the results of the naïve model, which examines the factors influencing environmental performance (EP) in the High-Tech sector. The results suggest that dynamic capabilities (DC) have a substantial and statistically significant impact on EP. Specifically, a one-unit increase in dynamic capabilities is associated with a significant 0.750 increase in environmental performance. This suggests that companies with strong dynamic capabilities are more adept at adapting and responding to environmental concerns, leading to better environmental performance outcomes.

However, the presence of females within this High-Tec sector, represented by the variable Female, does not appear to have a statistically significant impact on environmental performance in this model.

Equation (2) represents the impact of DC on EP, and it differs from equation (1) in that it includes other control variables that represent Eco-innovation, namely, Product innovation and Process innovation.

$$EP_i = \alpha + \beta_1 DC_i + \gamma\, Female_i + \beta_2 Product + \beta_3 Process + \varepsilon_i \quad (2)$$

Results in Table 5.4 model (2) demonstrated that DC have a statistically significant impact on EP; a one-unit increase in dynamic capabilities is associated with a significant 0.368 increase in environmental performance. Moreover, the presence of females within these High-tech sectors does not impact environmental performance in this model. However, both Product innovation and Process innovation have a positive and significant impact on environmental performance. A one-unit increase in Product innovation is associated with a significant 0.194-unit increase in environmental performance. A one-unit increase in Process innovation is linked with a significant 0.417-unit increase in environmental performance.

Equation (3) examines the moderating role of female presence in the high-tech industry on the relationship between DC and EP.

$$EP_i = \alpha + \beta_1 DC_i + \gamma\, Female_i + \mu\, DC_i X\, Female_i + \beta_2 Product + \beta_3 Process + \varepsilon_i \quad (3)$$

Results in Table 5.4 model (3) show the extended model that examines the moderating role of female presence in the High-Tech industry on the relationship between dynamic capabilities (DC) and environmental performance (EP).

The continued significance of DC on EP with a coefficient of 0.391 suggests that dynamic capabilities remain a significant driver of environmental performance in the High-Tech industry. The insignificance of the variable representing female presence on EP suggests that, within the context of this model and industry, the gender composition of the workforce does not seem to impact environmental performance independently.

The insignificance of the interaction term between DC and Female implies that this analysis does not observe the moderating effect of female presence on the relationship between dynamic capabilities and environmental performance. It suggests that, in this specific context, the presence of females in the High-Tech industry does not significantly alter how dynamic capabilities influence environmental performance.

Equation (4) examines the moderating role of female presence in the high-tech industry in the relationship between product innovation, which reflects the eco-innovation variable, and EP.

$$EP_i = \alpha + \beta_1 DC_i + \gamma\, Female_i + \beta_2 Product + \mu\, Product\ X\ Female_i + \beta_3 Process + \varepsilon_i \quad (4)$$

Table # model (4) assesses the moderating role of female presence in the High-Tech industry on the relationship between product innovation (reflecting the Eco-innovation variable) and environmental performance (EP); we find that the interaction term between product innovation and female presence is statistically insignificant.

Equation (5) investigates the moderating role of female presence in the high-tech industry in the relationship between process innovation, which again reflects the eco-innovation variable and EP.

$$EP_i = \alpha + \beta_1 DC_i + \gamma\, Female_i + \beta_2 Product + \beta_3 Process + \mu\, Process\ X\ Female_i + \varepsilon_i \quad (5)$$

Table 05 Model (5) demonstrates the same obtained results from equation (4).

Nevertheless, equation (6) examines the moderating role of female presence in High-Tec industry on the relationship between Process innovation and EP; however, we split the sample into those who occupy high positions (top) and those who occupy lower positions (low)

$$\begin{cases} EP_{i,top} \\ EP_{i,low} \end{cases} = \alpha + \beta_1 DC_i + \gamma\, Female_i + \beta_2 Product + \beta_3 Process + \mu\, Process\ X\ Female_i + \varepsilon_i \quad (6)$$

Table 5: The moderating role of female existence on the relationship between Dynamic capabilities, Eco-innovation, and EP (Niamat, R using PLS-SEM)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Naïve	Control	inter1	inter2	inter3	sub1	sub2
DC	0.750***	0.368***	0.391***	0.368***	0.396***	0.244	0.700***
	(0.0896)	(0.104)	(0.119)	(0.105)	(0.104)	(0.207)	(0.132)
Female	0.0668	0.0812	0.258	0.115	0.958**	0.797	1.298***
	(0.178)	(0.169)	(0.567)	(0.500)	(0.458)	(0.839)	(0.383)
		0.197**	0.194**	0.201*	0.174*	0.209*	0.102
		(0.0906)	(0.0907)	(0.103)	(0.0920)	(0.114)	(0.104)
		0.417***	0.417***	0.416***	0.514***	0.578***	0.366***
		(0.108)	(0.108)	(0.111)	(0.115)	(0.179)	(0.135)
Female X DC			-0.0531				
			(0.188)				
Female X				-0.0115			
				(0.174)			
Female X					-0.314*	-0.311	-0.328**
					(0.178)	(0.320)	(0.158)
Constant	0.121	-0.362	-0.436	-0.373	-0.681**	-0.566	-0.885***
	(0.310)	(0.316)	(0.347)	(0.324)	(0.313)	(0.810)	(0.320)
Observations	117	117	117	117	117	68	49
R-squared	0.292	0.426	0.426	0.426	0.441	0.320	0.6898

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

VARIABLES:

(1) Naïve model
(2) Control = With control dimensions of EI product and EI Process
(3) Inter1 = Interaction with EI
(4) Inter2 = Interaction with EI Product
(5) inter3 = Interaction with EI Process
(6) sub1 = Subgroup Top Level Hierarchy
(7) sub2 = Subgroup Lower Level Hierarchy

Table 05 Model (6) and Model (7) examine the moderating role of female presence in the High-Tech industry on the relationship between process innovation and environmental performance (EP); we have uncovered interesting results, especially when considering the distinction between those in high positions (top) and those in lower positions (low).

First, for both samples, process innovation is found to have a significant and positive impact on environmental performance, with a coefficient of 0.578 and 0.366, respectively. This suggests that companies in the High-Tech industry that implement process innovation strategies experience improved environmental performance outcomes, which aligns with the expectation that more efficient processes can reduce waste and resource consumption.

However, when examining the moderating role of female presence in this relationship, a noteworthy pattern emerges for those who occupy lower positions within the organization. For this group, female existence as a moderator negatively affects the relationship between process innovation and environmental performance, with an impact of -0.328. In practical terms, this suggests that in lower-level roles, where individuals may have less influence over decision-making and strategic planning, the presence of females diminishes the positive effects of process innovation on environmental performance.

These findings underscore the complexity of the relationship between gender diversity, innovation, and environmental performance within the High-Tech industry. They suggest that the impact of these factors can vary significantly based on an employee's position within the organization and that the presence of females may have unique effects in different hierarchical contexts.

Discussion

This chapter analyses the findings from the previous chapters to evaluate the hypotheses proposed in the theoretical model. The study focused on understanding how dynamic capabilities affect the environmental performance of Pakistan's small and medium-sized technology companies (SMEs).

Direct Impact of Dynamic Capabilities on Environmental Performance

H1: Proposed a positive direct impact of dynamic capabilities on environmental performance. The results partially support this hypothesis, indicating that reconfiguration and seizing have positive and significant impacts while sensing does not.

This suggests that not all dynamic capabilities affect environmental performance equally. Reconfiguration and seizing are particularly important for Pakistani high-tech SMEs seeking to improve environmental sustainability. However, sensing alone may not drive environmental improvements; organizations must actively reconfigure resources and seize opportunities to translate knowledge into action.

Dynamic Capabilities and Eco-Innovation

H2: Proposed a positive impact of dynamic capabilities on eco-innovation. The results show that seizing positively impacts product innovation, while sensing and seizing positively influence process innovation. Reconfiguration does not have a significant impact on either.

This highlights the importance of seizing opportunities for product innovation in the dynamic high-tech industry. Both sensing and seizing capabilities are crucial for process innovation. The lack of significance for reconfiguration suggests it may not be as critical for eco-innovation in this context.

Eco-Innovation and Environmental Performance

H3: Proposed that eco-innovation mediates the relationship between dynamic capabilities and environmental performance. The results indicate that process innovation significantly impacts environmental performance, while product innovation does not.

This suggests that internal processes and resource allocation improvements are crucial for enhancing environmental performance in Pakistani high-tech SMEs. However, while important, product innovation may not directly translate into significant environmental benefits due to consumer preferences and market conditions.

Mediating Role of Eco-Innovation

Including eco-innovation as a mediator reveals that seizing continues to have a direct positive impact on environmental performance, even when considering the indirect effect of eco-innovation. However, sensing and reconfiguration become insignificant, suggesting that they may need to be coupled with specific eco-innovation strategies to enhance environmental performance effectively.

Moderating Role of Female Executives

H4: Proposed that the presence of female executives moderates the relationship between dynamic capabilities, eco-innovation, and environmental performance. The results indicate that this moderating role is insignificant, except for a negative impact of lower-level female presence on the relationship between process innovation and environmental performance.

This suggests that the relationship between gender diversity, innovation, and environmental performance is complex and context-dependent. The negative impact of lower-level female presence may be attributed to bias, tokenism, and a lack of role models, which can hinder women's contributions to eco-innovation initiatives.

While our findings confirm female executives' statistically significant moderating effect on the relationship between eco-innovation and environmental performance,

the underlying mechanisms warrant further critical examination.

Women in executive roles may bring distinct perspectives and leadership styles that emphasize sustainability and long-term value creation (Glass, Cook, & Ingersoll, 2016). Research suggests that female leaders are more likely to champion corporate social responsibility and environmental practices due to their risk-averse, ethical, and stakeholder-oriented approaches (Post, Rahman, & Rubow, 2011; Bear, Rahman, & Post, 2010). In the context of high-tech SMEs, where flexibility and innovation are crucial, female leadership may catalyze aligning eco-innovation with environmental performance outcomes.

However, this moderating effect could be contingent on organizational culture, industry norms, and regional gender dynamics. In patriarchal or male-dominated business environments, such as those often observed in South Asian contexts, female executives might face structural barriers that limit their influence on strategic decision-making (Terjesen, Aguilera, & Lorenz, 2015). Thus, while statistically significant, the practical impact of female executives might vary depending on institutional support and inclusive governance.

The negative impact of female representation at lower levels of the executive hierarchy on process innovation and environmental performance may be particularly tied to the traditional socio-cultural order in Pakistani society. Even when women occupy executive roles, they often encounter limited access to core decision-making and restricted involvement in innovation strategy, especially in male-dominated industries. This disconnect between formal inclusion and actual influence reflects role stereotyping and potential tokenism, whereby gender diversity exists on paper but not in practice. These constraints may reduce their ability to shape innovation and sustainability outcomes, explaining the counterintuitive relationship observed. As Post et al. (2011) and Glass et al. (2016) highlight, symbolic representation does not equate to substantive influence.

Our findings contribute to a growing body of literature calling for gender-diverse leadership to drive sustainability performance (Liu, Wei, & Xie, 2014; Dadanlar & Abebe, 2018). However, the nuances in how female leadership affects environmental strategies remain underexplored, particularly in emerging economies.

Policy Implications

These findings have several policy implications:

- **Promote Reconfiguration and Seizing:** Policymakers should focus on creating an environment that supports high-tech SMEs in developing and enhancing their reconfiguration and seizing capabilities to drive environmental performance.
- **Encourage Seizing for Product Innovation:** High-tech SMEs should prioritize seizing opportunities for product innovation through market research, strategic alliances, and rapid technology adaptation.
- **Prioritize Process Innovation:** Given its significant impact on environmental performance, high-tech SMEs should focus on internal process improvements, such as adopting eco-friendly technologies and minimizing resource consumption.
- **Foster Product Innovation with Environmental Considerations:** While product innovation may not have a direct impact currently, it remains important for long-term sustainability. Policymakers can encourage the development and adoption of eco-friendly technologies and educate consumers about the environmental benefits of high-tech products.
- **Address Gender Diversity Challenges:** To fully leverage female executives' potential in driving eco-innovation and environmental performance, it is crucial to address challenges such as bias, tokenism, and lack of representation. This can be achieved through awareness campaigns, mentorship programs, and policies that promote gender equality in the workplace.

By implementing these policy recommendations, stakeholders can contribute to Pakistan's more sustainable and environmentally responsible high-tech industry.

Conclusions

Dynamic capabilities are crucial in achieving environmental performance, particularly in Pakistan's high-tech small and medium-sized enterprises (SMEs). This study explored the relationship between dynamic capabilities and environmental performance, emphasizing the role of eco-innovation and female leadership in shaping sustainable strategies.

The results indicate that seizing and reconfiguring positively influence environmental performance while sensing alone does not have a direct effect. Additionally, eco-innovation, particularly process innovation, is a key mediator between dynamic capabilities and environmental performance. Female leadership did not have a direct impact on environmental performance. However, it moderated the relationship between process innovation and environmental performance, suggesting that, under certain conditions, it can play a crucial role in fostering sustainable practices.

These findings have significant practical and policy implications. To enhance their environmental performance, high-tech firms in Pakistan should prioritize developing seizing and reconfiguration capabilities and invest in eco-innovation, particularly process innovation. At the

same time, policymakers should create supportive policies that enable businesses to integrate sustainability practices more effectively. The role of gender diversity in leadership should also be carefully considered to understand its influence on innovation and sustainability better.

Several important avenues for future research remain. A deeper examination of the roles of sensing and reconfiguration in eco-innovation could help uncover specific mechanisms that drive environmental performance. Further studies should explore how firms integrate eco-innovation within their dynamic capabilities and expand the analysis of gender diversity's impact across different organizational contexts.

