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e-Health Application, Implementation and Challenges: A Literature Review

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Abstract

Background: World Health Organization, through a partnership with European Union, encourages the implementation e-health systems. E-health is a relatively old concept that is upgraded with new technologies and is directed toward monitoring different health conditions with the help of technology. **Objectives:** This paper's main objective is to demonstrate e-health application possibilities in today's healthcare organisations and its impact on the quality of provided health care services using ISO/TR 14639 Health informatics Capacity-based eHealth architecture roadmap. **Methods/Approach:** In this paper, we used the e-health architecture model for literature review based on individual areas of the model - ICT infrastructure, e-health infastructure, health process domain components, governance and national ownership. **Results:** Research confirms that new technologies have a favourable and significant impact on population health; however, more developed countries show a better understanding of the concept and are moving towards implementing laws and regulations for e-health practices. **Conclusions:** Through this research, we concluded that new technology significantly impacts health, but this impact is limited due to different development of countries. That is why it is very important to develop health literacy, which is the ability to comprehend, access, retrieve, and use health information or health services.

Keywords: e-health, m-health, health systems, industry 4.0
JEL classification: O33
Paper type: Research paper

Introduction

E-health is a concept directed toward monitoring different health condition with the help of technology (Andrès et al, 2015) and is frequently used as an object of discussion and analysis when creating strategies and policies for health organisations (Showell et al., 2012). The concept of e-health began to be seriously considered in 1999 by combining electronic communications and technological achievements. Still, over the years, this term has been used more in merging different Internet technologies to enhance the quality of healthcare services (Oh et al., 2005). It can be said that e-health is a relatively old concept that has been upgraded with new technologies that arise with the development of Industry 4.0. New technologies important for the e-health concept are Big data, Artificial Intelligence (AI), sensors, the Internet of medical things (IoMT), drones, blockchain, etc. All mentioned technologies can be used to track a patient's status and inform the medical staff about it (Preuveneers et al., 2013). Eysenbach (2001) defines e-health as a field emerging at the nexus of medical IT, public health, and business, enabling improving conditions for providing public health services over the Internet and related Internet technologies. On the other hand, The World Health Organization (2003) defines e-health as the use of information communication technology to monitor and manage the treatment of users that use health services.

Many conceptual definitions are encountered in the literature, and each of them emphasises the importance of the Internet and Internet technologies in the context of expanding and providing adequate and user-demanded health care services. In recent work published in the last three years, e-health is often met by the term m-health, for which Barbabella et al. (2017) explain that it is an integral part of the e-health concept and is influenced by the development of smartphone technology. The development of Industry 4.0, as a result, enables medical staff to use different kinds of technology, like smartphones, to track patient status and to inform the medical staff about it (Preuveneers et al., 2013). But to use such technologies within healthcare processes, the organisation must conduct digital transformation, eliminating the traditional way of providing healthcare services and adopting a new way based on innovations that emerge from the technologies mentioned above (Haggerty, 2017). Using the concepts of m-health and e-health has several advantages but also faces some challenges. Scientific papers published so far are focused on understanding the term and possibilities of applying the concept, as well as examples of the introduction of the concept in healthcare organisations. For this reason, there is a need to look at the concept from different perspectives, including all the advantages, challenges, and opportunities that health organisations have by implementing some of the proposed e-health solutions.

The quality of life of today's society is decreasing with the ever greater influence and pressure of the environment. Quality of life has several determinants, psychic, physical, degree of individual independence, and its relation to the environment (Ruževičius, 2012). Consequently, healthcare organisations may have higher requirements for new approaches to providing health care. Success in meeting those demands correlates with the healthcare organisation's ability to adjust to the new requirements. The main purpose of this paper is to strengthen health systems in different countries and understand the importance of new concepts and technologies. This paper provides a holistic approach to e-health through the prism of quality of life. This paper offers a review based on the systematic architectural approach proposed by International Organization for Standardization.

The main objective of this paper is to demonstrate the possibilities and the challenges of implementing new technology within the healthcare system using

ISO/TR 14639 Health informatics — Capacity-based eHealth architecture roadmap. Through the proposed methodology, this paper offers a different approach that includes the relation between the implementation of new technology in healthcare and its impact on the quality of life of healthcare users. Also, the suggested framework is modified and showcases data collected through secondary research from relevant databases.

Following the proposed framework, this paper is divided into several different chapters. The first chapter has a background that explains terms and concepts important for understanding the e-health concept. The second chapter explains the methodology used in-depth, and the results are presented within the suggested framework in the third part. In the last part, there is a discussion and conclusion.

Background

About e-health concept

The importance of developing the e-health concept is recognised by the World Health Organization, which, through a partnership with European Union institutions, encourages the implementation of e-health systems (World Health Organization, 2016). It is important to point out that e-health is not just about the ability of health care users to explore and utilise available information about health conditions but also to arrange diagnostic, prognostic, research, auxiliary and other procedures that can be utilised to provide full service for healthcare users (Demiris, 2004). Table 1 presents an overview of the evolution of available health services.

Table 1
An overview of the evolution of available health services

Factor	Health 1.0	Health 2.0	Health 3.0	Health 4.0
Objective	Increasing system efficiency	Improving communication and productivity	Provide a user-focused solution	Real-time health monitoring
Focus	Easy automation	Connecting with other organisations	Interacting with patients	Integrated monitoring and diagnosis using artificial intelligence
Information Sharing	Within the organisation	Within a cluster of healthcare institutions	Inside the country	Within the entire supply chain
Key Technology	Administrative systems	Cloud computing	Big data	IoT, artificial intelligence, blockchain
Limitations	Limited functionality	Information sharing but the inability to interact	Different standards used	Privacy and data theft

Source: Adapted from Chanchaichujit et al. (2019).

The term e-health encompasses many different innovations and technologies based on the Internet and the Internet's potential. The e-health discourse encompasses the concept of m-Health, i.e. the use of smartphones as a means by which it is possible to perform some diagnostic or other activities.

However, e-health is not the only innovation available to today's healthcare hospital organisations. Through expert systems or sensors, artificial intelligence collects a lot of data. It creates so-called big data, enabling The digital transformation of healthcare organisations increases the flow of information through the system as much as increases the efficiency of such a system. But digital transformation also presents new challenges that come with the ability of third parties to make information about healthcare users available and to misuse that information.

The benefits of implementing e-health systems are primarily associated with financial savings. Research conducted in ten European countries has shown some financial benefits that the health care system has had after implementing the e-health system. With benefits associated with the health system, health care users are also susceptible to the positive impact of such a system. First, the benefits related to the safety in terms of making a proper medical decision about how a medical procedure is to be performed. Additionally, e-health provides easy access to information in all healthcare institutions with little or no probability that the information is not available now the user is on a contracted health check (Stroetmann et al., 2006). The implementation of e-health in the existing health system has several advantages starting with increasing efficiency and reducing costs, increasing the quality of the healthcare services provided, creating a new relationship between healthcare users and doctors as well as other medical staff and reducing the gap between health care beneficiaries who have financial resources and those who do not have (Raman et al., 2012). The applicability of the e-health system has shown particularly good results in countries where access to health care staff is low or none. In this case, e-health systems allow remote health services to open a medical facility, especially for settlements with insufficient populations (Naseem et al., 2014).

But, with some advantages, the e-health system has shortcomings. Lack of awareness of the need to integrate e-health systems into current healthcare systems presents difficulties and drawbacks. Additionally, the lack of information infrastructure, device-based innovation that can be used to support e-health data collection processes, and high investment costs are a challenge that some less developed countries can often not overlook (Adebesin et al., 2013).

When deploying an e-health system to an existing healthcare system, the available research suggests a series of requirements that must be met for successful implementation. First and foremost, it is necessary to define a strategy geared toward taking the steps required for implementation, which implies adopting policies geared toward developing the infrastructure and superstructures necessary for the normal functioning of such a system (Ross et al., 2016). Infrastructure and superstructure imply the development of electronic devices that will be used to monitor the health status, educate the operators involved in the e-health system, and develop databases and how the collection of collected data will be collected (Jin et al., 2018). Factors that encourage but may also be an obstacle to implementing e-health systems are technology availability, implementation costs, staff competence, policies and strategies (Ross et al., 2016). There are several different ways of using e-health. One of them is m-health, which is related to the possibilities of using mobile technology to track the health status of the healthcare user. With an increasing number of smartphones that today's sociality use, there are different kinds of possible usage of that kind of technology.

Furthermore, today's smartphones are equipped with different sensors that can be used for tracking healthcare status, such as heart rate (Preuveneers et al., 2013). With the growth of smartphones worldwide, more people are using m-heath to monitor their health. Additionally, there is an increase in the variety of applications that can

be downloaded to a smartphone and used to track a user's health state. These applications are particularly useful for groups of heart disease patients (Silva et al., 2015).

Health 4.0

The development of Industry 4.0 has the effect of creating innovations in all industries, including health. Industry 4.0 consequently has developed the so-called Health 4.0 concept that involves the application of technological solutions emanating from Industry 4.0 in healthcare (Estrela et al., 2018). Furthermore, with the development of Internet technologies and the ability to communicate through the Internet, many technological innovations developed within Industry 4.0 use the Internet to transmit information. Using the Internet with advantages such as availability of information, speed of data exchange, etc., also brings with it the risk associated with the security of information from third parties, which, if made available to them, could misuse the information. This is a particularly problematic area when it comes to healthcare to ensure the privacy of health service users.

The concept of Health 4.0 also implies the development of many other concepts related to the specific operations in healthcare facilities. For example, there is the development of Surgery 4.0, which improves communication within the team and the quality of surgical procedures performed. Surgery 4.0 uses a variety of automated systems, such as robots, that perform precise and complex surgical procedures (Feussner et al., 2017). Furthermore, Industry 4.0 affects the ability to deploy automated and robotic systems in healthcare and the ability to use technologies such as drones. The use of drones in the transportation of medical supplies or in the provision of assistance to injured persons in urban areas, where significantly more time is required for the arrival of an ambulance team. However, Health 4.0 also involves using artificial intelligence, which is used in expert systems through which medical staff can make a much more effective decision, that is, systems that make their own decisions based on the collected data. As a rule, data collection uses sensors that can be implemented in different places and systems, such as the so-called smartwatch, smartphone, smart TV, etc. (Javaid et al., 2019).

Using the innovations being developed within Industry 4.0, the digital transformation of hospitals and healthcare organisations is needed. Through digital transformation, such organisations are embracing innovations. Healthcare and hospital organisations benefit from improved communication, a higher quality of health care delivery, and consequently a higher quality of life for their users. Besides, the application of virtual and augmented reality enables significantly more effective education and extension of the competencies of medical staff performing medical and other interventions. The Health 4.0 concept is the result of evolution but also a revolution in technology and approach to service delivery. The table shows the evolution of the approach to healthcare delivery from the Health 1.0 concept to the Health 4.0 concept. The table shows how the focus moves from eliminating bureaucracy, i.e. unnecessary documentation, to monitoring the state of health care users in real-time and, according to the identified state, undertaking certain activities. Besides, new technology is making it much easier to disseminate information between all stakeholders in the supply chain.

However, it should be emphasised that Health 5.0 is expected to emerge through the development of Industry 5.0, which will certainly include collaboration between medical staff and advanced non-artificial intelligence-based automated systems. Furthermore, it should be emphasised that the development of the Health 5.0 concept will surely affect both the quality of the provided health service and users' satisfaction

with the health service. The E-health system is developing in parallel with the development of science and technology and because of increased demand for healthcare users. Particular importance and applicability of the e-health system are in situations where there is no adequate number of medical staff in the healthcare system that can respond to customer requirements.