One key limitation of this study is that the analysis of female executives' moderating role does not distinguish between hierarchical levels of influence or contextual authority. In traditional, male-dominated societies such as Pakistan, women in executive roles may hold nominal positions without substantial strategic input. This limitation suggests that future studies explore the presence of women in leadership and the depth of their involvement in decision-making processes. Additionally, our study does not account for the possible moderating effects of organizational culture, gender bias, or informal power structures, which could influence the observed relationship between female leadership and environmental performance. Moreover, this study's cross-sectional nature limits causal inferences. Future research should employ longitudinal data collection methods to better capture the evolution of dynamic capabilities and their impact on environmental performance over time. Additionally, qualitative methods such as interviews and case studies could provide deeper insights into the contextual factors influencing the relationship between gender diversity, innovation, and environmental sustainability. Integrating mixed-method approaches would strengthen an understanding of how firms can strategically leverage dynamic capabilities to enhance competitiveness and environmental responsibility.

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Dinamične zmogljivosti in okoljska uspešnost visokotehnoloških malih in srednje velikih podjetij v Pakistanu – vloga eko-inovacij in vodilnih žensk

Ozadje/Namen: Raziskava preučuje razmerje med dinamičnimi zmožnostmi in okoljsko uspešnostjo v visokotehnoloških malih in srednje velikih podjetjih v Pakistanu, pri čemer se osredotoča na ključne dimenzije zaznavanja, izkoriščanja in prestrukturiranja. Poleg tega raziskuje mediacijsko vlogo okoljske inovativnosti ter moderacijski vpliv ženskega vodstva na to razmerje.
Metode: Uporabljen je bil kvantitativni raziskovalni pristop s strukturiranim vprašalnikom, ki je bil razdeljen med moške in ženske glavne izvršne direktorje, višje vodstvene kadre ter druge vodstvene delavce v visokotehnoloških malih in srednje velikih podjetjih. Podatki so bili analizirani z modeliranjem strukturnih enačb za oceno razmerij med dinamičnimi zmožnostmi, okoljsko inovativnostjo in okoljsko uspešnostjo.
Rezultati: Ugotovitve kažejo, da imajo izkoriščanje virov in prestrukturiranje pozitiven vpliv na okoljsko uspešnost, pri čemer enoto povečanja izkoriščanja vodi v izboljšanje OU za 0,282 enote, enota povečanja prestrukturiranja pa za 0,227 enote. Tako procesne inovacije (koeficient poti = 0,384, p = 0,001) kot produktne inovacije (koeficient poti = 0,157, p = 0,043) pozitivno vplivajo na okoljsko uspešnost. Vodenje s strani žensk ni imelo statistično pomembnega neposrednega vpliva na okoljsko uspešnost. Vendar so ženske v moderacijski vlogi negativno vplivale na razmerje med procesnimi inovacijami in okoljsko uspešnostjo (-0,328), kar nakazuje, da lahko prisotnost žensk na nižjih vodstvenih položajih oslabi učinek procesnih inovacij na trajnostno uspešnost.
Zaključki: Študija zagotavlja empirične dokaze o vlogi dinamičnih zmožnosti in okoljskih inovacij pri izboljšanju trajnosti v visokotehnoloških MSP. Poudarja potrebo po krepitvi izkoriščanja virov in prestrukturiranja za izboljšanje okoljske uspešnosti. Prav tako priporoča spodbujanje okoljske inovativnosti ter strateško vključevanje spolne raznolikosti v vodstvene strukture pri načrtovanju inovacijskih in trajnostnih strategij. Ugotovitve ponujajo dragocene vpoglede za oblikovalce politik in strokovnjake v industriji, ki si prizadevajo za trajnostne poslovne prakse v visokotehnoloških MSP v Pakistanu.

Ključne besede: *Dinamične zmožnosti, Okoljska uspešnost, Visokotehnološka MSP, Okoljske inovacije, Vodenje s strani žensk*

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Effects of Corporate Purpose on Organizational Innovation: An Explanatory Mixed-Methods Analysis

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Purpose: The current study has two primary goals: first, to examine the influence of corporate purpose on organizational innovation and second, to analyze the sequential mediation effect of both a people-centric approach and infrastructure between corporate purpose and organizational innovation.
Design/Methodology: A sequential explanatory mixed-method design was used in this study. Confirmatory factor analysis (CFA) and PROCESS macro were applied based on 188 online questionnaires completed by employees of a leading Portuguese publishing company, followed by a thematic analysis of 37 structured interviews.
Results: The quantitative findings indicate that corporate purpose has a positive impact on organizational innovation and that both the people-centric approach and organizational infrastructure serve as significant mediators in the relationship between corporate purpose and organizational innovation. Moreover, the people-centric approach and organizational infrastructure sequentially mediate the relationship between corporate purpose and organizational innovation. The qualitative data corroborate and deepen these findings, revealing the crucial role of a people-centric approach and organizational infrastructure as mediators in corporate purpose to cope with organizational innovation.
Conclusions: Our study provides theoretical and practical implications for practitioners, researchers, and business leaders to better understand the relationship between these concepts and opportunities for further research.

Keywords: *Corporate purpose, Organizational infrastructure, Organizational innovation, People-centric approach, Sequential mediation*

1 Introduction

Peter Drucker, a prominent figure in modern management, was one of the first to stress the importance of having a clear corporate purpose. In his influential book "Management: Tasks, Responsibilities, Practices," published in 1974, Drucker emphasized the core purpose of a business as the chief goal of delivering value to customers and enhancing their well-being. Thus, one of the key elements contributing to a business's corporate purpose and potential economic success is proximity to customers. This factor enables validation of the business model, ensures its

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survival, attracts resources, and promotes the well-being of customers and other stakeholders. From this perspective, it can be reasoned that corporate purposes transcend marketing tactics (Harrison et al., 2020). Instead, it represents the driving force behind a company's existence, the reason for its business activities, and the foundation upon which its purpose is built (Gartenberg, 2023; van Ingen et al., 2021). Essentially, it serves as a catalyst for fostering customer well-being and business viability (Harrison et al., 2020).

Thus, the primary objective of any business is to prioritize customers, which involves capturing, satisfying, and retaining them. This requires continuous focus on organizational innovation and efficiency in the use of resources, capabilities, organizational infrastructure, systems, processes, and operations. By achieving these goals, a company can differentiate itself from its competitors in the marketplace and create a unified approach among the diverse stakeholders involved in the creation, shared production, and consumer welfare processes (Blair & Stout, 1999; Reichheld et al., 2021). This customer-centric approach enhances a company's sustainability because customers are considered valuable members of society who contribute to the economy by purchasing goods and services, benefiting both the company and society as a whole.

This customer-centric approach was further reinforced by Reichheld et al. (2021), who conducted a comprehensive analysis of numerous businesses, arguing that a company's purpose should be to improve the lives of its customers and that this mission should be embraced by all members of the organization. In 2011, Pink highlighted the significance of finding a purpose in one's work, which holds true for both employees and larger communities. According to Freeman and Ginena (2015), companies with a clear purpose can improve their quality of life and positively contribute to society.

Given the statements made above, corporate purpose refers to the meaning, identity, inspiration, actions, and consequences of a company on society and its stakeholders (Henderson & Van den Steen, 2015; Mayer, 2021; Porter & Kramer, 2019). This serves as a means for employees to align themselves with the overall goals that contribute to the long-term sustainability of the company and to improve society (Ellsworth, 2002). This promotes collaboration and performance among employees, teams, and knowledge networks, ultimately benefiting those who utilize a company's products or services (Breuer & Lüdeke-Freund, 2017; Hollensbe et al., 2014; Mourkogiannis, 2008).

To maintain a competitive edge, companies must engage in ongoing innovation cycles that focus on attracting, satisfying, and retaining their customers. This makes organizational innovation a key aspect of business endeavors. It involves the process of imbuing resources, capabilities, systems, and processes with newfound organizational effectiveness, resulting in improved economic and social outcomes and the creation of wealth. According to Drucker (1974) and Rogers (1995), this requires the implementation of new organizational practices that produce a significant impact and value while adhering to the company's purpose. Essentially, this study posits that organizational innovation reflects new practices implemented in a company that have a significant and meaningful impact. Thus, this study focuses on organizational innovation, encompassing fresh approaches to work, administrative modifications, and managerial styles that alter the process of converting imaginative concepts into tangible goods and services with the ultimate objective of attaining a competitive edge (Baregheh et al., 2009; Fay et al., 2014; Migdadi, 2019).

Referring to the concept of organizational innovation and the dynamic capabilities view (DCV), two crucial mediating constructs have emerged (Al-Tal & Emeagwali, 2019; Arraya & Ferreira, 2024; Carew et al., 2009): (1) employee-focused human resource practices and an internal network of motivated individuals who think and act proactively, that is, companies with a people-centric approach; and (2) a well-structured organizational infrastructure composed of resources, capabilities, competencies, processes, and routines that foster innovation.

The DCV posits that companies can gain a competitive advantage and attain significant economic returns by effectively adapting, integrating, reconfiguring, and coordinating their internal and external capabilities to respond to market dynamics through innovation (Kareem et al., 2024; Teece, 2023). Furthermore, this approach emphasizes the importance of a people-centric approach in developing organizational competencies that positively affect overall performance and enhance a company's competitive advantage (Buzzao & Rizzi, 2020; Harsch & Festing, 2019; Khan et al., 2020). Hence, human resources are given a people-centric approach as part of their dynamic capabilities, which can serve as a source of competitive advantage, its direct influence on organizational infrastructure, and its role as an unexplored mediator in the literature on corporate purposes and organizational innovation.

A company's organizational infrastructure refers to its organization, which includes resources, capabilities, processes, microsystems, routines, workflows, and practices that are aligned with its corporate purpose and support a customer-centric culture (Carew et al., 2009; Drucker, 1974; Grant, 2010). This organizational infrastructure should enable a company to rapidly adapt and innovate in response to changes in the external environment; streamline work processes; enhance the quality of products, services, and customer experience; expedite coordination between individuals and departments; and facilitate work (Carew et al., 2009; Lamberti, 2013). It also potentially serves as a mediator between corporate purpose and organizational innovation, which has not yet been explored.

The significance of corporate purpose as a guiding

Table 1: Search strategies to select articles

	(A)	(B)	(C)	(D)
"*Corporate purpose*" OR "*Company purpose*" (A)	-	23	3	0
"*Organizational innovation*" OR "*Innovation*" (B)	76	-	39	47
"*People centric*" (C)	36	12	-	7
"*Organizational Infrastructure*" (D)	1	15	8	-

Note: Scopus (left-side) e Web of Science (WoS) (right-side)

principle for organizational innovation cannot be overstated. Nevertheless, the effectiveness of this orientation can be amplified through the mediation of people-centric approaches and organizational infrastructure. To the best of our knowledge, no study has examined the interconnections between these four constructs. To demonstrate the scarcity of studies on the relationship between these constructs, a bibliographic search was conducted in the Scopus and Web of Science (WoS) databases. The search used the search string terms "corporate purpose" OR "company purpose"; "organizational innovation" OR "innovation"; "people-centric"; and "organizational infrastructure". The search was limited to peer-reviewed articles published in English journals with no imposed time limits. The search process encompassed "all fields" to identify relevant articles, and six search equations were processed, as shown in Table 1.

The literature search yielded 148 and 119 articles from the Scopus and Web of Science (WoS) databases, respectively, totaling 267 articles. After merging the two databases and removing duplicate studies based on title screening, 185 articles were selected for the review. The researchers searched for articles that fulfilled the four constructs defined in this study, and none of the studies presented a conjugation of these dimensions. According to research findings, it is apparent that academics have not demonstrated a growing interest in subject matter over the years.

Considering DCV, the following research question is posited: can the relationship between a company's purpose and organizational innovation be sequentially mediated by a human-centric approach and organizational structure? Thus, this study explores the research gap in the mediators that influence the relationship between corporate purpose and organizational innovation. An explanatory sequential design was chosen as the methodology for the study, as it involves using quantitative research (a serial multi-mediation model) as a preliminary step for subsequent qualitative investigation (Creswell & Plano Clark, 2017; Homer & Lim, 2024).

This study makes significant contributions to the existing literature on the significance of corporate purpose and organizational innovation. The first contribution is the identification of two sequential mediators, namely a people-centric approach and organizational infrastructure, which explain the relationship between corporate purpose and organizational innovation. The second contribution is a favorable environment for fostering innovation that results when the corporate purpose is combined with a people-centered approach and supportive organizational infrastructure. The third contribution is the crucial interaction between people and organizational infrastructure, which is essential for a company's adaptation to external trends and the maintenance of a creative network. The fourth contribution is the specificity of the organizational infrastructure, which makes it difficult to replicate or imitate, thus serving as a critical factor in maintaining a competitive market position. The fifth contribution is the direct virtuous cycle provided by the four constructs. Finally, this study identifies gaps and future directions that can help improve our understanding of the relationship between corporate purpose and organizational innovation. These contributions will enable practitioners, researchers, and business leaders to better comprehend the relationship between these concepts, prioritize initiatives, and develop operational methodologies that facilitate the long-term success of companies.

The remainder of this paper is organized as follows. Section 2 presents a literature review and formulates research hypotheses. Sections 3 and 4 describe the research methodology in detail along with the corresponding results. Section 5 discusses the implications and presents the conclusions, and Section 6 concludes with the limitations and future areas of investigation.

2 Theoretical Framework

The adoption of a corporate purpose that encompasses customer satisfaction and business viability, and promotes a better society, serves as a guiding light for a company's success (Henderson, 2020). To achieve this, it is crucial to involve all stakeholders and prioritize the well-being of employees and customers (Ellsworth, 2002; Henderson, 2020; Metcalf & Benn, 2012; Sisodia & Gelb, 2019). In doing so, the purpose directly influences the necessary changes in the company's policies and practices to enhance

customer operations, achieve better social outcomes, and improve stakeholder relationships (Mayer, 2021).

Alterations in the trajectory of improved performance standards necessitate a dynamic strategy that encompasses three fundamental elements (Peters 1987): adaptability, initiative, and entrepreneurial creativity. In simpler terms, this involves a fluid organizational structure that embraces change and fosters a culture of innovation and proactive problem-solving, underpinned by three foundational pillars: purpose, people, and strategy.

A clear and shared corporate purpose inspires commitment and drives action, resulting in the creation of value within a company (Ellsworth, 2002; Henderson, 2020; Pink, 2011). This can be achieved by aligning individuals with the company's purpose of finding meaning and encouragement in their work and designing an organizational infrastructure that supports the company's strategy and tactics (Henderson, 2020; Mayer, 2021). Additionally, promoting organizational innovation to meet customer and stakeholder needs can help achieve this goal. Ultimately, as Drucker (1974: 361) stated, "the purpose of an organization is to enable ordinary human beings to do extraordinary things."