Implementation of e-health systems increases challenges such as the need to educate future administrators, i.e. the operators who will be e-health management, and the need for infrastructure development that will enable the normal functioning of one established system. E-health and telemedicine systems are finding their applicability in different and numerous health states. In the future, we can expect an increase in e-health systems to be implemented in existing healthcare facilities. These systems' applicability will be in treating cardiovascular diseases, especially heart attacks (Saner, 2013). With the possibility of using e-health systems to treat various healthful apartments, the financial savings and the enhancement of the quality of healthcare provided based on information available through the e-health system are emphasised (Rooij et al., 2016). The e-health system application will enable all health care users to inspect their health status, based on information available through their smartphones or other devices specialised in accessing such information. Additionally, medical staff will be able to use scientific facts and recent achievements in the field or on the health condition they are trying to solve (Doupi et al., 2004).

E-health will also improve the standard of healthcare operations and the quality of treatment given to its users. Health organisations can develop, implement and rationalise e-health principles to reduce the operational costs associated with providing the required health services. This can result in increased patient flow through the health system, which means fewer waiting lists. In addition, implementing an e-health system will enable partial or complete elimination of the need for paper documents, which may result in the faster and simpler transfer of information obtained through diagnostic and other searches for healthcare users.

The recommendation to future researchers is to carry out primary research to explore the possibility of using e-health systems in countries where there are not enough users in the health care system. Still, there are waiting lists and research on the benefits of an e-health system implementation for healthcare organisations.

The development of Industry 4.0, in addition to enabling all organisations to transform and increase the efficiency of their healthcare delivery digitally, also enables them to increase the quality of their healthcare services. Increasing the quality of the health service provided can also increase the quality of life of the health service users. By using technologies such as big data, sensors, artificial intelligence, and automated and robotic systems, the healthcare hospital organisation can perform much more complex interventions that require significantly greater precision but, on the other hand, make significantly better diagnoses.

Methodology

This paper aims to provide an overview of ICT infrastructure and the health process of implementing e-health solutions. EHealth Architecture model presented by ISO/TR 14639-2 will be used to achieve this goal. ISO/TR 14639-2 describes eHealth processes, information, components and activities and is used to plan and improve health services through new technologies. Although this framework has a practical application, the basic components of the model will give an overview of the literature from individual areas of the model. This model is also proposed by Okereafor et al. (2020), Prodinger et al. (2017), Seebregts et al. (2017), and Taylor et al. (2015). The

eHealth architecture model (eHAM) comprises various component categories that are grouped under the following broad headings, shown in Table 2.

Table 2
Basic components of eHAM model

Category	Description
Foundation ICT infrastructure	Networking, servers, software, and IT professionals are basic IT technologies. Common standards, procedures, directives, and frameworks support foundational elements.
Foundation eHealth Infostructure	Data warehousing, consent and access control, data exchange interoperability, electronic health record repositories, and registries.
Health Process Domain Components	Patients who need healthcare services can access them through various processes involving the providers of such services. The health domains, which cover the continuum of care, include clinical (provider) assessment of health problems, diagnostic (test) assessments, treatments, and related elements, including payment for services and service evaluation, provider and patient education, and knowledge management.
Governance and national ownership	The governance and ownership category of the eHealth architecture model encompasses all organisational and governance components of eHealth, including funding, performance management, and the growth of local knowledge and capacity in health informatics. Infrastructure and infostructure both benefit greatly from standards.

Source: Taylor et al. (2015).

A simplified framework of eHAM is shown in Figure 1.

Figure 1
Simplified eHAM
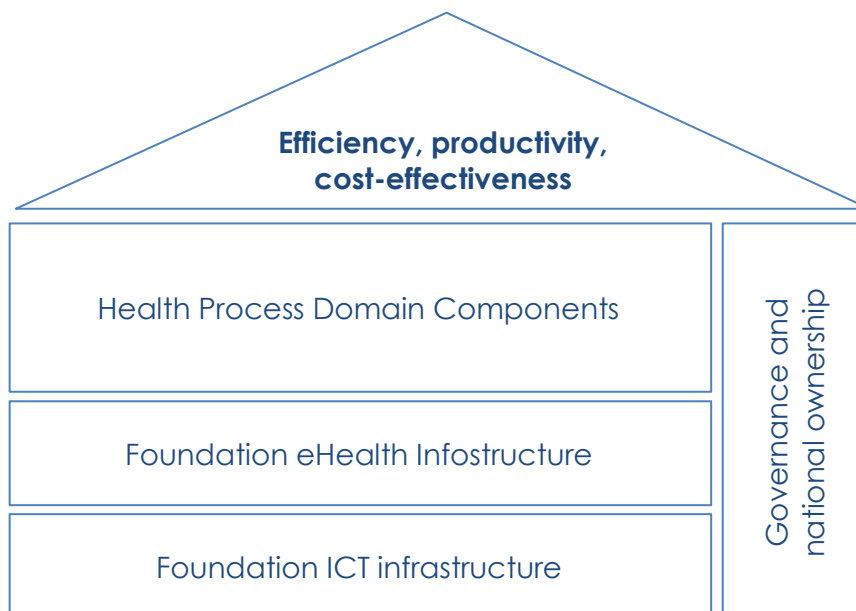
Source: Authors illustration

The aim of the framework presented in Figure 1, according to Taylor et al. (2015), is to support nations and organisations in achieving the enhancements and advantages shown in the pyramid (at the top of the model)—more specifically, improved care quality and access, increased productivity, efficiency, and cost-effectiveness, well-informed health policy, and increased evidence-based practice. The model's components are created to be typical, optional, and adaptable to meet local demands when used in any specific eHealth service. As a result, this model provides a framework for developing further architectural models for eHealth family applications such as patient records, image management, mobile health, and Telemedicine. A literature review based on the individual areas of the proposed framework presented in Figure 1 is shown in the following chapter.

Results

Foundation – ICT infrastructure

The development of ICT and the growing trend of application and connection of known technological and technical narratives in a network developed a new sector of the industry, IoT, an acronym for the Internet of Things. In the context of e-health, IoT is used through sensors that can be used to collect user health information, which then can be stored in the associated database (Kodali et al., 2015). However, using IoT in healthcare and in general, brings several challenges associated with establishing secure communication between devices and databases. Since all devices are connected to a wireless internet connection, there is a risk of data theft (Tarouco et al., 2012). IoT design features and the technology utilised are linked to additional difficulties with IoT implementation in health systems. IoT devices require the existence of a constant power supply that will allow them a period of autonomy, which is the basis for proper and unobstructed diagnosis. In addition, the challenges are also related to technology and the microchips used to perform defined tasks of the IoT device (Sebestyen et al., 2014).

Despite the potential dangers and risks inherent in using IoT in the health system, several advantages bind to using this technology. One of them is better and significantly more effective control of the health care user's condition and the real-time ability to monitor his condition. In addition, the increase in the number of sensors that can be used in monitoring the condition can greatly facilitate the diagnosis (Maksimović et al., 2017). Furthermore, with the development of the Internet of Things, the Internet of medical things (IoMT), which is related to making the network of different medical devices, is also developed. Besides, IoMT can track the health status of the healthcare user and inform the medical staff about the user's health status (Alsubaei et al., 2019).

Several studies confirmed the correlation between ICT and better health outcomes. Majeed et al. (2019) conducted a study on the contribution of ICT to health outcomes. Three proxies—internet users, mobile cellular subscriptions, and fixed telephone subscriptions—are used in this study to assess the ICT infrastructure. The empirical data point to information and communication technology's an important and positive effect on population health. According to the findings, healthcare programs should focus on policies that promote digital inclusion. The effects of information and communication technology (ICT) on health outcomes in 30 Asian countries from 2000 to 2016 were examined in a study by Dutta et al. (2019). The study's key conclusions show that ICT significantly affects health outcomes in several Asian countries. Based on the findings, this study addresses certain critical issues associated with ICT and

recommends some crucial policy implications, mostly for emerging countries. ICT infrastructure (accessibility and availability) and health data (usage and sharing) were the two components of a cross-country health analysis that Seddon et al. (2017) conducted using multivariate statistical methods. This study's quantitative indicators/metrics suggest three separate country groups: frontrunners, followers, and laggards. These classifications emphasise the radically varied socio-political and economic contexts that national health systems face, where ICT infrastructure and eHealth capability will only help to relieve health inequities to a limited extent.

A study by Ud Din et al. (2017) examined the importance of information and communication technology (ICT) and e-governance in Pakistan's health sector, where these services are still developing. This study collected primary information from 170 patients at public and private hospitals in the Peshawar province of Pakistan. According to the research, e-governance in the health sector is still in its early stages. ICT is used for medical purposes by a relatively small number of people, and however, the total rate is low. A need for education exists. Other favourable conditions for deploying e-governance in the health sector include infrastructure, electricity, a good user interface, and data privacy and confidentiality.

Foundation – eHealth Infostructure

The possibilities of applying e-health systems are many and depend on the factors that make the health system in which e-health is implemented. The healthcare system for the healthcare user consists of a device connected to the database. From the database, at any time, it is possible to extract information about the user's health status. The operator, in most cases the therapist or other medical staff, may take appropriate measures depending on the registered indicator. The simplest example of a health monitor system is a system that monitors a user's state over a smartphone or a smart TV. Such devices are permanently connected to the database through an Internet connection, and medical staff can track the recorded state (Kotevski et al., 2016). The E-health system can also help the medical staff decide on the user's health status or therapy. This system is called CDSS, an acronym of the English word Clinical decision support system, i.e. a system for supporting clinical decision-making. CDSS contains a database on which medical staff can conclude or suggest a way to treat the identified symptoms (Dinevski et al., 2011).

One of the components of an e-health system is m-health. The m-health system is based on mobile technology. Today's smartphones incorporate a range of sensors that, with the help of applications, can track the condition of a healthcare user. The likelihood and popularity of such applications are correlated with their availability and price, as well as the user's awareness of the possibilities of their application (Handel, 2011). Another part of e-health is also Telemedicine. Telemedicine is an approach that enables communication and transfer of data and information at big distances between health care users and medical staff. Telemedicine may take place based on real-time interaction depending on the available link or available media used for data transmission (Craig et al., 2005). Increasing demands associated with establishing better communication between health care users and medical staff or medical institutions resulted in an appearance of the CHI, an acronym for Consumer health informatics. CHI makes it possible to use and better understand collected and obtained information about diagnostic and other examinations performed in medical institutions (Dey, 2004).

The applicability of the e-health system was tested in some European countries, and one of them is Denmark. By implementing EMR, an acronym for electronic medical records, the availability of information on the patient's health was facilitated, while the

health care institutions largely released paperwork. However, the healthcare workers must remain logged in with their username and password in the information system, which can lead to abuses of such systems (Kierkegaard, 2013). Poland has implemented artificial intelligence in its healthcare system, which has been trying to contribute to better and more efficient decision-making. Artificial intelligence in the healthcare system enables medical personnel to considerably facilitate diagnostics, i.e. easier decision-making based on collected data on patient status (Ziuziański et al., 2014). In Europe, many countries have implemented different forms of e-health. Benedict et al. (2018) identified 23 systems implemented in Germany, Italy, Belgium, Norway, Denmark and Poland. Implemented systems, or platforms, are linked to enhancing how healthcare organisations share information about the patient's health and assisting the medical staff's decision about treatment. An example of good practice is India, which applies the e-health system to enable direct communication with the healthcare user after performed operation, thus reducing the need for the user to go to physical examinations and counselling with a doctor. Besides, the e-health system also enables the training of medical staff without the need to leave their institution to attend a seminar or training. However, the application of the e-health system entails the challenges associated with the system's financial sustainability, which is correlated with the number of users using e-health.