2.1 Corporate Purpose and organizational innovation

According to Ocasio et al. (2023), corporate purpose enables managers to overcome "business myopia" in response to crises and uncertainties, thereby enabling them to discover new insights, maintain their focus, and maintain the company's direction. Similarly, Henderson (2020) asserted that corporate purpose alerts a company to new business opportunities, thereby increasing the likelihood that the company will "see" the need for innovation. Madden (2017) posited that corporate purpose promotes the survival and prosperity of a company through innovation and efficiency gains by fostering feedback and learning, which are essential components of the company's innovation process.

Organizational ability, creativity, agility, initiative, technological advancement, and human resource management are the key factors in achieving innovation. These elements work together to foster continuous learning and exploration, as well as to acquire new resources, knowledge, and capabilities from the external environment. By incorporating these resources and capabilities into a company, stakeholders, particularly customers, value new products and processes (Camisón & Villar-López, 2014; Chen et al., 2019; Lawson & Samson, 2001; Silva & Cirani, 2020). A company's corporate purpose serves as a guide for its strategy and innovation activities, as it integrates resources, capabilities, methods, and business practices to align all departments towards a common goal, thereby fostering a culture of transformation within the organization (Aguilera, 2023; Gartenberg et al., 2019; Madden, 2017; Teece, 2023; Yemiscigil, 2019).

Given the vital role of innovation in attracting and retaining customers, it is imperative to investigate whether corporate purpose affects organizational innovation. Consequently, we propose the following hypothesis:

H1. Corporate Purpose is positively related to organizational innovation.

2.2 Multiple mediating roles of People-centric and Infrastructure

A people-centric approach refers to placing a company's employees at the center of everything. This involves understanding their needs, promoting knowledge sharing, fostering creativity, considering opinions in decision-making processes, and what inspires and motivating them to give their best (Lepeley, 2017; Upadhyay & Kumar, 2020).

This result was consistent with the findings of Halbesleben et al. (2014), Lepeley (2017), and Malnight et al. (2019), a people-centric approach serves as an essential strategic element for the success of any business irrespective of its unique business model and innovation process. This is due to the fact that employee engagement, enablement, and empowerment are crucial components of this approach. When employees feel valued and cared for, they are driven by a deep sense of purpose and strong intrinsic motivation, which has a significant impact on reducing absenteeism, turnover, safety incidents, and quality incidents (defects), and improving customer metrics, productivity, profitability, and outperforming competitors. This approach can lead to several benefits, including increased job satisfaction, higher talent retention, and improved productivity and profitability (Fu et al., 2015; Ma Prieto & Pilar Pérez-Santana, 2014). Consequently, for businesses to succeed, it is essential to maintain a work environment that fosters a sense of belonging, respect, and recognition among the employees. According to Meijerink et al. (2020) and Mehta et al. (2016), fostering such an environment can lead to increased employee engagement, improved communication, and heightened morale, ultimately resulting in a positive impact on a company's bottom line.

An enabling work environment is equipped with the essential resources, expertise, technology, and processes required to excel in roles and achieve objectives (Colenbaugh & Reigel, 2010). This fosters employee empowerment, which enhances the capabilities of individuals and benefits the company. Providing employees with the autonomy to make decisions without seeking approval from others is one way that leaders can demonstrate their appreciation, resulting in increased productivity, improved service quality, heightened job satisfaction, and improved skill development (Yin et al., 2019; Zhang et al., 2018).

Several studies have shown that adopting a people-centric approach can lead to improved safety records, reduced staff turnover, increased job satisfaction, and greater involvement, ultimately enhancing a company's overall performance (Buzzao & Rizzi, 2020; Upadhyay & Kumar, 2020).

Considering the aforementioned points, it can be concluded that a people-centric approach forms a crucial aspect of the paradigm of Person-Organization Adjustment, which considers the two types of relationships that may exist between individuals and organizations (Verquer et al., 2003). These relationships involve the mutual satisfaction of each other's needs and the sharing of similar characteristics and interests between the individual and organization. According to van Ingen et al. (2021), the adjustment of the founding purpose and values as part of the person–organization adjustment process serves as an explanatory mechanism that links corporate purpose with the organization's outcomes.

Moreover, a people-centric approach can positively affect innovation and the overall company performance. Commitment-oriented HR practices motivate employees to interact socially while carrying out their day-to-day tasks, thereby increasing creativity and innovation capacity (Ceylan, 2013; Popa et al., 2017). Therefore, companies adopting this approach are more likely to develop skills that benefit their innovation and performance. Consistent with these findings, our research posits that a people-centered approach serves as a mediator between an organization's purpose and its innovative endeavors. Therefore, the preceding arguments suggest the following hypothesis:

Hypothesis 2. A people-centric approach mediates the relationship between corporate purpose and organizational innovation.

We argue that organizational infrastructure is a strategic and operational system that consists of essential and core resources and capabilities to support operations and company objectives. Its agent is people, and its micro-level includes processes, routines, tools, workflow, and practices that enable it to achieve its goals in a financially viable, scalable, and sustainable manner (Arraya, 2024; Teece, 2023). Thus, a company's organizational infrastructure is a critical component that must be carefully planned and managed to ensure long-term success.

These elements are intended to foster a customer-centric culture and achieve predefined goals (Carew et al., 2009; Grant, 2010). A well-designed organizational infrastructure should facilitate a company's ability to adapt and innovate in response to external changes, streamline work processes, enhance product and service quality, and improve customer experience. Additionally, it should facilitate coordination between different work areas and individuals, and make work more efficient (Carew et al., 2009; Lamberti, 2013). Therefore, the preceding arguments suggest the following hypothesis:

H3. Organizational infrastructure mediates the relationship between corporate purpose and organizational innovation.

Previous research suggests that corporate purpose and organizational innovation are linked through a people-centered approach and organizational infrastructure, as evidenced by the arguments presented above. Employees are considered one of the most critical stakeholders as they are responsible for executing the company's initiatives and bearing their consequences (Aguinis & Glavas, 2012). For a company to achieve its corporate purpose, it is essential that its employees accept and support its objectives (Mossholder et al., 2011). In doing so, they can apply their knowledge and skills, offer innovative solutions, and undertake value-generating activities (Lepeley, 2017; Upadhyay & Kumar, 2020). However, this requires organizational infrastructure that supports and differentiates the company from its competitors. Such an infrastructure brings together resources and capabilities that, when working together, enable the company to operate effectively, generate innovative technological ideas, develop and execute them to penetrate the market, and create customer satisfaction and economic value (Barney et al., 2021). Based on this, we propose the following hypothesis:

H4. The people-centric approach and organizational infrastructure play sequential mediating roles in the association between corporate purpose and organizational innovation.

Integrating hypotheses H1–H4, the research model is presented in Figure 1.

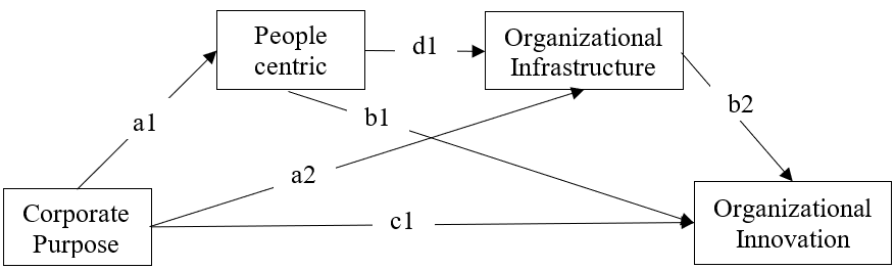

Figure 1: Conceptual model to examine the relationship between corporate purpose, people-centric and organizational infrastructure, and organizational innovation. The direction of the arrow signifies the influence of one dimension on the consequent

3 Methodology

A sequential explanatory mixed-methods design that integrated quantitative and qualitative approaches was implemented for triangulation to assess the extent to which quantitative and qualitative findings corroborated each other (Creswell & Plano Clarke, 2017; Morse, 2018). Quantitative and qualitative data were collected sequentially and analyzed independently, and the latter was used to elucidate the former and bridge gaps in the quantitative outcomes. Subsequently, the data were merged and integrated to generate research implications for theory and practice (Morse & Neihaus, 2009).

For the quantitative component, the population consisted of a single-company approach, which enabled researchers to obtain a comprehensive understanding of the elements and factors that influence the organizational context (Yin, 2009). For the qualitative component, the sample comprised respondents from highly competitive service industries with experience and familiarity with the concepts of corporate purpose and organizational innovation. By conducting interviews with a distinct sample from the population surveyed in the questionnaire, the potential bias in responses from middle- and high-level managers is mitigated as they tend to overestimate the positive aspects of the organizations they manage (Kianto, 2009). Furthermore, considering the constructs examined in this study, it is essential to triangulate the data using interviewees [good informants (Morse, 1989)] to ensure validity (Morse et al., 2006). Purposive sampling techniques have been employed to ensure data richness (Nyimbili & Nyimbili, 2024). The subsequent sections delineate the details of data collection, analysis, and results for each phase, including qualitative data.

3.1 Phase I: Quantitative Data Collection and Analysis

The empirical data used in this study were collected through an online cross-sectional survey conducted between April and May 2023. The survey consisted of 26 items and measured four dimensions: purpose — independent dimension based on Arraya and Ferreira (2024), people-centric — mediator dimension based on Arraya and Ferreira (2024), seven items; infrastructure — mediator dimension based on Arraya and Ferreira (2024), six items; and organizational innovation — dependent variable with ten items.

Since the study is explanatory, we collected data via an online survey of employees, administrative staff, and directors (Kianto, 2009) of a significant company in Portugal's publishing industry, employing over 250 individuals and operating through three distribution channels: stores, digital platforms, and resellers. This entity was chosen for the following reasons: (1) Grawe et al.'s (2009) finding that limiting the population to a single industry enhances the study's internal validity; (2) it is rational to choose a relevant company in the industry for in-depth research; (3) the company that has been selected has a well-defined corporate purpose: "the promotion of individual and social reading habits and the promotion of better knowledge and use, oral and written, of the Portuguese language"; (4) it experiences substantial competitive pressure on a consistent basis across all its operational segments, necessitating adaptation and innovation to maintain its competitive position; and (5) its strategic process incorporates corporate purpose as an element that provides direction, focus, and motivates employees to work toward a common objective.

Of the 188 participants who completed the survey, 31.90% were male and 68.10% were female. The average age of the participants was 38.92 years, and the average tenure was 10.77 years. In addition, 58.00% of the participants had a university degree.

The dimensions employed in this study were determined based on existing literature and evaluated using a 5-point Likert-type scale (1= "strongly disagree"; 5= "strongly agree"). A comprehensive list of measurement items is presented in Table 2.

Regarding the quality of the responses, we used every measure to ensure anonymity of the participants. Furthermore, to assess the potential for common method bias, we conducted Harman's single-factor test, which involved subjecting the research items to principal component factor analysis (Podsakoff et al., 2012). The results of this test indicated that the factor loading was below 40%, indicating that the common method bias was not a concern. Additionally, we carried out a full-collinearity test (Kock, 2015), and the results showed that the variance inflation factor values were below the threshold of 3.3, further confirming that common method bias was not present.

3.1.1 Exploratory and confirmatory factor analysis and test of psychometric properties

An exploratory factor analysis was performed to investigate the relationships between the items, and the suitability of the data for factor analysis was first evaluated. The Pearson correlation matrix showed coefficients of 0.50 or higher, the Kaiser-Meyer-Olkin overall MSA value was 0.940, and Bartlett's Test of Sphericity was statistically significant at 0.01, indicating that the correlation matrix was suitable for factor analysis (Table 2). The oblique promax technique was used, and four factors were extracted that explained 47.00% of the variance. All loadings are greater than 0.40. In addition, CFI=0.940 (>0.9), TLI=0.910 (>0.9), and RMSEA=0.068 (<0.09) were greater than the threshold values (Saunders et al., 2016).

Table 2: Means, standard deviations, and factor loadings

	Indicator	Mean (n=188)	Sd (n=188)	Factor Loading
Corporate Purpose	The leadership in our firm aligns with this shared purpose.	3.596	0.863	0.716
	People in our firm have a passion for shared purposes.	3.383	0.926	0.767
	In our firm, the purpose is properly defined and understood by people.	3.580	0.833	0.67
People-centric approach	Our firm continually incorporates new learning into standard ways of doing business.	3.346	0.861	0.792
	In our firm people are willing to exchange and combine ideas with their co-workers.	3.766	0.826	0.547
	In our firm people have easy access to the information they need to do their job effectively.	3.644	0.824	0.638
	Our firm provides people with appropriate information about important changes.	3.612	0.861	0.716
	In our firm everyone has the opportunity to influence the decisions that affect them.	2.979	0.986	0.607
Infrastructure	In our firm, systems, structures, and formal and informal practices are integrated and aligned.	3.479	0.797	0.766
	In our firm, formal and informal systems, structures, and practices make it easier for employees to complete their work.	3.335	0.889	0.73
	In our firm, people, processes, and work routines are hard-to-copy systems that allow us to do things better than competitors while creating value for customers.	3.410	0.832	0.674
	In our firm, all work processes are designed to make it easier for customers to conduct business with us.	3.511	0.824	0.641
	Our firm has a clearly stated set of capabilities–that is, things you do better than anyone else–that customers' values and competitors cannot beat.	3.521	0.843	0.597
	Our firm anticipates changes in the market and responds proactively.	3.463	0.868	0.685

Table 2: Means, standard deviations, and factor loadings (continue)

	Indicator	Mean (n=188)	Sd (n=188)	Factor Loading
Organizational Innovation	Our organization is often first-to-market with new innovations.	3.176	1.001	0.733
	In our organization, innovation is a way of life.	3.330	0.958	0.774
	We are constantly looking for ways to improve our business processes.	3.782	0.890	0.743
	Our senior managers are able to effectively cascade the innovation message throughout the organization.	3.484	0.933	0.739
	Our senior management team is diverse in their thinking – they have different ideas about how things should be done.	3.261	0.914	0.773
	Our organization has a clear innovation vision.	3.303	0.901	0.768
	Everyone in our organization knows what we want to achieve with our innovation programs.	3.340	0.890	0.722
	We have continuous strategic initiatives aimed at improving our performance.	3.564	0.948	0.767
	Our key executives are prepared to take risks to grow the organization or to improve performance.	3.441	0.909	0.746
	We are prepared to discontinue products and services that contribute only marginally to our success.	3.335	0.787	0.492

Reliability and validity tests were conducted to confirm internal consistency and reliability of the variables. Cronbach's alpha (>0.70) and composite reliability (CR>0.70) were used to verify the variables' internal consistency and reliability (Hair et al., 2010). Additionally, discriminant validity was established based on the Fornell and Larcker (1981) criterion and cross-loading, as all items loaded the highest on the corresponding latent constructs. Furthermore, the square root of the latent variable AVEs exceeded the corresponding latent-variable correlations in each instance (see Table 3). Confirmatory factor analysis (CFA) was performed to establish convergent validity and dimensionality of the factors. The model showed goodness of fit with $\chi 2/df=2.233$, CFI=0.907 (>0.9), NFI=0.903 (>0.9), TLI=0.901 (>0.9), and RMSEA=0.081 (<0.09). Thus, the model fit results are acceptable (Saunders et al., 2016).