Health Process Domain Components

Through health process domain components, several important areas are highlighted. Among them are payment, service evaluation, patient and provider education, knowledge management, and others. When using e-health systems, it is important to have health literacy. Health literacy is the capacity to comprehend, access, retrieve, and use medical information and services, according to Osborne et al. (2018). The authors contend that it is necessary to comprehend users' knowledge, skills, and experiences with current and upcoming systems. The level of e-Health literacy among university students studying medicine and health sciences in Mashhad, Iran, was evaluated by Dashti et al. (2017). The findings indicated a low degree of e-health literacy, and additional research is required to determine the factors that influence e-health literacy. Other research, made by Zhang et al. (2018), is focused on mobile healthcare applications (MHAs) that have been very popular in recent years, offering various innovative health services and information transfer techniques. The authors' article examined how users' perceived e-health literacy affects their motivation to keep using MHAs, developed on the elaboration likelihood model (ELM). The results show that ELM performs effectively in this model. The perceived level of e-health literacy significantly modifies the periphery route but not the centre. The most intriguing discovery is that perceived e-health literacy positively links to user satisfaction regarding continued adoption.

The financial aspect of the e-health system is also crucial. The relationship between alternative payment mechanisms (APMs), market competitiveness, and telehealth services in hospitals was the subject of research by Zhao et al. in 2020. The findings indicated that as clinical staff become more accustomed to using such technology, greater telehealth-related capabilities and deep integration into care-delivery systems under APMs present strong potential to improve clinical care quality and challenges. Authors Saranya et al. (2021) offer a Secure Authentication Protocol (SAP) payment over mobile in their study on e-health financing. To accomplish shared authentication between the server and the client, authors employ cryptographic techniques, which can be exploited to attack forged servers and falsified workstations. Compared to existing techniques, the suggested solution guarantees both distinct

privacy and the security of user account data as the payment industry transitions to mobile.

The safety of e-health systems is the most important when managing e-health systems. Through a study, Haryadi et al. (2017) provide a secure e-health system that depends on proving protocols to reveal and verify certain patient attributes while concealing others, thereby enhancing personal identity security. The experimental results showed that each proving protocol took less than a second to compute. Khan et al. (2018) assess the current methodology for ensuring the safety and security of a burgeoning and vital real-time e-health application domain. The approach is built on application and device requirements, including design and run-time elements. Given the application specification, the design component employs logical verification techniques to guarantee that the application architecture is resilient to faulty data. The authors use an example medical e-health application that controls and monitors blood glucose levels using an insulin pump to evaluate the methodology. A strategy for combining a cloud-based framework for monitoring electronic-health services is suggested by Kanchanadevi et al. (2020). With this, they hope to modify it for distributed computing. This framework has been upgraded to offer a larger variety of health services. The authors also integrate a security module to enhance patient privacy and safety in addition to this architecture. The proposed method improves access to health data while improving security, privacy, timeliness, and cost.

Governance and national ownership

Many countries around the world are developing regulations for e-health systems. E-health and electronic health records are being studied in Italy by Marino et al. (2020). As part of the reforms mandated by the Italian Government Law relating to the National Health Service, the nation is introducing information and communication technology, including eHealth and Electronic Health Records (EHR). This study's objective is to evaluate how widely used and accepted electronic health records are in southern Italy. The findings offer an early assessment of the usage of electronic health records, indicating that, in practice, electronic health records have yet to meet their goals and have had a lower influence on hospital operations than projected. Health professionals can create a coordination network to share knowledge and improve e-health standards across institutions. This phenomenon is viewed as an adaptable network-oriented standard governing paradigm for very large information infrastructures, according to Fossum et al. (2019). The authors advise e-health standardisation professionals to create profession-based network organisations that may operate as an intermediary between top-down and bottom-up standardisation operations to ease the inherent consolidation problem in standards governance in healthcare. De Pietro et al. (2018) are researching a new e-health strategy framework in Switzerland. According to the authors, as part of a larger e-health program that started a decade ago, Switzerland created a new federal law on patients' electronic health data in 2015. The reform compels hospitals to deploy interoperable EHRs to encourage data exchange and collaboration among healthcare professionals, resulting in healthcare quality and efficiency advances. Despite having the best intentions, the law's implementation was delayed by the significant institutional and organisational fragmentation of the Swiss healthcare system and a lack of complete stakeholder consensus on some crucial reform elements. Pilot trials showed that ambulatory participation is certain to be limited without the right incentives. Garmann-Johnsen et al. (2017) investigate the potential of e-health and welfare technologies. By identifying the essential characteristics that determine performance, the study contributes to e-health research. Government rules and laws have a

substantial impact on these elements. The author's findings cast doubt on the idea that welfare technology networks can be built from the ground up without governmental intervention. To get process performance indicators and foster innovation, regulatory interventions are required.

E-Health could enhance the delivery of healthcare services by enhancing communications, training the health workforce, and assisting with job-related duties and supervision. Additionally, the recent practice of precision medicine (PM) in low- and middle-income countries (LMICs) may assist in managing chronic diseases. Rayan's (2020) analysis focuses on mobile health's present developments, potential uses, and effects on people's lives in LMICs. It also exhibits awareness of the most effective methods for expanding electronic health (e-Health) initiatives in LMICs, guided by adaptation of knowledge from real case studies and assessment of the effect on developing and deploying future health initiatives, especially for women and children.

Discussion

There are different areas of e-health systems, and we used the e-health architecture model presented by ISO/TR 14639-2 to gather and categorise different research on this topic.

We simplified this model and used its main categories to give an overview of the literature. Based on conducted literature review, a summary using eHAM is presented in Table 3.

Table 3
Summary of the e-health literature review based on eHAM

Category	Results
Foundation ICT infrastructure	Studies made by Majeed et al. (2019), Dutta et al. (2019), Seddon et al. (2017), Ud Din et al. (2017) confirm the fact that information and communication technology has a favourable and significant impact on population health. However, critical issues associated with information and communication technology, mostly in developing countries, imply the need for some crucial policy implications.
Foundation eHealth Infostructure	Kierkegaard (2013), Ziuziański et al. (2014), Benedict et al. (2018) and other authors suggest that applying e-health systems depend on the factors that make the health system in which e-health is implemented. Also, the application of the e-health system entails the challenges associated with the system's financial sustainability, which is correlated with the number of users using e-health.
Health Process Domain Components	Osborne et al. (2018), Dashti et al. (2017), and Zhang et al. (2018) suggest that we need to understand users' knowledge, abilities, and experiences with current and upcoming e-health systems. Zhao et al. (2020) and Saranya et al. (2021) suggest alternative payment mechanisms for e-health services. Haryadi et al. (2017), Khan et al. (2018), and Kanchanadevi et al. (2020) present methodologies for ensuring the safety and security of e-health applications.
Governance and national ownership	Many countries are developing regulations for e-health systems; some practices are suggested by Marino et al. (2020), Fossum et al. (2019), De Pietro et al. (2018), and Garmann-Johnsen et al. (2017).

Source: Authors' work

These findings conclude that although information and communication technologies have a major impact on health, this impact is constrained by the varying levels of development worldwide. This research showed some critical issues in most emerging countries with underdeveloped health infrastructure. Providing health care services within highly populated urban areas is highly demanding. Those areas face challenges related to providing emergency health care services, but the roads that emergency response teams use are mostly crowded with cars and other vehicles. Some challenges are related to providing a safe connection between devices. This is crucial to secure the privacy of healthcare users and the privacy of employees providing healthcare services to the user. Research also shows that many countries are developing laws and regulations for using e-health, which can help manage this system more efficiently.

Many authors are looking at e-health and its application by describing the definition of e-health and considering different risks emerging from using technologies in e-health. This kind of perspective is very important to understanding the basis for e-health functioning. Other researchers in this area offer a practical use of the e-health architecture model and show different software used within health organisations. In this research, we wanted to overview important topics and components of the presented model. Additionally, this study goes into greater detail about the effect that e-health may have on the standard of care given to patients. Through four categories, this article covers a variety of experiences with e-health systems, rules, and regulations: ICT infrastructure, e-health infostructure, components and administration of the health process domain, and national ownership. This is secondary research, so it is limited in scope. However, we have shown that Industry 4.0 significantly impacts the quality of healthcare users provide.

Conclusion

In this paper, we described the possibilities of new technologies that emerged from Industry 4.0 in healthcare services. Technological innovations like RFID (Radio-frequency identification), IoT (Internet of things), drones etc. can increase the efficiency of today's healthcare organisations. New technologies can increase competitiveness in the market, so organisations that don't conduct digital transformation of business face many challenges. Through digital transformation, organisations can increase interested parties' satisfaction, leading to increased profit. It is important to emphasise that today's healthcare organisations face increasing demands for healthcare services because the quality of life in today's society is decreasing, which is correlated due to the increased stress level. Stress levels may determine new illnesses that will drive the need for creating a new way of managing them.

The practical implications of this research are related to all organisations considering implementing e-health technologies but are unaware of the benefits and challenges related to e-health. This research shows the most important aspects of building an e-health system. This research can also be used as a foundation to learn all the basic components of the e-health architecture model and to develop this system within different organisations. The presented model applies to all health systems. Since this model is developed and presented by ISO/TR 14639-2, it can help the institution in the different certification processes.

This paper's primary limitation is that it relied on secondary research, and the conclusion was based on research and data that is currently accessible. Future researchers in this area should conduct a primary study to identify the efficiency and

satisfaction of health users of healthcare organisations using traditional approaches and healthcare hospital organisations using Industry 4.0 innovations to provide services, such as big data (Connolly et al., 2018) or e-health records (Boilson et al., 2019).

References

1. Adebesin, F., Kotzé, P., Van Greunen, D. Foster, R., (2013), "Barriers & challenges to the adoption of E-Health standards in Africa", Health Informatics South Africa (HISA) Conference, 3-5 July 2013, Nelson Mandela University, Port Elizabeth, pp. 1-9.
2. Alsubaei, F., Abuhussein, A., Shandilya, V., Shiva, S. (2019), "IoMT-SAF: Internet of Medical Things Security Assessment Framework", Internet of Things, Vol. 8, pp. 1-30.
3. Andrès, E., Talha, S., Benyahia, A. A., Keller, O., Hajjam, M., Moukadem, A., Hajjam, A. (2015), "E-health: A promising solution for optimizing management of chronic diseases. Example of the national e-health project e-care based on an e-platform in the context of chronic heart failure", European Research in Telemedicine/La Recherche Européenne en Télémédecine, Vol. 4 No. 3, pp. 87-94.
4. Barbabella, F., Melchiorre, M. G., Quattrini, S., Papa, R., Lamura, G., (2017), "How can eHealth improve care for people with multimorbidity in Europe?", World Health Organization, Regional Office for Europe, Copenhagen, Denmark.
5. Benedict, M., Herrmann, H., Esswein, W. (2018), "eHealth-Platforms - The Case of Europe", in Ugon, A., Karlsson, D., Klein, G., Moen, A. (Eds.), MIE2018 Conference Proceedings, Studies in Health Technology and Informatics, IOS Press, Gothenburg, Sweden, pp. 241-245.
6. Boilson, A., Gauttier, S., Connolly, R., Davis, P., Connolly, J., Weston, D., & Staines, A. (2019), "Q-Method Evaluation of a European Health Data Analytic End User Framework", ENTRENOVA-ENTerprise REsearch InNOVAtion, Vol. 5 No. 1, pp. 187-199.
7. Chanchaichujit, J., Tan, A., Meng, F., Eaimkhong, S. (2019). An Introduction to Healthcare 4.0, Springer.
8. Connolly, J., Staines, A., Connolly, R., Boilson, A., Davis, P., Weston, D., & Bloodworth, N. (2018), "Evaluating Impact of an Emerging Big Health Data Platform: A Logic Model and Q-Methodology Approach", ENTRENOVA-ENTerprise REsearch InNOVAtion, Vol. 4 No. 1, pp. 81-87.
9. Craig, J. Petterson, V. (2005), "Introduction to the practice of telemedicine", Journal of Telemedicine and telecare, Vol. 11 No.1, pp. 3-9.
10. Dashti, S., Peyman, N., Tajfard, M., Esmaeeli, H. (2017) "E-Health literacy of medical and health sciences university students in Mashhad, Iran in 2016: a pilot study", Electronic physician, Vol. 9 No. 3, pp. 3966-3973.
11. De Pietro, C., Francetic, I. (2018) "E-health in Switzerland: The laborious adoption of the federal law on electronic health records (EHR) and health information exchange (HIE) networks", Health Policy, Vol. 122 No. 2, pp. 69-74.
12. Demiris, G. (2004.) "Home based E-health application", in Demiris, G. (Ed.) e-Health: current status and future trends, Ios Press, pp. 15-25.
13. Dey, A., (2004), "Consumer health informatics: an overview of patient perspectives on health information needs", Health Information Management, Vol. 33 No. 4, pp.121-126.
14. Dinevski, D., Bele, U., Sarenac, T., Rajkovic, U., Šušterčić, O. (2011), "Clinical Decision Support Systems", in Graschew, G., Rakowsky, S. (Eds.), Telemedicine Techniques and Applications, InTech, Rijeka, Croatia, pp. 185-211.
15. Doupi, P. Ruotsalainen, P., (2004), "eHealth in Finland: present status and future trends", International journal of circumpolar health, Vol. 63 No. 4, pp.322-327.
16. Dutta, U. P., Gupta, H., Sengupta, P. P. (2019), "ICT and health outcome nexus in 30 selected Asian countries: Fresh evidence from panel data analysis", Technology in Society, Vol. 59, pp. 1-7.
17. Estrela, V., Monteiro, A. C., França, R. P., Iano, Y., Khelassi, A., Razmjooy, N. (2018), "Health 4.0: applications, management, technologies and review", Medical Technologies Journal, Vol. 5 No. 6, pp. 262-276.