The results of the Pearson correlation analysis are presented in Table 3. Notably, all correlations were statistically significant at the 95% confidence level. Furthermore, all four factors showed positive correlations. The confirmed correlations and linear relationships between the predictors, mediators, and dependent variables satisfied the preconditions for conducting PROCESS analyses, as specified by Saunders et al. (2016). The empirical findings support this conceptual model.

3.2 Phase II: Qualitative Data Collection and Analysis

The open-ended interview protocol has several advantages, including its ability to concentrate specifically

Table 3: Pearson correlation and other key dimension measures

Variable	1	2	3	4	α	CR	AVE
1. Purpose	**0.773**				0.815	0.761	0.598
2. People-centric	0.791***	**0.793**			0.872	0.796	0.629
3. Infrastructure	0.648***	0.704***	**0.736**		0.811	0.840	0.542
4.Organizational Innovation	0.721***	0.733***	0.741***	**0.751**	0.925	0.918	0.564

Note: Internal consistency (α), critical ratio (CR), average variance extracted (AVE), square root of AVE estimates is presented in boldface.
*** p < 0,001

on the research topic at hand, obtain comprehensive and practical information, elicit perceived causal inferences, and access to individuals' fundamental experiences in the real world, especially when the phenomenon being studied is rare and infrequently observed. This approach is preferred for acquiring extensive and insightful empirical data (Kvale & Brinkman, 2015; Eisenhardt & Graebner, 2007; Yin, 2009).

Although the survey outcomes influenced the composition of the interview inquiries, they maintained an open-ended format to encourage participant-driven responses. These questions were developed by referencing existing literature, which was determined following the completion of the initial phase (Creswell & Plano Clark, 2017). The interviews followed a structured protocol with open-ended questions in four different areas: (1) the relationship between corporate purpose and organizational innovation; (2) the relationship between the people-centered approach, corporate purposes, and organizational innovation; (3) the relationship between organizational infrastructure, corporate purposes, and organizational innovation; and (4) how the relationship between the people-centered approach and organizational infrastructure simultaneously interferes with the relationship between corporate purposes and organizational innovation.

Purposive criterion sampling was used to select participants for the interviews (Nyimbili & Nyimbili, 2024) because the study aimed to explore the theoretical knowledge and practical experience of the phenomena being studied (Creswell & Plano Clarke, 2017). This sampling technique uses specific criteria, including (1) respondents possessing experience in highly competitive service industries and (2) respondents demonstrating familiarity with the concepts of corporate purpose and organizational innovation. Potential participants were identified through the professional social network LinkedIn and invited to participate via a private message.

Data saturation was attained through 37 interviews as the responses provided by the participants displayed a final similarity (Saunders et al, 2018). These interviews were conducted between June and July 2024, and as they were conducted in Portuguese in Portugal, they were transcribed and translated into English. The participants were 23 males and 14 females. Their average age was 51.6 years, with 52 percent between the ages of 50 and 59 years, and all 37 had a university degree (six bachelor's degrees, seven master's degrees, and 24 PhDs). The answers to the interviews were transcribed, summarized, and categorized according to similar factors to provide data for the qualitative study.

4 Results

4.1 Phase 1: Quantitative results

4.2 Robustness test

To assess the reliability of the mediating findings, we adhered to Baron and Kenny's (1986) procedure, which entails the following stages to evaluate People-centric and Infrastructure mediating effects on the relationship between Corporate Purpose and Organizational Innovation. First, we verified that Corporate Purpose significantly affects Organizational Innovation. Second, we verified that Corporate Purpose significantly affects both People-centric and Infrastructure. Third, we demonstrated the significant and positive indirect effect of Corporate Purpose on Organizational Innovation through People-centric, indicating that Corporate Purpose exerts a positive influence on Organizational Innovation by leveraging the impact of People-centric. Fourth, we demonstrate the presence of a significant indirect effect between Corporate Purpose on Organizational Innovation through Infrastructure, indicating that Corporate Purpose exerts a positive influence on Organizational Innovation through the mediation of Infrastructure. Fifth, we confirm the presence of a positive and significant indirect effect between Corporate Purpose on Organizational Innovation through both People-centric and Infrastructure, revealing that People-centric and Infrastructure sequentially and positively mediate the relationship between Corporate Purpose and Organizational Innovation.

4.3 Direct effects analysis

The PROCESS by JASP (0.18.3) computer program was used to perform direct effects tests. Table 4 presents the results of these tests, including the path coefficients for direct effects. According to our hypothesis, Purpose positively influences Organizational Innovation ($\beta = 0.265$, $p < 0.01$), and this effect was verified. Additionally, our findings indicate that People-centric has a positive and statistically significant impact on Organizational Innovation ($\beta = 0.250$, $p = 0.002$) as does Infrastructure ($\beta = 0.424$, $p < 0.01$). No control variables (gender or education) were found to have a statistically significant effect on Organizational Innovation.

4.4 Mediating effects analysis

This research focuses on investigating the mediating role of People-centric and Infrastructure in the connection between Purpose and Organizational Innovation, as suggested by hypotheses H2, H3, and H4.

Table 4 presents the results of the mediation analysis using the bootstrap method. The indirect effect of the People-centric approach on the relationship between Purpose and Organizational Innovation is significantly positive ($\beta = 0.175$, $p = 0.002$, 95% CI = 0.022–0.304) as the bootstrap confidence interval excludes zero. Thus, H2 is justified. Furthermore, the indirect effect of Infrastructure on the relationship between Purpose and Organizational Innovation is significantly positive ($\beta = 0.091$, $p = 0.007$, 95% CI = 0.024–0.176), as the bootstrap confidence interval does not contain zero. Therefore, H3 was verified. Finally, the multi-mediating effect of People-centric and Infrastructure on the relationship between Purpose and Organizational Innovation is significantly positive ($\beta = 0.151$, $p < 0.001$, 95% CI = 0.080–0.240). with bootstrap confidence intervals greater than zero. Hence, H4 was confirmed.

Table 4: Results of the multiple mediator model: direct and indirect effects

	Label	Estimate *β*	Std. Error	z-value	*p*
Corporate Purpose → Organizational Innovation	c1	0.265	0.067	3.977	< .001
People-centric → Organizational Innovation	b1	0.250	0.081	3.096	0.002
Organizational Infrastructure → Organizational Innovation	b2	0.424	0.065	6.511	< .001
Corporate Purpose → People-centric	a1	0.697	0.039	17.713	< .001
Corporate Purpose → Organizational Infrastructure	a2	0.215	0.073	2.952	0.003
People-centric → Organizational Infrastructure	d1	0.510	0.083	6.173	< .001
Mediation effects	Label	Estimate *β*	Std. Error	z-value	*p*
Corporate Purpose → Organizational Innovation	c1	0.265	0.067	3.977	< .001
Corporate Purpose → People-centric → Organizational Innovation	a1*b1	0.175	0.057	3.050	0.002
Corporate Purpose → Organizational Infrastructure → Organizational Innovation	a2*b2	0.091	0.034	2.689	0.007
Corporate Purpose → People-centric → Organizational Infrastructure → Organizational Innovation	a1*d1*b2	0.151	0.035	4.343	< .001
Total effects	Label	Estimate *β*	Std. Error	z-value	*p*
Corporate Purpose → Organizational Innovation | Total	c1+a1*b1+a2*b2+a1*d1*b2	0.682	0.048	14.266	< .001
Corporate Purpose → Organizational Innovation | Total Indirect	a1*b1+a2*b2+a1*d1*b2	0.417	0.059	7.005	< .001

Note. Confidence intervals are bias-corrected percentile bootstrapped. Path coefficients (Bootstrap = 5000). Standard errors, z -values and p -values are based on the delta method.

4.5 Phase 2: Qualitative results

The qualitative results are organized and presented below, and categorized according to the four questions. Table 5 summarizes the themes, frequency, and exemplary quotes relating to how the people-centered approach and infrastructure serve as mediators in the relationship between Corporate Purpose and Organizational Innovation.

5 Discussion

In this research, we aim to investigate the link between corporate purpose and organizational innovation while also assessing the sequential mediating roles of the people-centric approach and organizational infrastructure in the relationship between these two variables. To the best of our knowledge, no previous study has explored these relationships, as proven by bibliographic research.

The results of both investigations indicate a positive correlation between corporate purpose and organizational innovation. This finding supports the notion that corporate purpose acts as a driving force for organizational innovation (Schultz, 2014). The quantitative data (β=0.265) further confirms that corporate purpose has a positive impact on organizational innovation, a conclusion shared by the interviewees. Interviewee I32 is an example of a widely held opinion when he states, "corporate purpose can play a crucial role in organizational innovation, as it provides a clear and inspiring direction that can motivate all levels of the organization". However, interviewee I37 takes it a step further by asserting that corporate purpose is the

Table 5: Themes, meaning, frequency, and exemplary quotes related to participants' interviews

Theme	Meaning	Frequency	Exemplary Quotes
Corporate Purpose impacts or influences organizational innovation.	Corporate Purpose is the objective of motivating teams of skilled individuals to collaborate and carry out specific tasks that ultimately benefit those who utilise their products or services. (Hollensbe et al., 2014; Mourkogiannis, 2008). Organizational innovation is the process of converting creative ideas into concrete products, services, administrative modifications, novel working methods, or management styles to secure a competitive advantage. (Baregheh et al., 2009; Fay et al., 2014; Migdadi, 2019).	34	I1: "A shared vision of corporate purpose is essential for promoting organizational innovation, as it serves as a guide, providing a compass that directs individual and collective innovation activities and initiatives. … Finally, it boosts cooperation between team members and within the organization, facilitating the implementation of new ideas and innovative solutions." I4: "The corporate purpose, by clearly defining the company's values and goals, provides a frame of reference for all employees. This alignment of objectives is crucial for organizational innovation." I5: "When an organization's employees are aligned with its corporate purpose, this will have a positive impact on the organization." I7: "For organizational innovation to take place there needs to be alignment with the corporate purpose." I11: "Corporate Purpose forces organizational innovation." I15: "Corporate purpose influences by establishing a clear vision and fundamental values that guide the company's actions and decisions." I17: "Corporate purpose, in my opinion, is also reflected in organizational leadership, which can play an important role in change, particularly in the shift towards organizational innovation." I23: "A common purpose promotes a sense of organization and collaboration, which are essential for innovation." I28: "When a company has a clear purpose of creating value for stakeholders and improving economic and social results, it tends to encourage its employees to think creatively and constantly look for new solutions. Often, corporate purposes include commitments to sustainability and social responsibility, which drive organizational innovation towards more efficient and responsible practices." I32: "Corporate purpose can play a crucial role in organizational innovation, as it establishes a clear and inspiring direction that can mobilize all levels of the organization." I37: "It (corporate purpose) represents the organization's DNA, translating its present and future impact on all its stakeholders. Considering that innovation consists of a way of being in the world that relegates permanent updating, as a way, even of subsistence and progress, I would say that innovation is inherent to purpose."

Table 5: Themes, meaning, frequency, and exemplary quotes related to participants' interviews (Continue)

Theme	Meaning	Frequency	Exemplary Quotes
People-centric approach is a third dimension that interferes with the relationship between corporate purpose and organizational innovation.	People-centric approach focuses on prioritizing employees within a company by understanding their needs, encouraging knowledge sharing, fostering creativity, considering their opinions in decision-making, and identifying what motivates them to perform at their best (Lepeley, 2017; Upadhyay & Kumar, 2020).	15	I1: "This perspective is more in line with reality, as a people-centered approach creates a more conducive environment for experimentation and creativity. By understanding and meeting employees' needs, promoting knowledge sharing and considering their opinions in decision-making processes, the organization not only inspires and motivates its employees, but also creates fertile ground for innovation." I4: "I believe that a people-centered approach ensures that employees understand and commit to the corporate purpose in a deep and personal way, thus facilitating organizational innovation. Furthermore, by valuing and considering the opinions of all employees, the company benefits from a diversity of perspectives." I5: "... after all, it's the people who can make the difference in an organization". I13: "Innovation only happens when people feel part of the organization, are heard, and even if they make mistakes, they know that they can always get it right and be recognized for it; the victories of each one are the victories of all and that are celebrated by everyone because everyone is proud to belong to the organization to which they dedicate themselves daily." I15: "The people-centered approach acts as an integrating element that strengthens the relationship between corporate purpose and organizational innovation. By ensuring that employees are involved, motivated and included in decision-making processes, this approach creates a favorable environment for innovation." I16: "Firstly, because it takes account of the skills resident in the organization. Secondly, because it makes it possible to create sharing and synergy between the various departments/ stakeholders." I17: Employees are agents of organizational change (innovation), and if they become aware of a company's purpose (corporate), they can contribute to achieving organizational goals. I24: "A people-centered approach is indispensable if employees are to understand, accept and mobilize themselves to apply organizational innovation in the light of the corporate purpose. The corporate purpose must serve as an aggregating factor to harmonize ideas and visions." I28: "The people-centered approach, by putting employees at the center of everything, acts as a crucial dimension linking Corporate Purpose and Organizational Innovation. This approach positively influences both elements in a number of ways: By putting employees at the center, the company creates a working environment aligned with its values and objectives, fosters creativity, commitment and productivity, in a culture of continuous and sustainable innovation." I32: "The people-centered approach can act as a bridge between Corporate Purpose and Organizational Innovation: 1. Involvement and alignment with purpose ....; 2. Stimulation of creativity and innovation .... 3. knowledge sharing and collaboration ..." I37: "In fact, I consider that the people-centered approach does not refer only to the organization's employees, but also to all the people affected by the organization's performance, where, in reality, the organization's own employees will be the center. As mentioned above, this underlies the purpose, and therefore, innovation."