18. Eysenbach, G. (2001), "What is e-health?", Journal of medical Internet research, Vol. 3 No. 2, pp.1-2.

19. Feussner, H., Ostler, D., Kranzfelder, M., Kohn, N., Koller, S., Wilhelm, D., Schneider, A. (2017), "Surgery 4.0. Health 4.0: How Virtualization and Big Data are Revolutionising Healthcare", Springer International Publishing, Cham.

20. Fossum, K., Fossum, S. M., Hanseth, O., Sanner, T. A. (2019), "Adaptive networked governance of e-health standards: the case of a regional health information infrastructure in Norway", in Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019, pp. 1-15.

21. Garmann-Johnsen, N. F., Eikebrokk, T. R. (2017), "Dynamic capabilities in e-health innovation: Implications for policies", Health Policy and Technology, Vol. 6 No. 3, pp. 292-301.

22. Haggerty, E. (2017), "Healthcare and digital transformation", Network Security, Vol. 2017 No. 8, pp. 7-11.

23. Handel, M. J. (2011), "mHealth (mobile health) - using apps for health and wellness", EXPLORE: The Journal of Science and Healing, Vol, 7 No. 4, pp.256-261.

24. Haryadi, A. D., Yuliana, M., Soelistijorini, R., Sudarsono, A. (2017), "Secure E-Health: Managing Risks to Patient Personal Identity", European Scientific Journal, Vol. 13 No. 24, pp. 377-388

25. Javaid, M., Haleem, A. (2019), "Industry 4.0 applications in medical field: a brief review", Current Medicine Research and Practice, Vol. 9 No. 3, pp. 102-109.

26. Jin, W., Kim, D. H. (2018), "Design and Implementation of e-Health System Based on Semantic Sensor Network Using IETF YANG", Sensors, Vol. 18 No. 2, pp. 629-648.

27. Kanchanadevi, P., Selvapandian, D., Raja, L., Dhanapal, R. (2020), "Cloud-based Protection and Performance Improvement in the E-Health Management Framework", in 2020 Fourth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), IEEE, Palladam, India, pp. 268-270.

28. Khan, M. T., Serpanos, D., Shrobe, H. (2018), "Highly assured safety and security of e-health applications", in 2018 14th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), IEEE, Limassol, Cyprus, pp. 137-144.

29. Kierkegaard, P. (2013), "eHealth in Denmark: a case study", Journal of medical systems, Vol. 37 No. 6, pp. 1-10.

30. Kodali, R. S., Govinda Boppana, L. (2015), "An implementation of IoT for healthcare", in 2015 IEEE Recent Advances in Intelligent Computational Systems (RAICS), IEEE, Trivandrum, India, pp. 411-416.

31. Kotevski, A., Koceska, N., Koceski, S. (2016), "E-health monitoring system", in International Conference on Applied Internet and Information Technologies, ICAIIT 2016, 3-4 June, 2016, Bitola, pp. 259-265.

32. Majeed, M. T., Khan, F. N. (2019), "Do information and communication technologies (ICTs) contribute to health outcomes? An empirical analysis", Quality & quantity, Vol. 53 No. 1, pp. 183-206.

33. Maksimović, M. Vujović, V. (2017), "Internet of Things based e-health systems: ideas, expectations and concerns", in Khan, S., Zomaya, A., Abbas, A. (Eds.), Handbook of Large-Scale Distributed Computing in Smart Healthcare, Scalable Computing and Communications, Springer, Cham, pp. 241-280.

34. Marino, A., Pariso, P., Landriani, L. (2020), "E Health and Electronic Health Record: The Italian experience in the European Context", available at: https://doi.org/10.21203/rs.3.rs-31655/v1 (20 October 2019)

35. Naseem, A., Rashid, A., Kureshi, N. I. (2014), "E-health: effect on health system efficiency of Pakistan", Annals of Saudi medicine, Vol. 34 No.1, pp. 59-64.

36. Oh, H., Rizo, C., Enkin, M. Jadad, A. (2005), "What is eHealth? a systematic review of published definitions", World Hosp Health Serv, Vol. 41 No. 1, pp. 32-40.

37. Okereafor, K., Marcelo, A. (2020), "Addressing Cybersecurity Challenges of Health Data in The Covid-19 Pandemic", International Journal in IT & Engineering (IJITE), Vol. 8 No. 6, pp. 1-12.

38. Osborne, R., Kayser, L. (2018), "Skills and characteristics of the e-health literate patient", BMJ: British Medical Journal, Vol. 361 No. 1656.
39. Preuveneers, D., Berbers, Y., Joosen, W. (2013), "The future of mobile e-health application development: exploring HTML5 for context-aware diabetes monitoring", Procedia Computer Science, Vol. 21, pp. 351-359.
40. Prodinger, B., O'Connor, R. J., Stucki, G., Tennant, A. (2017), "Establishing score equivalence of the Functional Independence Measure motor scale and the Barthel Index, utilising the International Classification of Functioning, Disability and Health and Rasch measurement theory", Journal of rehabilitation medicine, Vol. 49 No. 5, pp. 416-422.
41. Raman, V. V. R., Tewari, V. (2012), "E-health Implementation–Pros and Cons", International Journal of Management Theory and Practices, Vol. 4 No. 1, pp. 33-49.
42. Rayan, R. (2020), "E-health opportunities for the low and middle-income countries", Global Journal of Public Health Medicine, Vol. 2 No. SP1, pp. 158-163.
43. Rooij, T. V., Marsh, S. (2016), "eHealth: past and future perspectives", Personalized Medicine, Vol. 13 No.1, pp.57-70.
44. Ross, J., Stevenson, F., Lau, R., Murray, E. (2016), "Factors that influence the implementation of e-health: a systematic review of systematic reviews (an update)", Implementation science: IS, Vol. 11 No. 1, pp. 1-12.
45. Ruževičius, J. (2012), "Management de la qualité. Notion globale et recherche en la matière", Vilnius, Maison d'éditions Akademinė leidyba.
46. Saner, H. (2013), "eHealth and telemedicine: current situation and future challenges", European journal of preventive cardiology, Vol. 20 No. 2, pp. 1-2.
47. Saranya, A., Naresh, R. (2021), "Efficient mobile security for E health care application in cloud for secure payment using key distribution", Neural Processing Letters, Vol. 1 No. 12, pp. 1-12.
48. Sebestyen, G., Hangan, A., Oniga, S. Gál, Z. (2014), "eHealth solutions in the context of Internet of Things", in 2014 IEEE International Conference on Automation, Quality and Testing, Robotics, IEEE, Napoca, Romania, pp. 1-6.
49. Seddon, J. J., Currie, W. L. (2017) "Healthcare financialisation and the digital divide in the European Union: Narrative and numbers", Information & Management, Vol. 54 No. 8, pp. 1084-1096.
50. Seebregts, C. J., Pillay, A., Crichton, R., Singh, S., Moodley, D. (2017), "Enterprise Architectures for Digital Health", in Celi, L. A. G., Fraser, H. S. F., Nikore, V., Osorio, J. S., Paik, K. (Eds.), Global Health Informatics: Principles of EHealth and MHealth to Improve Quality of Care, The MIT Press, Cambridge, pp. 173-180.
51. Showell, C. Nohr, C. (2012), "How should we define eHealth, and does the definition matter?", quality of life through quality of information, Vol.180, pp. 881-884.
52. Silva, B. M., Rodrigues, J. J., de la Torre Díez, I., López-Coronado, M., Saleem, K. (2015), "Mobile health: A review of current state in 2015", Journal of biomedical informatics, Vol. 56, pp. 265-272.
53. Stroetmann, K. A., Jones, T., Dobrev, A., Stroetmann, V. N. (2006), "eHealth is Worth it: The economic benefits of implemented eHealth solutions at ten European sites", available at: https://leadership2017.eu/fileadmin/ehealth_impact/documents/ehealthimpactsept200 6.pdf (23 October 2019)
54. Tarouco, L. M. R., Bertholdo, L. M., Granville, L. Z., Arbiza, L. M. R., Carbone, F., Marotta, M. de Santanna, J. J. C. (2012), "Internet of Things in healthcare: Interoperatibility and security issues", in 2012 IEEE international conference on communications (ICC), IEEE, Ottawa, ON, Canada, pp. 6121-6125.
55. Taylor, A., Morris, G., Tieman, J., Currow, D., Kidd, M. Carati, C. (2015), "Building an Architectural Component Model for a Telehealth Service", E-Health Telecommunication Systems and Networks, Vol. 4 No. 3, pp. 35-44.
56. Ud Din, I., Xue, M. C., Abdullah, Ali, S., Shah, T., Ilyas, A. (2017), "Role of information & communication technology (ICT) and e-governance in health sector of Pakistan: A case study of Peshawar", Cogent Social Sciences, Vol. 3 No. 1, pp. 2-18.
57. World Health Organization (2003), "Improving data quality: a guide for developing countries", World Health Organization, Geneva, Switzerland.

58. World Health Organization (2016), "From innovation to implementation - eHealth in the WHO European region", World Health Organization, Geneva, Switzerland.
59. Zhang, X., Yan, X., Cao, X., Sun, Y., Chen, H., She, J. (2018), "The role of perceived e-health literacy in users' continuance intention to use mobile healthcare applications: an exploratory empirical study in China", Information Technology for Development, Vol. 24 No. 2, pp. 198-223.
60. Zhao, M., Hamadi, H., Haley, D. R., Xu, J., White-Williams, C., Park, S. (2020), "Telehealth: advances in alternative payment models", Telemedicine and e-Health, Vol. 26 No.12, pp. 1492-1499.
61. Ziuziański, P., Furmankiewicz, M., Sołtysik-Piorunkiewicz, A., (2014), "E-health artificial intelligence system implementation: case study of knowledge management dashboard of epidemiological data in Poland", International Journal of Biology and Biomedical Engineering, Vol. 8 No. 8, pp.164-171.

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Big Data in Sports: A Bibliometric and Topic Study

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Abstract

Background: The development of the sports industry was impacted by the era of Big Data due to the rapid growth of information technology. Unfortunately, that has become an increasingly challenging Issue. **Objectives:** The purpose of the research was to analyze the scientific production of Big Data in sports and sports-related activities in two databases, Web of Science and Scopus. **Methods/Approach:** Bibliometric analysis and topic mining were done on 51 articles selected after four exclusion criteria (written in English, journal articles, the final stage of publication, and a detailed review of all full texts). The software tool used was Statistica Data Miner. **Results:** We found that the first articles appeared in Scopus in 2013 and WoS in 2014. USA and China are countries which produced the most articles. The most common research areas in WoS and Scopus are Public environmental and occupational health, Medicine, Environmental science ecology, and Engineering. **Conclusions:** We conducted that further research and literature review will be required as this is a broad and new topic.

Introduction

The phenomenon of Big Data has emerged and has been investigated extensively so far (Zhao et al., 2015). Due to the speed growing data volume, various devices, i.e., the Internet of Things and Social Networks, are used. With a growing population, about 2 billion people are connected to the Internet, and 5 billion use various mobile devices (Worldometer, 2021). These billions of people, through multiple devices, will produce an enormous amount of data (Khan et al., 2014). The estimation in 2013 was that in 2020 50 billion devices will be connected to the Internet. Therefore, data production would be 44 times greater than in 2009 (Sagiroglu et al., 2013). As information is transferred and shared at the speed of light on optical fibre and wireless networks, the volume of data and marker growth speed increase (Khan et al., 2014, Che et al., 2013). This data is known as the term Big Data. Big Data is "a collection of data that is huge in volume yet growing exponentially with time. It is data with such a large size and complexity that no traditional data management tools can store it or process it efficiently" (Favaretto et al., 2020). The pervasive nature of digital technologies and the broad range of data-reliant applications have also made this expression widespread across disciplines, including sociology, medicine, sports science, biology, engineering, economics, management, and information science (De Mauro et al., 2016).

In response to the ever-increasing network data challenges, there is a globally noticeable development trend of convergence with big data frameworks, network analytical modelling, link or path prediction, and recommendation systems (Li et al., 2019). Big Data is characterized and defined differently by different authors. Some authors (Dijcks, 2012; Schroeck et al., 2012, Chen et al., 2014) define Big Data with four characteristics (volume, velocity, variety and value). Another author (Suthaharan, 2013) argues that "data can be defined using three data characteristics (cardinality, continuity and complexity)". They are also defined with three characteristics, i.e. volume, velocity and variety (Laney, 2021). Furthermore, Big Data can be described in the five V's, which stand for value, volume, velocity, variety, and validity) (Oguntimilehin et al., 2014) or even more precisely by ten characteristics: venue, variety, volume, variability, value, validity, veracity, velocity, vocabulary, and vagueness (Borne, 2021).

These characteristics provide a research horizon for researchers and practitioners to effectively manage Big Data. Three main characteristics of Big Data will be presented below. Volume refers to the unimaginable amounts of information generated every second from social media, cell phones, cars, credit cards, sensors, images, videos, etc. (Rajeshwari Sreenivasan, 2017). Variety is one of the important characteristics of Big Data. It refers to structured, unstructured, and semistructured data gathered from multiple sources (De Mauro et al., 2016, 2015). Nowadays, data comes in various forms, for example, emails, PDFs, images, videos, audio, SM spots, transactions, and long data (Owais et al., 2016). The third characteristic is velocity. This is the speed at which the data is generated, stored, analyzed, and processed (Al Nuaimi et al., 2015). Velocity essentially refers to the speed at which data is being created in real-time. It comprises the rate of change in a broader prospect, linking incoming data sets at varying speeds and activity bursts. It is challenging to analyze Big Data that is generated at a very high velocity (Morbetz, 2021).

Big Data is "the most valuable and powerful fuel that can run the massive IT industries of the 21st Century. Big Data is the most widespread technology used in almost every business sector (Chen et al., 2014)". It has gained interest and application in various fields such as government, healthcare and medicine, retail sector, agriculture, research, online and social media, telecommunication and banking

(Singh et al., 2015). It can also be applied in a different scientific discipline (Khan et al., 2014).

Lifestyle is the typical way of life of an individual, group, or culture-dependent on many different factors. It is divided into a healthy and unhealthy lifestyle. Sports and physical activity have an important role in a healthy lifestyle. In the last two decades, the importance of physical health has grown, and people nowadays give close and thoughtful attention to the healthy development of their bodies. Many studies show a positive correlation between sports and life quality (Snedden et al., 2019, Wu et al., 2017, Marker et al., 2017).

The period of Big Data has also impacted sport development, and it still has influence. However, it has influenced professional sports and various fields connected with the sport and sports industry (Liu et al., 2020). Advanced Big Data technique has brought changes in sports. In sports, Big Data has generated new opportunities and challenges with the aim of spreading sports data (Patel et al., 2020). Big Data services closely related to it, including exercise performance, training statics, data connected with body characteristics, health data, analysis, etc., can effectively help athletes in daily training, planning, and developing sports skills and motor capabilities. Consequently, Big Data is becoming indispensable and helps win the competition (Pappalado et al., 2019).

Big Data is common in professional sports but is not the only one. The connection between Big Data and different sports fields can be found in many areas that are not directly related to sports (Cheng et al., 2021). The mentioned areas of research on the use of sport and Big Data are, for example, engineering (Kim et al., 2020), medicine (Hayano et al., 2019, Al-Mallah et al., 2014) and public health (Park et al., 2020), social and computer science (Hou et al., 2017), business and management (Khazaeli et al., 2016), environmental science (Phan et al., 2020) and some others.

In short, given the topic's interest, it would be informative to research trends in Big Data utilization in sports to identify trends and topics that emerge in the literature. The study about Big Data and sport was driven by the five research questions that guided us through the work: (RQ1) What has been production status over time?; (RQ2) Which countries produce the most papers?; (RQ3) What are the most common areas of research?; (RQ4) Which are the most frequent words and phrases in papers?; and (RQ5) What is the analysis according to the "Topic mining" method?

Methodology

A literature review on using Big Data in sports and sports-related activities was done, were articles published on or before February 25th were analyzed. Two databases were used: Scopus and Web of Science (WoS). The following steps were used for gathering literature. First, research platforms were used to identify relevant papers. Second, we reviewed and tried different keywords based on the read literature. Third, a logical combination of keywords was used to find relevant documents. This was a combination of keywords: (("Big Data") AND ("sport activity" OR "physical activity" OR "professional sport")). The Boolean operators "AND" and "OR" were used.

Our study used only articles published in peer-reviewed journals. This was our first exclusion criterion of choosing, and the review was limited to open-access documents and documents written in English. The first search before exclusion criteria resulted in 344 results, of which 166 were published in WoS and 178 were published in Scopus. Based on our exclusion criteria, the search resulted in 88 articles, of which 64 were published in WoS and 24 were published in Scopus. One article was published in both databases.

We performed a detailed review of all abstracts and full texts to select the articles that are focused on our research topic and not just mention it sporadically. Based on this criterion, 51 of 88 articles were selected, and a bibliometric analysis was conducted on 51 articles. The next step was text mining which was conducted using Provalis Wordstat. Finally, we analyzed the texts according to the clusters identified by topic mining.

Results

This literature review presented insight into Big Data's incidence in sports and targeted 51 articles published on or before February 25th, 2020, published in two databases, namely Scopus and Web of Science.

Bibliometric analysis

Considering the variable "year production", a similar evolution was observed in both databases. The first contributions to Big Data in sports were detected in WoS 2014 and Scopus one year earlier – in 2013. The number of contributions has been increasing since the year 2016. A change was recorded in 2015 because there were no published articles in both database. In WoS were the higher rate of published articles in 2020 (13 articles; 35,1 %), 2019 (8 articles; 21,6 %) and 2018 and 2017 (both 6 articles; 16,2 %). In Scopus were the higher rate of published articles in 2018 (5 articles; 35,7 %), 2017 (3 articles; 21,4 %) and 2019 (2 articles, 14,3 %). The results showed the maximum production peaks in each database; the maximum was reached in Scopus in 2018 and WoS two years later, in 2020.

Figure 1 shows the number of publications on "Big Data and sport" from 2013 to 2021.

Figure 1
Scientific yearly production in WoS and Scopus (# of publications)
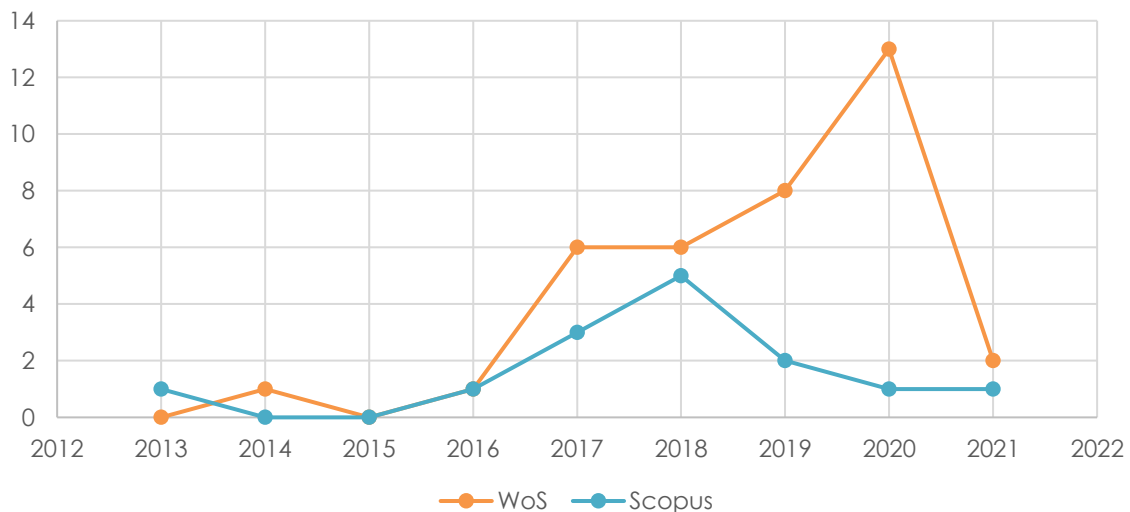
Source: Author's work

Considering the variable "country" that produced the most literature, the first place was different in WoS and Scopus. While the USA was first in WoS (43,2 %), it was second in Scopus (35,7 %). China produced the most articles in Scopus (42,8 %). There were three countries with the same percentage (14,3 %) in the database Scopus in third place, i.e. Australia, the Netherlands and India. China which took first place in Scopus

in WoS was in second place with England. Their percentage was 13,5 %. South Korea, with 10,8 %, took third place. In WoS, Australia produced 8,1 % of literature and the Netherlands 5,4 % of literature. Both countries were in third place in Scopus. India, which shared third place with Australia and the Netherlands, had not produced any articles in the WoS database.

Table 1 shows countries with the highest production in WoS and Scopus.

Table 1
Countries with the highest production in WoS and Scopus

Country	WoS		Scopus		Both databases	
	N	%	N	%	N	%
USA	16	41,2	5	35,7	21	41,2
China	5	13,5	6	42,8	11	21,5
England	5	13,5	-	-	5	9,8
South Korea	4	10,8	-	-	4	7,8
Australia	3	8,1	2	14,3	5	9,8
Germany	3	8,1	-	-	3	5,8
Finland	2	5,4	-	-	2	3,9
France	2	5,4	-	-	2	3,9
the Netherlands	2	5,4	2	14,3	4	7,8
Spain	2	5,4	-	-	2	3,9
India	-	-	2	14,3	2	3,9
Canada	1	2,7	1	7,1	2	3,9

Source: Author's work

For the variable "organizations", the two databases' institutions with more references differed. Besides, those that appeared in WoS were not found in Scopus. In Scopus, we analyzed 14 articles, and all articles had a different institution. In WoS, Johns Hopkins University and the University of London had three references (8,1 %), and twelve articles had two references (5,4 %).