Table 5: Themes, meaning, frequency, and exemplary quotes related to participants' interviews (Continue)

Theme	Meaning	Frequency	Exemplary Quotes
Infrastructure is a third dimension that interferes with the relationship between corporate purpose and organizational innovation.	Infrastructure is a strategic and operational system that consists of essential and core resources and capabilities to support operations and company objectives. Its agent is the people, and its micro-level includes the processes, routines, tools, workflow, and practices that enable it to achieve its goals in a financially viable, scalable, and sustainable manner (Arraya, 2024; Teece, 2023).	21	I1: "The greater the formality and rigidity of the infrastructure, the less flexibility there is for improvisation and experimentation, which are essential for organizational learning and innovation processes." I1: "Excessive formalization can create barriers to creativity and agility, which are fundamental characteristics for innovation." I1: "Formal infrastructure can lead to a disproportionate emphasis on operational efficiency to the detriment of exploring new possibilities." I2: "The infrastructure is related to the strategy. Therefore, if this is a strategy, then resources and capabilities are essential elements to guarantee the relationship between corporate purpose and organizational innovation." I4: "In addition, well-defined processes and routines aligned with the corporate purpose ensure that the company's daily activities are always geared towards strategic objectives, allowing room for innovation." I6: "Formal infrastructure allows a company to be organized and facilitates communication, autonomy, and innovation." I7: "Formal infrastructure determines how organizational innovation is conducted. Innovation does not happen unless the company has the capacity to do so." I8: "The means and resources made available by the company to its employees are fundamental to achieving the desired objectives and without which, no matter how goodwill and dedication you have, you will always fall short of the desired goal." I13: "Overly formal and hierarchical infrastructures are cumbersome and slow structures that increasingly have difficulty in being close to their audiences." I14: "I think that this third dimension of "organizational infrastructure" contributes to the improvement of the relationship between corporate purpose and organizational innovation (and vice versa; that is, if there is no organizational infrastructure or it is weak, this worsens the relationship between corporate purpose and organizational innovation). Reason 1: With more organizational infrastructure, organizations are more empowered and have more tools to innovate. Reason 2: With the existence of a strong organizational infrastructure, employees feel that resources, skills, processes, routines, tools, and workflows are made available in an organized/structured way, which encourages employees to develop their work and contribute to organizational innovation in an organized/structured way. I15: "Formal infrastructure ensures that the company's resources, systems, and processes are aligned with its corporate purpose, creating a cohesive environment geared toward innovation." I18: "The formal structure should be an enabler or instrument to achieve the company's goals. The profile, simplicity, logic of the structure and the availability of resources will certainly influence the purpose and innovation." I23: "A well-designed organizational structure can facilitate communication and collaboration, ensuring that everyone works towards the same purpose." I32: "A company's organizational infrastructure should act as a mechanism that enables and enhances the relationship between corporate purpose and organizational innovation: 1. Structural support for strategic alignment …; 2. Efficiency and Consistency in Innovation Implementation …; 3. facilitation of a culture of innovation and collaboration..." I37: "Organizational infrastructure can promote or retract from innovation. Purpose: The organization's DNA impacts the structure and tends to change it in order to improve the impact of the organization's activity on its different stakeholders. In this sense, the purpose tends to counteract the possible negative effects of formal infrastructure on innovation and promote its alteration to promote innovation."

Table 5: Themes, meaning, frequency, and exemplary quotes related to participants' interviews (Continue)

Theme	Meaning	Frequency	Exemplary Quotes
People-centric approach and Infrastructure play sequential mediating roles in the association between corporate purpose and organizational innovation.	See concepts above.	17	I2: The relationship between corporate purpose and organizational innovation rests on the condition that resources and capabilities are properly matched, as well as the infrastructure that follows." I4: "A people-centered approach and formal infrastructure act simultaneously in the relationship between corporate purpose and organizational innovation, creating a balanced environment where employees' motivation and capacity are harnessed." I7: "The relationship between corporate purpose and organizational innovation is mediated by the people-centered approach and the infrastructure form." I15: "The people-centered approach and the formal infrastructure act simultaneously in the relationship between corporate purpose and organizational innovation, creating an environment where culture and structure complement each other." I17: "People need infrastructure to carry out their missions in the organization. An infrastructure that is coherent with people's roles is "halfway there" to achieve the corporate purpose and support organizational change (innovation)." I19: "A purpose obviously needs to exist, but it alone does not result in innovation." I23: "The people-centered approach and the formal infrastructure act in a complementary way in the relationship between corporate purpose and organizational innovation." I28: "They work to strengthen the relationship between corporate purpose and organizational innovation... creating a synergy that aligns the organizational culture with the structure to support innovation."

company's DNA, "it (corporate purpose) represents the organization's DNA, reflecting its present and future impact on all its stakeholders". He argues that innovation is inherently linked to purpose as it involves a constant update of ways of being in the world that is necessary for survival and progress.

The metaphor of DNA is instructive because of its significance in the survival and prosperity of a company. DNA contains the necessary instructions for a company to develop, function, and achieve agility and authenticity in dynamic environments (Bonchek, 2016). A company's DNA serves as the foundation upon which its vision and values are built, as it encompasses not only its identity, but also the motivation it imparts to stakeholders for practices that are advantageous to society as a whole.

A company operates within an ecosystem based on the mutually beneficial and adaptive interdependence of its DNA with the environment (Arraya, 2024; Bonchek, 2016; Joly, 2021). Its primary objective is not to maximize profits but rather to fulfill its corporate purpose, which is to benefit all stakeholders, especially customers. It is plausible to suggest that the impact of corporate purpose on organizational innovation is due to an architecture that puts employees, in order to serve the well-being of customers, at the heart of the business, as evidenced by the result of the people-centric approach mediation between corporate purpose and organizational innovation [c1 (β=0.265) < a1*b1 (β=0.175)]. as interviewee I1says" it enhances (corporate purpose) cooperation between team members and within the organization, facilitating the implementation of new ideas and innovative solutions," fostering the development of authentic relationships with employees in a manner that leads to optimal outcomes. Essentially, business fundamentally involves fostering human relationships supported by individuals working together for a common purpose. This shared purpose motivates, inspires, and passionates them to work collaboratively with colleagues, customers, and everyone within the company's sphere of influence to achieve the collective goal (Joly, 2021).

The results indicate that corporate purpose, as a factor influencing the person–organization adjustment process, is closely tied to organizational innovation. In an interview, I28 stated, "When a company has a clear purpose of creating value for stakeholders and achieving economic and social outcomes, it typically motivates its employees to think creatively and persistently seek innovative solutions". It is reasonable to posit that individuals perceive the myriad resources provided by a company as serving to focus their attention on their work, motivating them and fostering effective performance. Effective leadership within a company fosters a focus on people; however, to be successful, it must seek and choose individuals who possess characteristics, behaviors, and attitudes that align with the corporate purpose, prevailing culture, values, objectives, and existing practices (Ashfaq & Hamid, 2021; Huang, 2021). Through the adaptation of their emotions, thoughts,

knowledge, and behaviors to new environments, they can achieve goals and fulfill work commitments (Davies et al., 2019; Thorpe & Schmüller, 1958). While corporate purpose encompasses the entire organization, its success ultimately depends on its leadership. As interviewee I13 mentioned, "leaders exist to serve their people," and interviewee I17 emphasized that "the corporate purpose, in my view, is also reflected in organizational leadership, which can play an important role in driving change, particularly in organizational innovation." Leaders at all levels play crucial roles in creating, developing, implementing, and supervising corporate goals. However, strong leadership at higher levels can strengthen and expand these efforts (Smith et al., 2018). Rey and Bastons (2019) also highlighted the importance of leadership and employee commitment to the corporate purpose and the alignment of the purpose with company practices in achieving desired goals.

A company's practices are underpinned by its organizational infrastructure, which comprises resources, methods, procedures, routines, and tactics that support leadership, decision making, and the pursuit of its corporate purpose and objectives (Bocken & Geradts, 2020). The mediation of organizational infrastructure between corporate purpose and organizational innovation [c1 (β=0.265) < a2*b2 (β=0.091)] reveals its impact on facilitating the efficient operation of organizational innovation. As stated by some of our interviewees, "organizational infrastructure is a vehicle" (I20) with a "clear but flexible structure" (I3), whose "well-defined processes and routines aligned with the corporate purpose ensure that the company's daily activities are always directed towards strategic objectives, allowing room for innovation" (I4) and that "the relationship between corporate purpose and organizational innovation is supported by the condition that the resources and capabilities are properly adequate, as well as the structure followed" (I2). However, interviewee I7 drew attention to "organizational infrastructure conditions in the way organizational innovation is conducted. Innovation does not happen without a company having the capacity to do so. Therefore, even if supported by corporate purpose, organizational infrastructure conditions impose limits on organizational innovation initiatives". It is reasonable to assert that organizational infrastructure ensures the daily functioning of the company and, through appropriate organizational capabilities, enables the identification, exploitation, and shaping of new opportunities while continually transforming the company's business model via organizational innovation (Weerawardena et al., 2015; Teece, 2023). Thus, organizational infrastructure is recognized as a mediator that contributes to the success of innovative work (Carew et al., 2009).

The theoretical significance of corporate purpose and organizational infrastructure has often been recognized, but their relationship with organizational innovation is only possible because people are the common denominator (Felin & Foss, 2005). Thus, it is the knowledge and skills possessed by employees that execute their corporate purpose, utilize infrastructure, and innovate. In other words, understanding and internalizing a company's purpose can significantly influence how employees achieve their goals and enhance customer and worker satisfaction. Furthermore, the results confirm that the people-centric approach and organizational infrastructure sequentially mediate [c1 (β=0.265) < a2*d1*b2 (β=0.151)] between corporate purpose and organizational innovation. Our interviewees excel in the same vein, "the combination of a clear purpose with a culture of valuing human capital results in a more dynamic, creative organization capable of continuously innovating. ... The people-centered approach and formal infrastructure act simultaneously in the relationship between corporate purpose and organizational innovation, creating an environment where culture and organizational infrastructure complement each other" (I15), "the people-centered approach and organizational infrastructure complement each other to facilitate organizational innovation in alignment with corporate purpose. Together, they create a clear and efficient work environment, empower and empower employees, sustaining an inclusive and continuous culture of innovation" (I33), and "when an organization esteems its employees and takes them into account in the construction of its corporate purpose, it will always want to find innovative solutions and changes that improve the team's results. It's a win-win situation" (I5).

This highlights the importance of focusing on employees and their skills and competencies to transform or reconfigure organizational resources and capabilities that reshape infrastructure and influence innovation as well as how this organizational infrastructure facilitates work and contributes to successful organizational innovation (Chaubey et al., 2022; Farida & Setiawan, 2022; Teece, 2023). Additionally, a combination of these dimensions drives innovation, but the ability to generate innovation is not only a cognitive ability, but also a function of learned and practiced behaviors (Dyer et al., 2011). As such, the guiding beacon behavior of corporate purpose, business behavior centered on people who work and strive for the company, and the organizational infrastructure that builds and adapts to all aspects of the company's architecture, resources, capabilities, processes, routines, and relationships serve to enhance creative impact, innovation, and customer well-being.

5.1 Contributions for theory and practice

Considering the outcomes highlighted, our aim is to make a meaningful contribution to the existing body of knowledge on how these mediators facilitate the impact of

corporate purpose on organizational innovation, ultimately delivering value to customers while simultaneously promoting their well-being. To this end, our research adds value to the literature on corporate purpose, DCV, and organizational innovation in various ways, with the principal implications outlined below.

First, our study suggests that corporate purpose, when combined with a people-centric approach and supportive organizational infrastructure, can foster an environment that encourages innovation. By prioritizing people, a company can facilitate the sharing of new ideas and promote a learning culture that increases the likelihood of successful innovation.

Second, it is important to recognize the role of people within a company's micro-fundamentals. However, the interplay between individuals and organizational resources, capabilities, and practices is essential to allow a company to adapt to external trends and to modify or transform the organizational infrastructure to develop and nurture an unspoken creative network and maintain a competitive edge.

Third, our study emphasizes the mediating role of organizational infrastructure. Each company has a unique configuration of resources, capabilities, skills, and knowledge that enables it to coordinate and execute activities and utilize its assets for organizational innovation. The specificity of a company's infrastructure makes it difficult to replicate or imitate, thus providing a competitive advantage for the company that develops it. Therefore, organizational infrastructure is a critical factor in maintaining a competitive position in the market.

Finally, our study revealed a straightforward virtuous cycle. Customer satisfaction is one of the primary goals for a company's corporate purpose. To achieve this objective, it is essential to promote an approach centered on individuals who share the company's purpose. This approach motivates and empowers individuals and teams to exhibit credible and trustworthy behaviors. Simultaneously, they built, promoted, and nurtured the infrastructure to support this purpose. This results in innovation and enhancement of products and experiences valued by customers, which in turn sustains a competitive advantage. However, it is crucial for a company to maintain consistency and coherence in their actions to achieve their goals. This requires articulating values, strategies, core business processes, decision-making orientations, and operations coherently and consistently.

6 Conclusion

This study makes a significant contribution to the analysis of the relationship between corporate purpose and organizational innovation from the perspective of dynamic capabilities view. The research incorporated a people-centric approach and organizational infrastructure as sequential mediators in the analysis. The importance of corporate purpose in maintaining and enhancing a company's competitiveness through customer satisfaction and organizational innovation is indisputable. This study corroborates the significance of corporate purpose in organizational innovation and demonstrates how the sequential mediation of a people-centric approach and organizational infrastructure reinforces this connection.

This research suggests that adopting a people-centric approach and organizational infrastructure may serve as an effective means for a company to enhance its organizational innovation. An organization in which one of the objectives of the corporate purpose is customer satisfaction demonstrates proficiency in identifying, seizing, and creating new opportunities, transforming resources and capabilities, and adapting to customer needs and technological advancements in the market, all of which are crucial to the pursuit of organizational innovation. By considering the people-centric approach and organizational infrastructure as core constructs, a company facilitates organizational innovation, leverages knowledge, and improves its ability to satisfy customers. This approach emphasizes essential human requirements, extends a company's scope, and expands its market beyond its current operations.

Therefore, corporate purpose, people-centric approach, and infrastructure collectively contribute to promoting organizational innovation. This study enhances the understanding of the virtuous cycle "corporate purpose – people-centric – organizational infrastructure – organizational innovation" as a fundamental component of customer satisfaction and organizational success.

Although this research presents significant contributions to theory and practice, there are avenues for further investigations, such as: (1) exploring and understanding whether the customer's perception of the company's corporate purpose is a significant factor in the purchase decision; (2) comparing whether the innovation strategies employed in the company reflect its corporate purpose; (3) conducting exploratory research to assess whether the corporate purpose helps the company withstand internal or external shocks; (4) investigating whether human resource management practices incorporate corporate purpose as a guiding principle and contribute to driving organizational innovation; (5) in this study, we considered the mediation of a stakeholder (an approach centered on the individuals employed by the company) and we suggest investigating the mediating or moderating role of other stakeholders and how they enhance the development and leverage of the relationship between organizational purpose and organizational innovation; and (6) future research may employ longitudinal design and different populations to confirm the direction of causality and examine the effects of two of the four constructs studied on company performance: corporate purpose and organizational infrastructure.

Finally, it is essential to acknowledge the potential

limitations of this study: (1) a cross-sectional design was employed, which reflects the respondents' perceptions at a single point in time, necessitating caution in generalizing the results to other industries and populations (Tsang, 2014); (2) the quantitative component of this study focused solely on one company in Portugal, and although the rigor of the field research ensures internal validity, construct validity, and reliability (Gibbert & Ruigrok, 2010), the results should be interpreted with caution when generalized (Tsang, 2014). Consequently, future research employing a longitudinal design and comparing the results across different regions and sectors may contribute to the elimination of contextual and cultural biases. Finally, (3) external reliability could be enhanced by conducting surveys across various types of companies (e.g., technology, industry, and financial) to ascertain their perceptions of corporate purpose and its influence on business performance.

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Učinki korporativnega namena na organizacijske inovacije: pojasnjevalna analiza z uporabo mešanih metod

Namen: Raziskava ima dva glavna cilja: prvič, preučiti vpliv korporativnega namena na organizacijske inovacije in drugič, analizirati zaporedni mediacijski učinek tako pristopa, usmerjenega v ljudi, kot tudi infrastrukture med korporativnim namenom in organizacijskimi inovacijami.
Načrt/Metodologija: V raziskavi je bil uporabljen zaporedni pojasnjevalni načrt z uporabo mešanih metod. Izvedeni sta bili potrditvena faktorska analiza (CFA) in uporaba orodja PROCESS, temelječa na 188 spletnih vprašalnikih, ki so jih izpolnili zaposleni v vodilnem portugalskem založniškem podjetju. Temu je sledila tematska analiza 37 strukturiranih intervjujev.
Rezultati: Kvantitativne ugotovitve kažejo, da ima korporativni namen pozitiven vpliv na organizacijske inovacije ter da pristop, usmerjen v ljudi, in organizacijska infrastruktura predstavljata pomembna mediatorja v odnosu med korporativnim namenom in organizacijskimi inovacijami. Poleg tega pristop, usmerjen v ljudi, in organizacijska infrastruktura zaporedno mediirata odnos med korporativnim namenom in organizacijskimi inovacijami. Kvalitativni podatki te ugotovitve potrjujejo in poglabljajo ter razkrivajo ključno vlogo pristopa, usmerjenega v ljudi, in organizacijske infrastrukture kot mediatorjev pri uresničevanju korporativnega namena za spopadanje z izzivi organizacijskih inovacij.
Sklepi: Raziskava ponuja teoretične in praktične implikacije za praktike, raziskovalce in vodje za boljše razumevanje odnosa med temi koncepti ter ponuja priložnosti za nadaljnje raziskave.

Ključne besede: *Korporativni namen, Organizacijska infrastruktura, Organizacijske inovacije, Pristop, usmerjen v ljudi, Zaporedna mediacija*

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Open-Source Transformer-Based Information Retrieval System for Energy Efficient Robotics Related Literature

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Background and Purpose: This article employs the Hugging Face keyphrase-extraction-kbir-inspec machine learning model to analyze 654 abstracts on the topic of energy efficiency in systems and control, computer science and robotics.
Methods: This study targeted specific arXiv categories related to energy efficiency, scraping and processing abstracts with a state-of-the-art Transformer-based Hugging Face AI model to extract keyphrases, thereby enabling the creation of related keyphrase networks and the retrieval of relevant scientific preprints.
Results: The results demonstrate that state-of-the-art open-source machine learning models can extract valuable information from unstructured data, revealing prominent topics in the evolving field of energy-efficiency.
Conclusion: This showcases the current landscape and highlights the capability of such information systems to pinpoint both well researched and less researched areas, potentially serving as an information retrieval system or early warning system for emerging technologies that promote environmental sustainability and cost efficiency.

Keywords: *Energy efficiency, Keyphrase extraction, Early warning system, Information system, Semantic network, Transformers, Industry 4.0*

1 Introduction

The fourth industrial revolution, or Industry 4.0, propelled by advancements in cyber-physical systems, artificial intelligence (AI), big data, and the Internet of Things, demands innovative methodologies to evaluate the impacts of these technologies on society and industry (Boas et al., 2005; Jazdi, 2014; Warner & Wäger, 2019). Industry 4.0 integrates highly adaptable robotic systems and energy-efficient solutions to boost sustainability in manufacturing, thereby aiding environmental protection. This industrial paradigm holds significant potential for sustainable transformation through green production, smart digitization, and a commitment to environmental stewardship (Wang et al., 2017; Jena et al., 2019; Rocca et al., 2020; Dinu 2024).

Research on energy efficiency in robotics has utilized multiple innovative approaches to reduce energy consumption, from more efficient algorithms to energy-saving hardware design, among other things (Carabin et al., 2017; Wang et al., 2017; Ghungrad et al., 2023). Digital transformation, epitomized by Industry 4.0, acts as a disruptive force in small and medium manufacturing enterprises, enhancing organizational agility, improving competitiveness, and driving industry wide change. This transformation encourages the adoption of technologies that enhance the energy efficiency and technological sophistication of manufacturing processes through robotics. Such changes promote sustainability and innovation, positioning SMEs for competitive advantages in a rapidly evolving industrial

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landscape (Ghobakhloo, 2020; Roblek et al., 2021; Philbin et al., 2022).

Text mining, a branch of AI, analyzes texts extensively, in order to extract valuable insights, often from unstructured text found in project documents, emails and social media posts, among other sources. This accelerates project management objectives and boosts digital strategies by providing deep insights into topics, while also tackling the challenges of traditional decision support systems amid increasing amounts of textual data, converting natural language into actionable insights and managing information overload efficiently (Froelich & Ananyan, 2008; Gajzler, 2010; Khan, 2018; Vasiliev & Goryachev, 2022).

Text mining has been shown to be a topic of interest for research in the field of information systems. Unstructured data accounts for 80 percent of today's data due to Web 2.0 and social media, particularly when manual analysis of these documents is too time consuming to be a worthwhile consideration. Text mining goes beyond information retrieval, aiming to discover relationships between texts, as well as create new information. Text mining covers several topics, all of which can help discover knowledge that would otherwise remain hidden or hard to find (Babu et al., 2014; Debortoli et al., 2016; Firoozeh et al., 2020).

One way to mine text is to use Automatic Term Extraction (ATE). Initially relying on handcrafted rules and NLP tools, ATE systems progressed to incorporate statistical measures and, later, hybrid approaches combining linguistic and statistical information. The latest advancements in ATE leverage neural techniques, particularly Transformer-based models, which offer automatic feature deduction and domain independence. These neural systems either utilize embedding representations for classification or fine-tune pretrained language models through transfer learning. Throughout this evolution, the core ATE process has remained consistent: extracting candidate terms and then determining their validity (Tran et al., 2023).

The goal of this article is to test a new open-source state-of-the-art (SOTA) natural language processing (NLP) model for ATE (henceforth referred to as keyphrase extraction), in order to do text mining and potentially reveal dominant research themes. Another goal is to construct a network that can be used to quickly retrieve relevant keyphrases and scientific articles related to energy efficiency within the field of systems and control, computer science and robotics. The results of the current study could guide future research and implementation strategies in a manner that prioritizes sustainability and societal well-being. Such a system could help scientists, engineers, managers in industry and policy makers, in cases when information needs to be retrieved as efficiently as possible for the purpose of quick decision making.

2 Method

2.1 Data retrieval (arXiv)

The arXiv preprint repository, initiated by physicist Paul Ginsparg in the early 1990s, has expanded from its origins in physics to include numerous disciplines, such as computer science and robotics (cs.RO). It serves as a platform for open access articles, accessible prior to peer review, and is supported by institutions like Cornell University and the Simons Foundation. The structured taxonomy of arXiv aids in the efficient organization and retrieval of over 1.5 million scientific article preprints uploaded to arXiv since 1991 until the end of 2024, approximately 0.5 million of these being in computer science and physics. It supports researchers in exploring a vast array of scholarly work and presents an intriguing prospect for benchmarking next-generation machine learning models (Clement et al., 2019; Rosenbloom, 2019; arXiv, 2024; Bagchi et al., 2024).

Also, several authors have found that authors that publish arXiv preprints receive more citations in the long run and is regarded as a contemporary counterpart to the conventional practice of manuscript sharing among peers for swift dissemination of findings (Davis & Fromerth, 2006; Moed, 2006; Sutton & Gong, 2017; Ferrer-Sapena et al., 2018; Bagchi et al., 2024). While arXiv e-print prevalence in computer science varies widely; it exceeds 60 percent in theoretical computer science and machine learning, but remains minimal in other areas, though generally on the rise. In addition, 23 percent of all papers in 2017, on the topic of computer science, were published on arXiv, compared to only 1 percent in 2007 (Sutton & Gong, 2017).

For the purpose of this study, which is to test the usefulness of current AI solutions for creating networks of related keyphrases on the topic of energy efficiency and as a means of retrieving scientific preprints related those keyphrases, the categories cs.RO (computer science and robotics), cs.SY (Systems and Control) and eess.SY (Systems and Control) were selected for web scraping (see Table 1).

The category cs.RO is the most direct and obvious choice, as energy efficiency and robotics are being researched. The category cs.SY and eess.SY were also scraped, as they are fields critical for robotics, CPS, and energy-related systems. They deal with the analysis, design, and optimization of control systems, which are essential for making robots and CPS operate effectively (arXiv, 2024).

For scraping purposes, pandas, xml.etree.ElementTree, io, and requests libraries were used. The http request used the following boolean query: "cs.SY" OR "eess.SY" OR "cs.RO" AND "energy efficiency". Http requests were

Table 1: Subcategories of cs.RO, eess.SY / cs.SY

Category	Sub-categories and Focus Areas
Robotics (cs.RO)	This includes autonomous vehicles, commercial robotics and applications, kinematics / dynamics, manipulators, interfaces, propulsion, sensors, workspace organization (arXiv, 2024; Association for Computing Machinery, 2012)
Systems Engineering (eess.SY/cs.SY)	This includes automatic control systems, using robotics, reinforcement learning, sensor networks, cyber-physical and energy systems, among others. The category cs.SY is an alias for eess.SY (arXiv, 2024)

Source: Author's work

made until no new data was being returned. Each request returned an XML file, from which information of interest was extracted into a Pandas DataFrame. For the purpose of the study, the column 'abstracts' in the DataFrame was used to test the open-source SOTA NLP model, where keyphrases were extracted from each row of the column.

2.2 Data processing (Hugging Face AI Model)

A neural network model, employing the Transformer architecture, was utilized in this study. First introduced by Google in 2017, the Transformer has become a dominant architecture in natural language processing (NLP). It underpins several prominent commercial large language models (LLMs), including GPT-4, Claude, and Gemini. Additionally, open-source models developed by organizations such as GitHub, Google, Microsoft, Hugging Face, Facebook, and Salesforce, have also significantly contributed to this architecture and related open-source machine learning platforms (Gauci et al., 2018; Kochhar et al., 2021; Naveed et al., 2024).

The Transformer architecture surpasses convolutional and recurrent neural networks in language understanding and generation tasks. It scales effectively with both data and model size, facilitates efficient parallel training, offers multimodal representations, and has the ability of self-attention. The Transformers Python library, developed by Hugging Face, provides robust implementations suitable for both research and production environments. It includes comprehensive tools for tokenization, fine-tuning, and deployment, and offers compatibility with PyTorch and TensorFlow. Additionally, the library's Model Hub hosts an extensive array of pretrained models, enhancing accessibility to advanced NLP technologies and promoting community collaboration (M. Chen et al., 2019; Shin & Narihira, 2021; Yang et al., 2021; Bengesi et al., 2023).

Keyphrase extraction automates the extraction of representative phrases from documents, enhancing digital information systems with applications in semantic indexing, search, clustering, and classification. Keyphrases consist of multiple words, and serve a variety of purposes, such as identifying representative phrases from a document that succinctly summarize its content (Papagiannopoulou & Tsoumakas, 2019).

Keyphrase extraction tools, such as those found on Hugging Face, leverage deep learning techniques to pinpoint critical phrases in scientific documents. However, their capabilities are often confined to English-language documents and may falter in other linguistic or contextual settings, as is the case with keyphrase-extraction-kbir-inspec. Keyphrases are typically categorized as either extractive, derived directly from the text of the document, or abstractive, which, although not explicitly present in the document, effectively summarize its content.