Articles used in the analysis were published in different journals in both databases. In Scopus, only one journal published more than one contribution, Boletin Tecnico Technical Bulletin (21,4 %), and other journals published one contribution. In the database WoS, three journals have published more than one contribution, i.e. four articles International Journal of Environmental Research and Public Health (10,8 %) and two articles (5,4 %) in BMC Public Health and Sensors.

The variable "research areas" was similar in both databases because they were mostly connected with medicine, public health, computer and environmental science and engineering. The four most common research areas in WoS were 27,0 % for public environmental and occupational health, 16,2 % for environmental science ecology, 10,8 % for computer science, engineering and science technology other topics and 8,1 % for other topics were also three areas: chemistry, medical informatics and psychology. Other research areas in WoS have had less than eight per cent. The three most common research areas in Scopus were two areas with 19,2%: engineering and medicine, three areas with 11,5 %: computer science, materials science and social sciences and three areas with 7,7 %: biochemistry, genetics and molecular biology, health professions and business, management and accounting. Other research areas in Scopus have had less than seven per cent.

Table 2 presents the most common research areas in both databases in percentages.

Table 2
The most common research areas in WoS and Scopus

Researching areas	WoS	Scopus
	%	%
Public environmental and occupational health	27,0	-
Medicine	-	19,2
Environmental science ecology	16,2	-
Computer science	10,8	11,5
Engineering	10,8	19,2
Science, technology, other topics	10,8	-
Chemistry	8,1	-
Medical informatics	8,1	-
Psychology	8,1	-
Material science	-	11,5
Social science	-	11,5
Biochemistry, genetics and molecular biology	-	7,7
Health professions	-	7,7
Business, management and accounting	-	7,7

Source: Author's work

Topic mining

To discover the most frequent topics found in abstracts, we used the phrase and word extraction process and cluster analysis functions provided by the software, namely WordStat Provalis. The analysis was done with a method by Column Frequency-Inverse Document Frequency (TF-IDF), which shows the importance of each phrase within the collection of papers. A phrase with higher TF-IDF values is highly important (the last column in Table 3).

Figure 2 shows the word cloud of the most frequent words found in 51 abstracts.

Figure 2
Wordcloud of the most frequent word

Source: Author's work

The most commonly found word was: data (frequency 137), analysis (frequency 54), health and study (both with frequency 51), based (frequency 51) and sports (frequency 40). Five words with the highest TF-IDF were sports (32,2), cycling (30,3),

weather (24,6), exercise (22,0) and obesity (21,6). Table 3 presents the following most frequently used phrases, where the frequency of occurrence was higher or equal to 4.

Table 3
Most frequent phrases in papers (frequency 4+)

Phrase	F	NO. C.	% C.	L	TF • IDF	Phrase	F	NO. C.	% C.	L	TF • IDF
Heart rate	11	4	7,84%	2	12,2	Human movement	5	1	1,96%	2	8,5
Machine learning	9	7	13,73%	2	7,8	Kcal min	5	1	1,96%	2	8,5
Senility death ratio	8	1	1,96%	3	13,7	Regression models	5	4	7,84%	2	5,5
Wearable devices	8	5	9,80%	2	8,1	Smartphone app	5	2	3,92%	2	7,0
Bicycle usage	6	2	3,92%	2	8,4	Social media	5	2	3,92%	2	7,0
Chronic disease	6	2	3,92%	2	8,4	Tai chi	5	1	1,96%	2	8,5
Colorectal cancer	6	1	1,96%	2	10,2	Time series	5	4	7,84%	2	5,5
Decision making	6	4	7,84%	2	6,6	Weather conditions	5	1	1,96%	2	8,5
Deep learning	6	4	7,84%	2	6,6	Behaviour change	4	1	1,96%	2	6,8
Google street view	6	3	5,88%	3	7,4	Cancer survivors	4	1	1,96%	2	6,8
Green parks	6	1	1,96%	2	10,2	College students based	4	2	3,92%	3	5,6
Sports activities	6	5	9,80%	2	6,1	Cultural space	4	1	1,96%	2	6,8
Case studies	5	1	1,96%	2	8,5	Geographic information	4	4	7,84%	2	4,4
Energy expenditure	5	3	5,88%	2	6,2	Green spaces	4	2	3,92%	2	5,6
Fit project	5	1	1,96%	2	8,5	Neural networks	4	2	3,92%	2	5,6
Health outcomes	5	2	3,92%	2	7,0	Older adults	4	2	3,92%	2	5,6

Note: Legend: F – frequency, No. C. – number of cases, % C. – percentages of cases, L – length
Source: Author's work

The most used phrases: heart rate (frequency 11), machine learning (frequency 9), senility death ratio (both with frequency 8) and bicycle usage, chronic disease, colorectal cancer, decision making, deep learning, Google street view, green parks and sports activities (all with frequency 6). Four phrases with the highest TF-IDF were senility death ratio (13,7), heart rate (12,2) and colorectal cancer and Google street view (both 10,2).

Figures 3 and 4 present the cluster analysis results that identified seven topics concerning sports and sports activities related to Big Data:
o *Cluster 1* includes abstracts with the co-occurring phrases: case studies, green spaces, green parks, and social media.
o *Cluster 2* includes abstracts with the co-occurring phrases: bicycle usage, weather conditions, real-time, cancer survivors, and quality of life.
o *Cluster 3* includes abstracts with the co-occurring phrases: cycling behaviour, form interventions, urban form, time-series, geographic information, kcal/min, health management, neural networks, wearable devices, machine learning, heart rate, and senility death ratio.
o *Cluster 4* includes abstracts with the co-occurring phrases: energy expenditure, human movement, and smartphone app.
o *Cluster 5* includes abstracts with the co-occurring phrases: chronic disease and prevention and management.

o *Cluster 6* includes abstracts with the co-occurring phrases: deep learning, greenery variables, walking time, Google street view, health outcomes, premature mortality, past month, and regression models.

o *Cluster 7* includes abstracts with the co-occurring phrases: college student-based, sports activities, cultural space, folk sports, tai chi, and table tennis players.

Figure 3
Cluster analysis of phrases
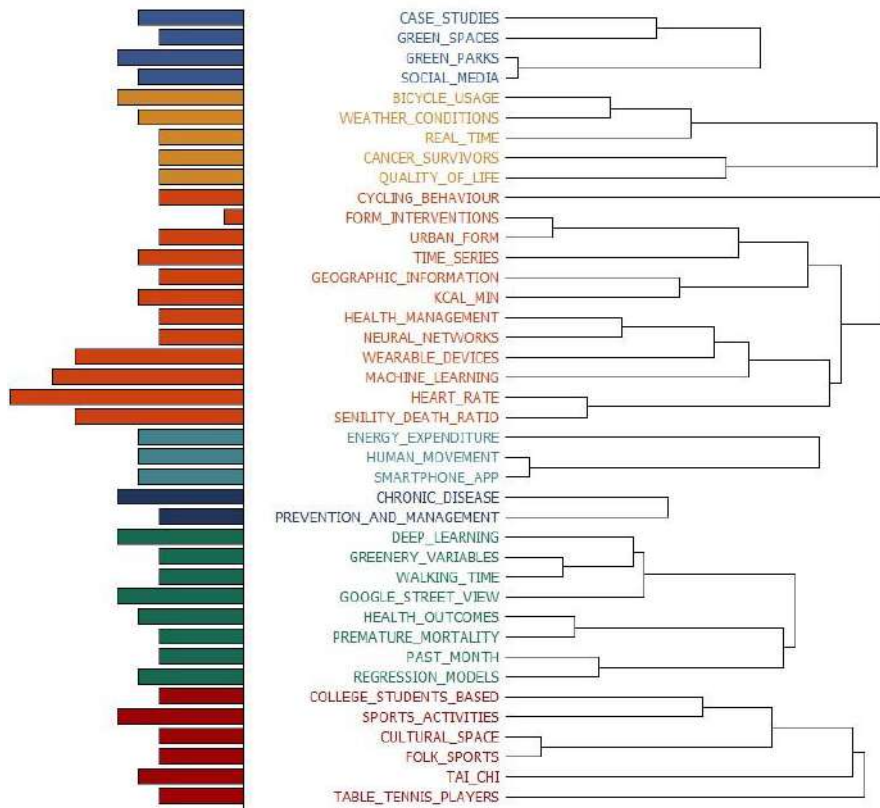
Source: Author's work

Figure 4
Mapping of clusters
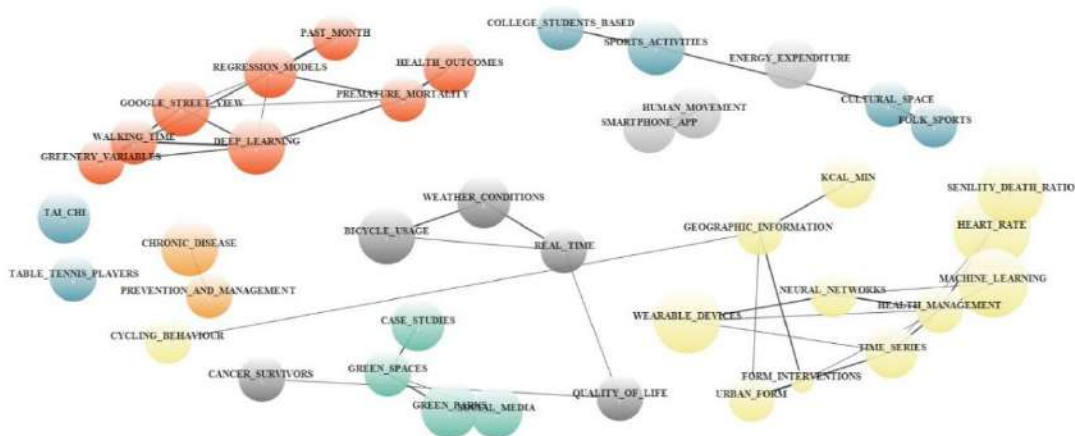
Source: Author's work

We did the additional analysis with the link analysis feature to visualize the connections between keywords. In our case, we used phrases instead of keywords, which offers a high level of interactivity, and allows us to explore relationships and detect underlying patterns and structures of co-occurrences. A line between elements shows a relationship between elements, and the thickness of this line represents the strength of this relationship. Figure 5 presents six network graphs indicating most often co-occurred phrases within each cluster.