For this study, the keyphrase-extraction-kbir-inspec model, developed by the ML6team and available on Hugging Face, was selected due to its state-of-the-art (SOTA) status. This extractive model is based on the Transformers architecture, finetuned on the Inspec dataset and demonstrates proficiency in extracting key phrases from scientific paper abstracts, achieving an F1 score of 62 percent on the Inspec dataset (Kulkarni et al., 2022; ML6Team, 2024; Zhu et al., 2024).

A Google Scholar search, using the keyword "keyphrase-extraction-kbir-inspec", yields 5 results showing that the tool has previously been used in research papers, since its release in March 2022 (ML6Team, 2024), to aid in the development of a hierarchical model for unraveling conspiracy theories (Melnick, 2024; Zhu et al., 2024), the development of the keyphrase extraction portion of a research project aimed at making scientific texts easier to understand for non-expert readers (Engelmann et al., 2023), finding NLP papers by asking multi-hop questions (Li & Takano, 2022), as well as a master's thesis on the automated selection of credible health information online (Bayani, 2024).

For this study, an array of Python libraries were utilized, including transformers, torch, sklearn, os, accelerate, re, concurrent.futures, psutil, pandas, nltk, gc, collections, ast, itertools, and matplotlib to facilitate tasks related to the Hugging Face model. Additionally, two custom modules were imported to enhance multiprocessing capabilities and streamline data cleaning. The code was run locally using an Nvidia Geforce 3070. Using Python, articles retrieved from the arXiv dataset underwent preprocessing.

First duplicates were removed, then each row in the 'abstract' column was processed to convert strings to lowercase and remove special characters. Stopwords were not removed, in order to make the text as close to the original as possible. The keyphrase extraction tool was then applied to extract keyphrases from each row. Subsequently, these keyphrases were lemmatized to reduce variations and decrease the complexity of the resultant networks. Finally, 50 example abstracts were selected and rated on how well the keyphrase extraction method determined keywords, in order to give a qualitative perspective on the resulting network.

The frequency of each keyword across all texts was computed, followed by the creation of tuples representing edges within a network graph, each tuple (edge) linking two keyphrases (nodes). Network graphs, which depict entities and their interconnections, can model diverse systems—from neuronal pathways to transportation networks (MATLAB, 2024). Analysis focused on the network's structure, specifically the number of edges and nodes. Additionally, a subnetwork was selected for detailed analysis to demonstrate what such an information retrieval system can do (see Figure 1 and Figure 2).

To visualize the data, the Python libraries collections, os, pandas, itertools, networkx, and matplotlib.pyplot were employed. Networks were designed to display up to ten edges per keyphrase to maintain clarity and prevent visual clutter in the representations. Such visualization can be used for many purposes, such as for networks of authors and publications across different academic fields (Kwon, 2022).

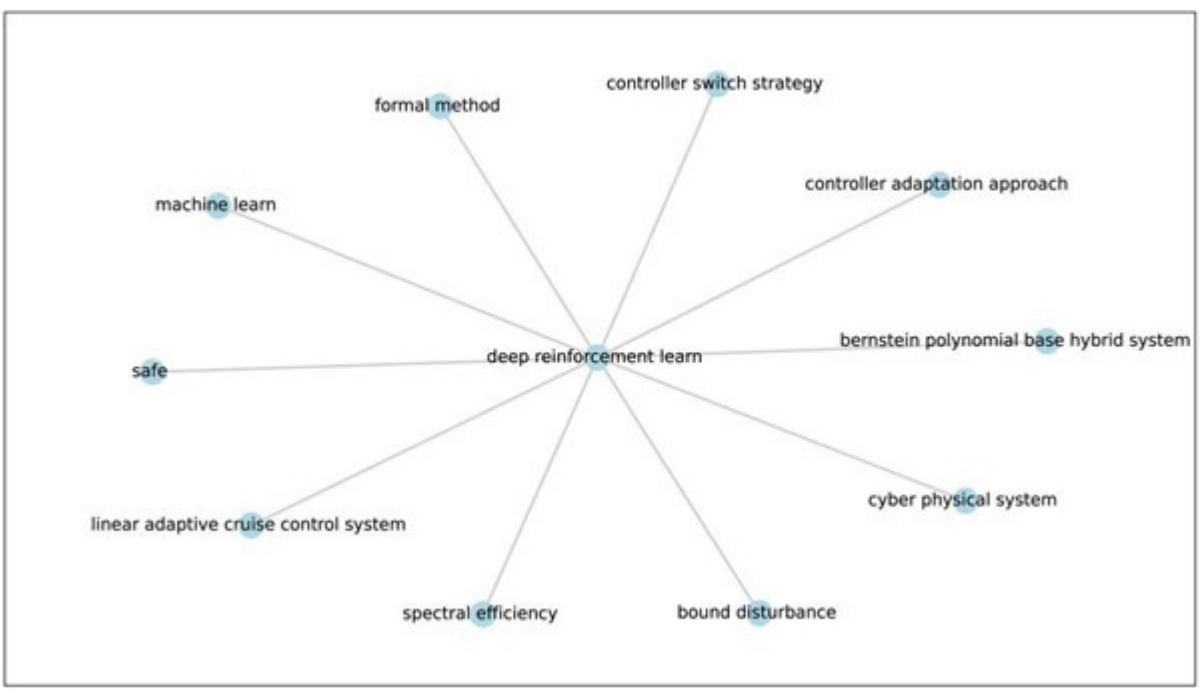

Figure 1: The initial keyphrase selected for traversing the network ("deep reinforcement learn.")
Source: Author's work

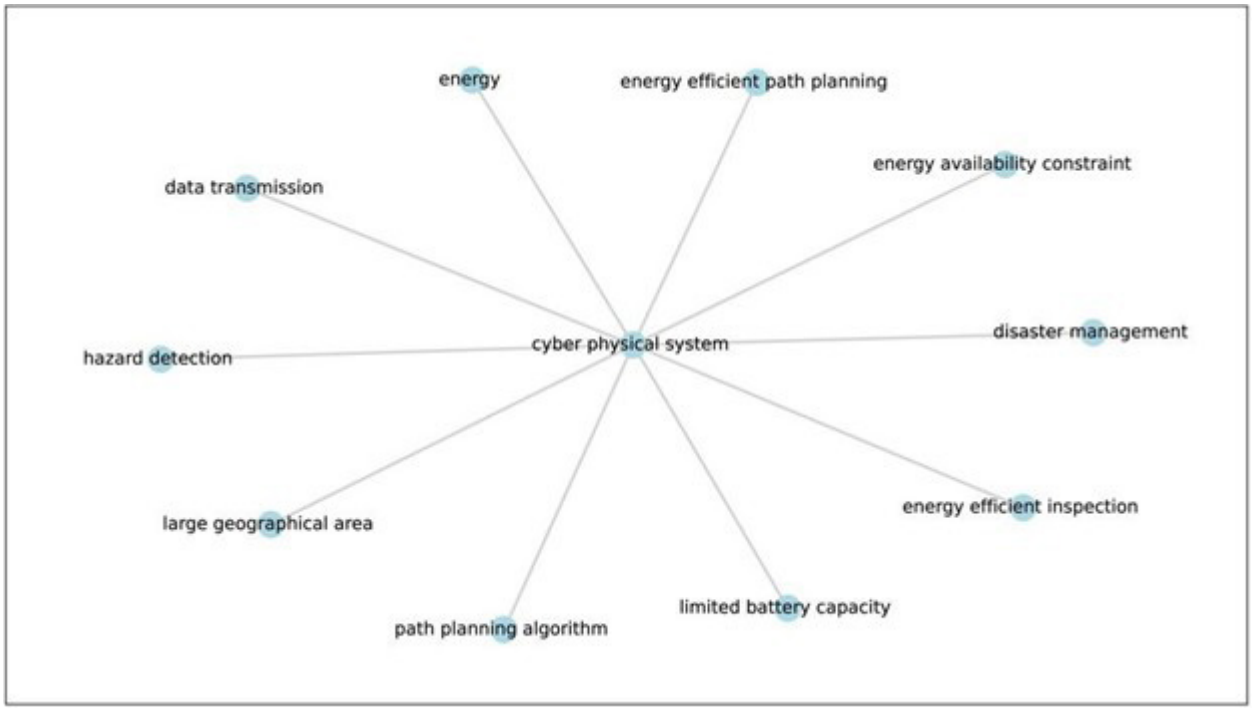

Figure 2: 10 edges of the keyphrases (node) "cyber physical system", expanding the network from Figure 1
Source: Author's work

Table 2: Keyphrase Frequencies Related to Energy Efficiency

(energy efficiency, 191), (reinforcement learn, 27), (deep reinforcement learn, 27), (unmanned aerial vehicle, 22), (simulation, 21), (energy consumption, 20), (machine learn, 18), (robustness, 17), (air conditioning, 17), (mobile robot, 17), (predictive control, 14), (efficiency, 14), (deep learn, 14), (model, 13), (legged robot, 13), (wireless network, 12), (automate vehicle, 12), (hvac system, 11), (autonomous vehicle, 11), (energy, 10), (sustainability, 10), (computational complexity, 10), (neuromorphic hardware, 10), (electric vehicle, 9), (hvac, 9), (occupant comfort, 9), (system, 9), (trajectory planning, 9), (trajectory optimization, 9), (heating ventilation, 8), (uncertainty, 8), (optimization, 8), (deep neural network, 8), (internet things iot, 8), (model predictive control, 8), (signalize intersection, 8), (power consumption, 8), (throughput, 8), (controller, 7), (privacy, 7), (fpga, 7), (security, 7), (simulation result, 7), (spectral efficiency, 7), (iot, 7), (cellular network, 7), (cost function, 7), (control, 7), (autonomous drive, 7), (locomotion, 7)

Note: The top 50 keyphrases are displayed above, each in a tuple showing the keyphrase and the frequency it appears in the abstracts.
Source: Author's work

3 Results and discussion

From a dataset of 1,092 articles retrieved from arXiv, 654 were found to be unique after merging the csRO, csSY, and eessSY dataframes and subsequently removing duplicates. The keyphrase extraction tool yielded 6,437 unique keyphrases, averaging approximately 10 keyphrases per abstract. An analysis of the Excel files for the categories csSY and eessSY revealed that csSY comprised of 449 preprints. Of these, 383 were also classified as eessSY preprints, which is the same number as there were eessSY preprints altogether. Additionally, there were 52 that were both categorized as eessSY and csRO. The category csRO, having 258 preprints, constituted about 39% of the total preprints.

Table 3: Number of Node Edges for Each Keyphrase

(energy efficiency, 2327), (deep reinforcement learn, 332), (reinforcement learn, 286), (energy consumption, 285), (unmanned aerial vehicle, 284), (simulation, 259), (robustness, 229), (machine learn, 221), (mobile robot, 204), (air conditioning, 179), (deep learn, 173), (predictive control, 164), (wireless network, 162), (efficiency, 161), (model, 153), (computational complexity, 146), (energy, 131), (legged robot, 131), (hvac system, 129), (trajectory optimization, 126), (autonomous vehicle, 124), (automate vehicle, 123), (electric vehicle, 122), (neuromorphic hardware, 121), (system, 120), (uncertainty, 114), (sustainability, 111), (trajectory planning, 109), (security, 107), (simulation result, 105), (signalize intersection, 103), (classification, 103), (optimization, 102), (internet things iot, 100), (occupant comfort, 97), (power consumption, 96), (model predictive control, 95), (throughput, 95), (spectral efficiency, 95), (convex optimization, 95), (control, 95), (hvac, 94), (controller, 94),, 94), (cellular network, 94), (dynamic program, 91), (privacy, 91), (iot, 89), (smart grid, 86), (data transmission, 85)

Note: The top 50 keyphrases with the most edges are shown above, each represented as a tuple with the keyphrase and its associated edge count.
Source: Author's work

Two-word phrases were found to be the most frequent across a wide variety of datasets. This pattern is consistent not only in scientific domains but also in business, media, and bureaucratic contexts (Nomoto, 2022), as well as in the corpora analyzed for the purposes of this study (see Table 2). Handling multi-word terms, as well as distinguishing terms from general words, appears to be done well by the keyphrase-extraction-kbir-inspec algorithm. This allowed for the creation of networks of keyphrases, as seen in Figure 1.

The current study has shown that using the keyphrase-extraction-kbirinspec model is a reliable method for extracting keyphrases. The 50 examples of articles, where keyphrases were manually looked at, appeared to be of high quality and demonstrated proficiency in extracting keyphrases from abstracts in scientific papers, ignoring stopwords and other irrelevant keyphrases from the abstract, leaving only keywords that represented the abstract.

The high quality could be due to the fact that it was fine-tuned on the Inspec dataset, that is on a collection of 2,000 expert-annotated computer science papers with identified keyphrases, as well as the fact that most of the preprints were on the topic of computer science (Kulkarni et al., 2022; ML6Team, 2024; Zhu et al., 2024).

As illustrated by comparing Table 2 with Table 3, although keyphrases that appear more frequently in the abstracts tend to have more edges, higher frequency does not invariably correlate with a greater number of edges.

Text mining within the realm of data analytics is increasingly acknowledged as an efficient method for leveraging unstructured textual data. By analyzing data, text mining can reveal new knowledge and reveal significant patterns and correlations that would otherwise remain obscured (Hassani et al., 2020).

The networks created during this study, as detailed in Table 2 and Table 3, demonstrate that text-mining methods such as keyphrase extraction, using Transformer-based architecture, are useful for identifying related keyphrases (the nodes and edges of the network). These results show that such methods can effectively reduce the amount of time required to identify relevant or related keyphrases, as opposed to reading through all of the abstracts individually and identifying relevant keywords that way.

Terminology plays a crucial role in specialized knowledge, particularly in its development, representation, and communication through language (Leonardi, 2009). As such, terminology is useful for managers and employees that need a common up-to-date and representative source of information about specialized knowledge within their company. While the keyphrases found in Table 2 and Table 3 are likely not representative of the full literature, they could be expanded upon by scraping additional scientific articles or literature that is representative of the field of energy efficiency and are not found on the arXiv website (or by looking at other categories on arXiv), eventually leading to a more complete collection of keyphrases relevant to improving energy efficiency within a company or elsewhere. It should be noted that only the top 50 most frequent keyphrases were looked at and that there are thousands remaining that could potentially show less researched areas that might be gaining importance, which could act as an early warning system.

The keyword "deep reinforcement learn" from Table 3 was chosen to traverse the network and find subnetworks. As depicted in Figure 1, 10 keyphrases were selected that are related to the keyphrase "deep reinforcement learn" (out of a total of 332 keyphrases). Among these 10 keyphrases, "cyber physical system" was selected for further

exploration, in order to delve deeper into the network structure (see Figure 2).

Deep learning is an advanced subset of AI and machine learning that uses multi-layered neural networks to learn directly from raw data. Unlike traditional approaches, it automatically discovers patterns without extensive human intervention, using multiple processing layers to create increasingly abstract data representations. This allows deep learning to handle large datasets efficiently, with its effectiveness typically improving as data volume grows. By mimicking the brain's hierarchical learning process, deep learning models excel at solving complex problems across various domains, making it a core technology of the Fourth Industrial Revolution (Sarker, 2021). Reinforcement Learning, on the other hand, is one of three main machine learning paradigms, in addition to supervised learning and unsupervised learning. In reinforcement learning, agents learn optimal behavior through trial-and-error interactions with an environment, without requiring labeled data (Al-Mahamid & Grolinger, 2021).

Finally, within the "cyber physical system" network, the keyword "energy efficient path planning" was chosen (see Figure 2), which was a node that has only two prepublications associated with it. According to M. Chen et al. (2019), energy-efficient path planning is defined as "given a start location, a goal location, and a set of obstacles distributed in a workspace: find a safe and efficient path for the robot".

The preprint abstract by Monwar et al. (2018) has the nodes "energy efficient path planning" and "cyber physical system" associated with it; however, it should be noted that this preprint no longer has "deep reinforcement learn" associated with it. The preprint proposes an energy-efficient path planning algorithm for a swarm of unmanned aerial vehicles (UAVs) tasked with inspecting a large geographical area. The algorithm aims to minimize the overall energy consumption of the swarm, taking into account the energy required for flying, hovering, and data transmission by each individual UAV (see Table 4).

According to Hambarde & Proença (2023), Information Retrieval (IR) "is to identify and retrieve information that is related to a user's query. As multiple records may be relevant, the results are often ranked according to their relevance score to the user's query." The above results show that using the keyphrase-extraction-kbir-inspec model is effective in creating an IR system, where the user traverses a network of keyphrases, in order to find articles of interest. As seen above, there is no score based on relevance, which is often a part of IR systems (Hambarde & Proença, 2023; Jiang et al., 2023); however, the network could still be useful to do an exploratory search of articles, especially when there are already specific keywords of interest to search for. This method could complement other methods, such as clustering or Retrieval Augmented Generation (RAG), which has been shown to be a viable way to reduce hallucinations in LLMs (Jiang et al., 2023). However, using RAG, instead of (or in addition to) keyphrase extraction / network creation, could potentially be a much more costly alternative, as LLM models, particularly bigger ones, typically use A100 or V100 Nvidia graphics cards, whereas this study used one consumer Geforce 3070 card (Samsi et al., 2023).

Recent advancements in commercial and open-source machine learning algorithms have produced model's adept at extracting information pertinent to decision-makers, in the current study, for those with expertise in energy efficiency, robotics or systems and control research; however, the proposed network of relevant kephrases used for information retrieval is only a proof-of-concept. There need to be several improvements made before the network is practical.

Before starting to improve such a system, one approach could involve having several domain experts validate portions of the network and rating the usefulness of such a system for their work. If such a network is highly rated, then further improvements could be done to the network. According to Rosenbloom (2019), arXiv moderates submissions for content appropriateness rather than scientific validity; thus, for creating networks with scientific validity, a collection of published peer-reviewed articles would be necessary.

Nevertheless, the current network could lead to decision-makers discovering a preprint that has undergone peer review since its release on arXiv. In addition, other information could be added to the network for greater detail, such as citation count, year of publication etc.

Future enhancements to the proposed network could involve categorizing keyphrases under umbrella terms and linking synonyms within the same network. These improvements could significantly increase the speed at which users could browse technologies or other relevant information, enabling instant access to all scientific articles related to the selected keyphrases.

In the future, it would be interesting to look at additional methodologies, such as clustering or RAG, or even more elaborate data wrangling approaches, as they could enhance the proposed system, particularly in regards to improving article retrieval, as well as provide a comparison to the current network.

An enhanced version of the current network could benefit managers in engineering and other decision-making roles by allowing them to spend less time searching for pertinent articles and more time analyzing articles that contain information related to potentially disruptive technologies. In a sense, it could act as an early warning system for aforementioned technologies. Additionally, it could help them discern connections that might not be immediately apparent.

Table 4: Preprint of article that had "cyber physical system" and "energy efficient path planning" in it

Title: Optimized Path Planning for Inspection by Unmanned Aerial Vehicles Swarm with Energy Constraints (DOI: 10.1109/GLOCOM.2018.8647342)
Abstract (snippet): Autonomous inspection of large geographical areas is a central requirement for efficient hazard detection and disaster management in future cyber-physical systems such as smart cities. In this regard, exploiting unmanned aerial vehicle (UAV) swarms is a promising solution to inspect vast areas efficiently and with low cost. In fact, UAVs can easily fly and reach inspection points, record surveillance data, and send this information to a wireless base station (BS). Nonetheless, in many cases, such as operations at remote areas, the UAVs cannot be guided directly by the BS in real-time to find their path. Moreover, another key challenge of inspection by UAVs is the limited battery capacity. Thus, realizing the vision of autonomous inspection via UAVs requires energy-efficient path planning that takes into account the energy constraint of each individual UAV...
The following are keyphrases that were extracted from the above abstract using Hugging Face model (keyphrase-extraction-kbir-inspec): ['autonomous inspection', 'cyber physical system', 'data transmission', 'disaster management', 'energy', 'energy availability constraint', 'energy efficient inspection', 'energy efficient path planning', 'hazard detection', 'large geographical area', 'limited battery capacity', 'path planning algorithm', 'polynomial time', 'smart city', 'surveillance data', 'unmanned aerial vehicle uav swarm', 'wireless base station']

Note: Example article and related information that a node can lead to using the proposed information system.
Source: Author's work

Also, in the current state, as was already mentioned, synonyms are not grouped within the same network, which means that it is possible not all relevant preprints related to "cyber-physical systems" and "energy efficient path planning" were identified within the subnetwork in this study. Moreover, the list of extracted keyphrases is extensive, making it challenging to define a few overarching categories for all of the keyphrases, though not impossible. Also, the network was traversed by starting with the keywords "deep reinforcement learn", which was associated with "cyber physical system" but was not associated with "energy efficient path planning". As a result, to improve the network, a feature could be added that informs the user when a keyphrase of interest is no longer associated with other keyphrases of interest downstream.

Such a final version of the network as is mentioned above, could help companies save money and be seen as environmentally friendly. Energy efficiency improvements are crucial for increasing product competitiveness in the global market, which can lead to decreased energy-related operating costs, increased return on equity, return on assets, return on investment, and return on sales, among other things (Backlund et al., 2012; Fan et al., 2017; Melnik & Ermolaev, 2020; de la Rue du Can et al., 2022; Knuutila et al., 2022)

The European Regional Development Fund and the Cohesion Fund were the primary EU funds targeting energy efficiency in enterprises, allocating €2.4 billion from 2014-2020. Estimates indicate that saving one unit of energy was cheaper than purchasing the same amount of electricity, suggesting that these investments were generally efficient (ECA, 2022).

Backlund et al. (2012) found that energy-intensive firms seem to be more successful when it comes to adopting energy management practices, e.g. an employed energy manager and the existence of an energy strategy. However, all companies should be thinking of increasing energy efficiency. For example, SMEs represent 99 percent of global businesses and 13 percent of world energy consumption. Despite barriers like high costs and lack of awareness, they have significant potential to improve energy efficiency. Low-cost measures and larger investments in processes and energy supply can lead to substantial savings and benefits, contributing to climate change mitigation and sustainable development (Gennitsaris et al., 2023).

Research indicates that maximum warming from CO2 emissions occurs about a decade after emission, with actions to reduce emissions potentially yielding benefits

within our lifetimes (Ricke & Caldeira, 2014). The Paris Agreement aims to limit global warming to 2°C above pre-industrial levels, with probabilistic analysis showing a 25 percent chance of staying below this threshold if cumulative CO2 emissions are limited to 1,000 Gt CO2 by 2050. The chance of staying below the threshold was predicted to be 50 percent if we reduce CO2 emissions by 1,440 Gt. To get a perspective of what that means, it is important to note that 234 Gt CO2 were emitted between 2000 and 2006 (Meinshausen et al., 2009). Additionally, Smith et al. (2018) predicted a 38 percent chance of exceeding the 1.5 °C threshold in a given month and a 10 percent chance in any given year between 2017 to 2021 (Smith et al., 2018). The Great Barrier Reef is already experiencing coral die-off when heat exposure surpasses critical thresholds, and by the 2030s, major crops will face extreme heat exposure, threatening food security. Such historical trends and future projections underscore the urgent need for robust, long-term climate strategies to mitigate ongoing warming (Hansen et al., 2006; Gourdji et al., 2013; Hughes et al., 2018). Overall, these studies amplify the need for quick decision making in regards to implementation of technologies that are energy efficient.

Text mining, particularly those advanced methods such as AI, and IT systems, such as Information Systems, use a lot of energy. Overall, the ICT sector's electricity consumption was estimated to be 4.7 percent of the global total, contributing approximately 1.7 percent of global CO2 emissions (National Research Council, 2011; The World Bank and ITU, 2024). However, implementing artificial intelligence could lower energy consumption and carbon emissions by about 8 to 19 percent by 2050. When combined with energy policies and low-carbon power generation, it could potentially reduce energy consumption by 40 percent and carbon emissions by 90 percent compared to business-as-usual scenarios (Ding et al., 2024). This is highly important, as energy efficiency does not only help organizations save money, but it also helps fight climate change. Climate change poses a significant threat, already damaging urban and natural systems and causing global economic losses exceeding $500 billion (L. Chen et al., 2023). Ritchie & Roser (2020) indicated that the energy sector accounts for 73.2 percent of all CO2 emissions, with industrial energy use contributing 24.2 percent of these emissions. Swifter implementation of new energy-efficient solutions is crucial for reducing greenhouse gas emissions, aligning with the EU's commitment to combating climate change.

Meeting the Paris Agreement targets is essential to limit global warming to less than 2°C above preindustrial levels, with an aspirational goal of not exceeding 1.5°C. Rapidly adopting these technologies is vital for achieving these objectives (Brugger et al., 2021; Dinu et al., 2023; Virjan et al., 2023).

Such an information retrieval system can be useful to various kinds of SMEs, particularly in manufacturing and logistics, where highly energy intensive process benefit greatly from a Knowledge Management system. KM process, such as knowledge acquisition, dissemination, and application, significantly contribute to environmental, economic, and social sustainability, by increasing green innovation and organizational agility, which in turn enhance corporate sustainability performance. Overall, KM is vital for integrating sustainable strategies across firms, supporting both innovation and long-term sustainability goals (Abbas & Sağsan, 2019; López-Torres et al., 2019; Shahzad et al., 2020; Sharma, Jabbour, & Lopes de Sousa Jabbour, 2021). The proposed system in the current study could help organizations create a new KM system or add to their pre-existing one. As such, further research is need to determine the usefulness of such open-source models in achieving these goals.

4 Conclusion

This study demonstrates the effectiveness of keyphrase extraction techniques, particularly the keyphrase-extraction-kbir-inspec model, in efficiently and accurately categorizing scientific abstracts. The results reveal that keyphrase networks, can be valuable in developing information retrieval systems, as demonstrated with energy efficiency scientific abstracts. The ability to traverse networks of keyphrases can provide decision-makers with rapid access to relevant information.

However, further improvements are necessary to enhance the usefulness of such a network. These improvements include incorporating peer-reviewed articles, validating the network through domain experts, linking synonyms, exploring additional methodologies like clustering and RAG, incorporating broader datasets in other arXiv categories or sources other than arXiv to ensure a comprehensive representation of the field, among other things.

The study underscores the critical role of energy efficiency in improving business competitiveness and mitigating climate change. Despite their own energy demands, the integration of AI and text mining tools could contribute significantly to reducing global energy consumption and carbon emissions, aligning with broader sustainability goals.

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Dr. Tine Bertoncel is an assistant professor of business informatics at the University of Primorska's Faculty of Management. With a diverse professional background spanning data analysis, data science, and digital marketing, he brings a wealth of experience from various industries to his academic role.

Odprtokodni Transformer sistem za iskanje informacij v literaturi povezani z energetsko učinkovito robotiko

Ozadje in namen: Uporabili smo strojno učenje po modelu Hugging Face za analizo 654 povzetkov na temo energetske učinkovitosti v sistemih, nadzoru, računalništvu in robotiki.
Metode: V raziskavi so bile izbrane specifične kategorije arXiv, ki so povezane z energetsko učinkovitostjo in zajemanjem ter obdelavo povzetkov s sodobnim odprtokodnim Hugging Face keyphrase-extraction-kbir-inspec modelom za ekstrakcijo ključnih besed. Na ta način smo oblikovali povezana omrežja ključnih besed za pridobivanje relevantnih znanstvenih predpublikacij.
Rezultati: Rezultati raziskave kažejo, da sodobni odprtokodni modeli strojnega učenja iz nestrukturiranih podatkov lahko izvlečejo relevantne informacije o pomembnih temah na še vedno premalo raziskanem področju energetske učinkovitosti.
Zaključek: Prikazali smo trenutno stanje in možnosti za nadaljnje raziskovanje informacijskih sistemov za iskanje relevantnih informacij, ki lahko služijo odločevalcem kot managerski sistem zgodnjega obveščanja z uporabo sodobnih digitalnih tehnologij, ki spodbujajo okoljsko trajnost in izboljšujejo energetsko učinkovitost.

Ključne besede: *Energetska učinkovitost, Ekstrakcija ključnih besed, Sistemi zgodnjega obveščanja, Informacijski sistem, Semantično omrežje, Transformerji, Industrija 4.0*

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