Figure 5
Proximity plots of phrases in selected clusters
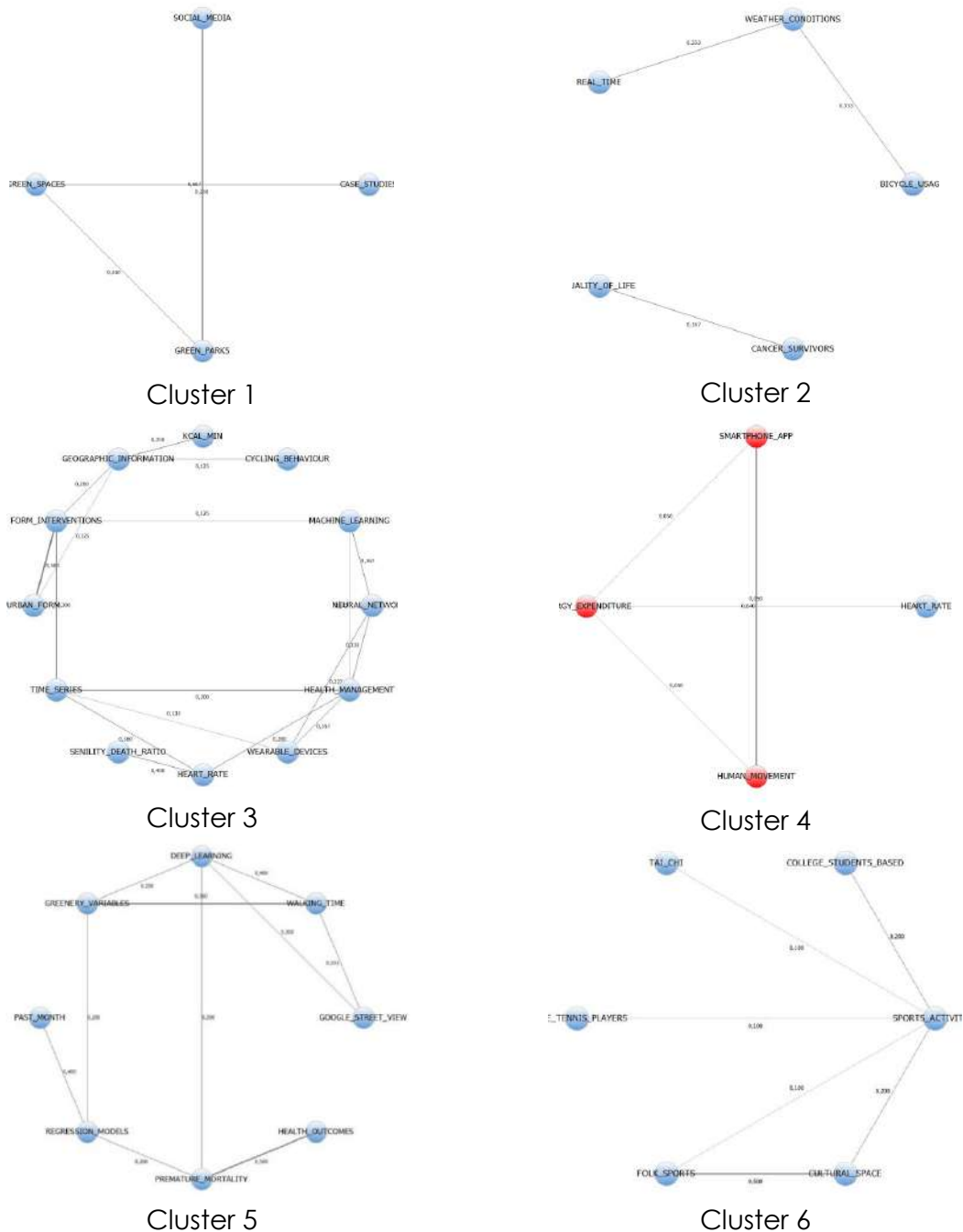
Source: Author's work

Table 4 presents an overview of the most salient topics from 51 abstracts using state-of-the-art automatic topic extraction techniques. Column sign with Coh. (coherence) shows the percentage of coherence explained, which means the smaller the segment, the lower percentage. Column F (frequency) displays the total frequency of all items listed in the keyword column, and column sign with C displays the number of cases containing at least one of the items listed in the column with keywords. The topic with the highest total frequency and the highest number of cases is the topic "devices data" (percentage of cases is 92,16 %).

Table 4
Topic mining

NO	TOPIC	KEYWORDS	Coh.	F	C	% C
1	MANAGEMENT PREVENTION	management; prevention; change; lifestyle; disease; support; knowledge; program; health;	0,423	69	31	60,78%
2	SMARTPHONE APP HUMAN MOVEMENT	human; smartphone; analytics; people; healthcare; human movement; smartphone app;	0,322	32	17	33,33%
4	HEALTHCARE ASSOCIATIONS	proposed; collected; services; results; variables; paper; built; healthcare; show; associations; system;	0,411	73	44	86,27%
5	INTERVENTIONS CHALLENGES	provide; challenges; individual; understanding; time; volume; interventions; information; healthy; large;	0,427	82	43	84,31%
6	SENSORS DESIGN	sensors; design; people; life; monitoring; technologies; user; support;	0,395	50	32	62,75%
7	DEVICES DATA	devices; data; activity; daily; patterns; collected; frequency; wearable; analysis;	0,407	144	47	92,16%
8	URBAN TRAVEL	bus; mode; urban; travel; mile; city; metro; gsv;	0,423	65	15	29,41%
9	RISK FACTORS	factors; risk; networks; volume; cross; healthy; prediction; population; life; large; study; results; obesity; risk factors;	0,422	98	43	84,31%
10	HOME CONFINEMENT	home; confinement; activity; monitoring; home confinement;	0,381	38	19	37,25%
11	WOMEN MEN	women; men; ratio; death; age; higher; low;	0,530	61	16	31,37%
12	DEVELOPMENT TRAINING	development; training; system; performance; technology; user; quality; lifestyle; proposed; psychological; sports; sports activities;	0,425	73	34	66,67%
13	ACCELEROMETER ACTIVITIES	accelerometer; living; compared; feature; participants; measures; activities;	0,416	50	29	56,86%
14	PARK WEATHER	park; findings; users; behaviour; weather; show; features; distance; study; feature; results; related;	0,426	85	39	76,47%
15	ENVIRONMENTAL RUNNING	environmental; mile; distance; performance; running;	0,338	38	18	35,29%
16	GREEN BEHAVIOR	greenery; traditional; green; methods; activities; daily; show; variables; life; low; time; behaviour;	0,379	83	43	84,31%
17	STUDENTS SPORTS	students; sports; physical; fitness; technology; paper; analysis; activities; based; change; Big Data analysis;	0,428	124	45	88,24%
18	CITY SOCIAL	built; social; methods; analytics; survey; traditional; studies; challenges; understanding; collected; city; knowledge;	0,388	74	41	80,39%
19	REGRESSION MODELS	walking; GPS; survey; models; neighbourhood; greenery; index; regression models;	0,372	53	21	41,18%

			Coh.	F	C	% C
20	MODEL PREDICTION	model; increasing; user; variables; show; provide; paper; distance; models; frequency; prediction; change; training; networks;	0,435	88	45	88,24%
21	CANCER EXERCISE	cancer; exercise; patients; individual; factors; total; years; social;	0,385	75	33	64,71%
22	RESEARCH OBESITY	research; influence; obesity; health; understanding; knowledge;	0,394	67	38	74,51%
23	HEART RATE	rate; heart; death; metro; healthcare; analysis; low; performance; heart rate;	0,402	63	34	66,67%
24	GOOGLE STREET VIEW	street; view; level; environment; mortality; built; associations; obesity; green; Google street view;	0,457	77	29	56,86%
25	MODELS DEVELOPMENT	features; including; models; disease; learning; features; techniques; studies; low; development;	0,410	62	39	76,47%
26	ROAD CYCLING	road; cycling; weather; city; cities;	0,401	50	12	23,53%
27	WALKABILITY CITIES	walkability; cities; framework; index; related; city;	0,379	36	23	45,10%
28	POPULATION QUALITY	behaviour; increasing; metro; low; large; population; associations; environmental; quality; patterns;	0,397	60	36	70,59%
29	OUTCOMES CARDIOVASCULAR	outcomes; population; age; years; related; knowledge; clinical; cardiovascular; influence; design; studies; mortality;	0,433	71	37	72,55%
30	WEARABLE DEVICES	wearable; devices; healthcare; large; techniques; risk; monitoring; services; technology; wearable devices;	0,409	58	32	62,75%

Note: Legend: Coh. – coherence, F – frequency, C – cases, % C – % cases
Source: Author's work

Bibliometric analysis of the literature shows us that Big Data in sports occurs differently. The term "sport". We found that the term "sport" occurs in a very wide range, not just as the "sport" that we all imagine (e.g. running, group workout, tennis …). As we have already written and shown in Table 4, the topic "devices data" has the highest percentage of cases. The group of topics with a high percentage of cases (% C) is related to medicine, health and public health, namely topics "healthcare associations" (86,27 %), "interventions challenges" (84,31 %), "risk factors" (84,31 %), "research obesity" (74,51 %), "outcomes cardiovascular" (72,55 %), "heart rate" (66,67 %) and "cancer exercise" (64,71 %). Research related to this topic has analyzed different sizes and types of data. Some authors (Kharabian Masouleh et al., 2018) have determined the effects of common cardiovascular risk factors on vulnerable grey matter networks in a large and well-characterized population-based cohort that involved 616 healthy elderly of the LIFE-Adult-Study. Researchers (Hayano et al., 2019) have examined the regional difference in senility death ratio with the regional differences in heart rate variability and physical activity in 108,865 men and 136,536 women. Other researchers (Nguyen Quynh et al., 2017) examined the relationship between these neighbourhood characteristics and obesity and diabetes diagnoses (Type 1 and Type 2). They collected 422,094 tweets and leveraged administrative and clinical records on 1.86 million individuals. Phan and co-researchers (Phan et al., 2020) wanted to discover the associations between select neighbourhood-built environment indicators (e.g. crosswalks) and health outcomes (e.g. obesity, diabetes), and premature mortality, at the state level. Using deep learning techniques, they utilized 31,247,167 images collected from Google Street View to

create indicators for neighbourhood-built environment characteristics. These four studies show the extent and size of Big Data and the different spectrum of use. However, a smaller initial number of participants or measuring devices does not necessarily mean a smaller number of final data. Several different data can be obtained from one measured participant or measuring device or monitored for a longer period (Wang et al., 2021, Sung-Un et al., 2020, Raywood et al., 2020)

Discussion

Big Data has become of utmost importance in competitive and professional sports, and its processing leads to sports analytics, which is part of data science (Kaur et al., 2020). The effective use of Big Data opens substantial doors because it can influence the results and, consequently, athletes' careers. Athletes can gain the best from individual and personalized training sessions, which is made possible by a large database. Thus, the coach can focus on the athlete's weaker side and precise goals (Morgulev et al., 2019, Liu, 2019).

Table 4 shows that the topics "development training", "model prediction", and "models' development" have a relatively high percentage of cases, between 66,67 % and 88,24 %. All three topics are linked to professional sports and play a key role. The topic of "model prediction" stands out among these three topics, as it is not only related to professional sports but many research areas; for example, rehabilitation and medicine (Kokkotis et al., 2020, Emig et al., 2020), recreation and urban mobility – prediction of physical activity (Goel et al., 2018, Saez et al., 2016).

As described in the "Results" section, the databases first appeared in 2013 in Scopus and in 2014 in WoS. In 2013, the results of a consensus meeting on non-communicable chronic disease prevention were sponsored by the International Olympic Committee in April 2013 in Lausanne. They wanted to encourage new creative approaches that leverage and integrate evidence through the support of Big Data, technology, and design thinking in different areas (Sports and Exercise Medicine, lifestyle, modern technology, prevention etc.) (Matheson et al., 2013). In WoS in 2014 was published research about The FIT Project (the Henry Ford Exercise Testing Project), which "is unique in its combined use of directly measured clinical exercise data retrospective collection of medical history and medication treatment data at the time of the stress test" with the help of administrative and medicine databases for a prognosis for physical activity and health factors (Al-Mallah et al., 2014). In both articles, we can observe that it is a topic related to health and lifestyle concerning prediction.

Conclusion

The purpose of the study was to conduct bibliometric analysis and data mining using Statistica Data Miner analysis on the use of Big Data in sports and sports-related activities. We used two databases, WoS and Scopus, from which we selected 51 articles. The last part of the methodology was analysis according to the clusters identified by the topic mining. Our study has shown interesting connections between Big Data and sport (research areas, applicability, different sample size, etc.). However, the study has certain limitations. The main limitations are i) only two databases were used; ii) the search was limited to articles written in English; iii) only three sports-related keywords were used. We believe that the number of articles will increase, as the topic of "Big Data in sport" is a relatively new topic that will be further developed.

References

1. Al Nuaimi, E., Al Neyadi, H., Mohamed, N., Al-Jaroodi, J. (2015), "Applications of big data to smart cities", Journal of Internet Services and Applications, Vol. 6 No. 1, pp. 25.
2. Al-Mallah, M. H., Keteyian, S. J., Brawner, C. A., Whelton, S., Blaha, M. J. Rationale (2014), "Design of the Henry Ford ExercIse Testing Project (The FIT Project)", Clinical Cardiology, Vol. 37 No. 8, pp. 456-461.
3. Borne, K. (2021), "Top 10 List – The V's of Big Data. Data Science Central – a Community for big data practitioners", available at https://www.datasciencecentral.com/profiles/blogs/top-10-list-the-v-s-of-big-data (8 March 2021)
4. Che, D., Safran, M., Peng, Z. (2013), "From big data to big data mining: challenges, issue, and opportunities", Database Systems for Advanced Applications, Vol. 19 No. 2, pp. 1-15.
5. Chen, M., Mao, S., Liu, Y. (2014), "Big data: A survey", Mobile Networks and Application, Vol. 19 No. 2, pp. 171-209.
6. Cheng, Y., Song, Y. (2021) "Sports big data analysis based on cloud platform and its impact on sports economy", Mathematical Problems in Engineering, Vol. 21 No. 2, pp. 1-12.
7. De Mauro, A., Greco, M., Grimaldi, M. (2015), "What is big data? A consensual definition and a review of key research topics", AIP Conference Proceedings, Vol. 1644 No. 1, pp. 97-104.
8. De Mauro, A., Greco, M., Grimaldi, M. (2016), "A formal definition of big data based on its essential features", Library Review, Vol. 63 No. 1, pp. 122-135.
9. Dijcks, J. (2012), "Oracle: Big data for the enterprise", Redwood Shores, USA, pp. 1–16.
10. Emig, T., Peltonen, J. (2020), "Human running performance from real-world big data", Nature communications, Vol. 11 No. 1, pp. 4936-4945.
11. Favaretto, M., De Clercq, E., Schneble, C. O., Elger, B. S., Fischer, F. (2020), "What is your definition of Big Data? Researcher's understanding of the phenomenon of the decade", PLoS One, Vol. 15 No. 2, pp. 1-20.
12. Goel, R., Garcia, L. M. T., Goodman, A., Johnson, R., Aldred, R., Murugesan, M., Brage, S., Bhalla, K., Srinivasan, M. (2018), "Estimating city-level travel patterns using street imagery: A case study of using Google Street View in Britain", PLoS One, Vol. 13 No. 5, pp. 1-22.
13. Hayano, J., Kisohara, M., Yoshida, Y., Sakano, H., Yuda, E. (2019), "Association of heart rate variability with regional difference in senility death ratio: ALLSTAR big data analysis", SAGE Open Medicine, Vol. 7 No. 2, pp. 1-7.
14. Hou, X., Jiang, J. (2017), "Analysis on the mental quality and performance of table tennis players based on the cloud computing big data", Technical Bulletin, Vol. 55 No. 1, pp. 348-354.
15. Kaur, G., Jagdev, G. (2020), "Analyzing and Exploring the Impact of Big Data Analytics in Sports Science", in Indo - Taiwan 2nd International Conference on Computing, Analytics and Networks, Indo-Taiwan ICAN, pp. 218-224.
16. Khan, N., Yaqoob, I., Targio Hashem, I. A., Inayat, Z., Mahmud Ali, W. K., Alam, M., Shiraz, M., Gani, A. (2014), "Big Data: Survey, Technologies, Opportunities, and challenges", The Scientific World Journal, Vol. 2014 No. 2, pp. 1-18.
17. Kharabian Masouleh, S., Beyer, F., Lampe, L., Loeffler, M., Luck, T., Riedel-Heller, S., Schroeter, M. L., Stumvoll, M., Villringer, A., Witte, A. V. (2018), "Gray matter structural networks are associated with cardiovascular risk factors in healthy older adults", Journal of Cerebral Blood Flow & Metabolism, Vol. 38 No. 2, pp. 360-372.
18. Khazaeli, M., El Kari, C. (2016), "The effects of technology and big data in sports industry", in Proceedings of the 2016 Industrial and Systems Engineering Research Conference, ISERC 2016-2020, pp. 2404-2409.
19. Kim, S. W., Lee, K., Sohn, J. S., Cha, S. W. (2020), "Product development using online customer reviews: A case study of the South Korean subcompact sport utility vehicles market", Applied Sciences, Vol. 10 No. 19, pp. 1-12.
20. Kokkotis, C., Moustakidis, S., Giakas, G., Tsaopoulos, D. (2020), "Identification of Risk Factors and Machine Learning-Based Prediction Models for Knee Osteoarthritis Patients", Applied Sciences, Vol. 10 No. 19, pp. 1-23.
21. Laney, D. (2012), "3D Data Management: Controlling Data Volume, Velocity and Variety", available at http://blogs.gartner.com/doug-laney/files/2012/01/ad949-3D-Data-Management-Controlling-Data-Volume-Velocity-and-Variety.pdf (15 March 2021)

22. Li, J., Deng, K., Huanh, X., Xu, J. (2019), "Analysis and application of location-aware big complex network data", Complexity, Vol. 2019 No. 1, pp. 1-2.
23. Liu, G., Luo, Y., Schulte, O., Kharrat, T. (2020), "Deep soccer analytics: learning an action-value function for evaluating soccer players", Data Mining and Knowledge Discovery, Vol. 34 No. 2, pp. 1531-1559.
24. Liu, H. (2019), "Opportunities, challenges and Countermeasures for the development of China's sports industry in the era of big data", Journal of Physic: Conference Series, Vol. 1237 No. 2, pp. 1-14.
25. Marker, A. M., Steele, R. G., Noser, A. E. (2017), "Physical activity and health-related quality of life in children and adolescents: A systematic review and meta-analysis", Health Psychology, Vol. 37 No. 1, pp. 893-903.
26. Matheson, G. O., Klügl, M., Engebretsen, L., Bendiksen, F., Blair, S. N., Börjesson, M., Budgett, R., Derman, W., Erdener, U., Ioannidis, J. P. A., Khan, K. M., Martinez, R., van Mechelen, W., Mountjoy, M., Sallis, R. E., Schwellnus, M., Shultz, R., Soligard, T., Steffen, K., Sundberg, C. J., Weiler, R., Ljungqvist, A. (2013), "Prevention and Management of Noncommunicable Disease", Clinical Journal of Sport Medicine, Vol. 23 No. 2, pp. 419-429.
27. Mobertz, L. (2019), "The Four V" s of Big Data", available at https://www.bigdataframework.org/ four-vs-of-big-data/ (24 March 2021)
28. Morgulev, E., Azar, O. H., Lidor, R. (2018), "Sports analytics and the big-data era", International Journal of Data Science and Analitics, Vol. 5 No. 4, pp. 156-159.
29. Nguyen Quynh C., Brunisholz, K. D., Yu, W., McCullough, M., Hanson, H., Litchman, M. L., Li, F., Wan, Y., VanDerslice, J. A., Wen, M., Smith, K. R. (2017), "Twitter-derived neighborhood characteristics associated with obesity and diabetes˝, Scientific Report, Vol. 7 No. 1, pp. 1-10.
30. Oguntimilehin A., Ademola E. O. (2014), "A Review of Big Data Management, Benefits and Challenges", A Review of Big Data Management, Benefits and Challenges, Vol. 5 No. 6, pp. 433-438.
31. Owais, S. S., Hussein, N. S. (2016), "Extract Five Categories CPIVW from the 9V "s Characteristics of the Big Data", International Journal of Advanced Computer Science and Applications, Vol. 7 No. 3, pp. 254-258.
32. Pappalardo, L., Cintia, P., Rossi, A., Massucco, E. (2019), "A public data set of spatio-temporal match events in soccer competitions", Scientific Data, Vol. 6 No. 1, pp. 1-15.
33. Park, S. U., Ahn, H., Dong, K., So, W. (2020), "Big Data Analysis of Sports and Physical Activities among Korean Adolescents", International Journal of Environmental Research and Public Health, Vol. 17 No. 15, pp. 5577-5589.
34. Patel, D., Shah, D., Shah, M. (2020), "The intertwine of brain and body: a quantitative analysis on how big data influences the system of sports", Annals of Data Science, Vol. 7 No. 1, pp. 1-16.
35. Phan, L., Yu, W., Keralis, J. M., Mukhija, K., Dwivedi, P., Brunisholz, K. D., Javanmardi, M., Tasdizen, T., Nguyen, Q. C. (2020), "Google Street View Derived Built Environment Indicators and Associations with State-Level Obesity, Physical Activity, and Chronic Disease Mortality in the United States", International Journal of Environmental Research and Public Health, Vol. 17 No. 10, pp. 3659-3669.
36. Rajeshwari Sreenivasan, R. (2017), "Characteristics of Big Data – A Delphi study", Newfoundland, Faculty of Business Administration Memorial University of Newfoundland, pp. 13-34.
37. Raywood, E., Douglas, H., Kapoor, K., Filipow, N., Murray, N., O'Connor, R., Stott, L., Saul, G., Kuzhagaliyev, T., Davies, G., Liakhovich, O., Van Schaik, T., Furtuna, B., Booth, J., Shannon, H., Bryon, M., Main, E. (2020), "Protocol for Project Fizzyo, an analytic longitudinal observational cohort study of physiotherapy for children and young people with cystic fibrosis, with interrupted time-series design", BMJ Open, Vol. 10 No. 10, pp. 1-10.
38. Saez, Y., Baldominos, A., Isasi, P. (2016), "A Comparison Study of Classifier Algorithms for Cross-Person Physical Activity Recognition", Sensors, Vol. 17 No. 1, pp. 66-92.
39. Sagiroglu, S., Sinanc, D. (2013), "Big data: a review", in Proceedings of the International Conference on Collaboration Technologies and Systems (CTS '13), San Diego, California, USA, pp. 42-47.
40. Schroeck, M., Schockley, R., Smart, J., Morales D. R. (2012), "Analytics: the real-world use of big data: how innovative enterprises extract value from uncertain data", executive report,

IBM Institute for Business Value and Said Business School at the University of Oxford, Somers, USA.

41. Singh, J., Singla, V. (2015), "Big Data: Tools and Technologies in Big Data", International Journal of Computer Application, Vol. 112 No. 15, pp. 6-10.
42. Snedden, T. R., Scerpella, J., Kliethermes, S. A., Norman, R. S., Blyholder, L., Sanfilippo, J., McGuine, T. A., Heiderscheit, B. (2019), "Sport and Physical Activity Level Impacts Health-Related Quality of Life Among Collegiate Students", American Journal of Health Promotion, Vol. 33 No. 5, pp. 675-682.
43. Sung-Un, P., Hyunkyun, A., Dong-Kyu, D., Wi-Young, S. (2020), "Big Data Analysis of Sports and Physical Activities among Korean Adolescents", International Journal of Environmental Research and Public Health, Vol. 17 No. 15, pp. 5577-5588.
44. Suthaharan, S. (2013), "Big Data Classification: Problems and challenges in network intrusion prediction with machine learning", ACM Sigmetrics, Vol. 41 No. 4, pp. 70-73.
45. Wang, S., Scheider, S., Sporrel, K., Deutekom, M., Timmer, J., Krose, B. (2021), "What are good sitiations for running? A machine learning study using mobile and geographical data", Frontiers in Public Health, Vol. 8, pp. 1-15.
46. Worldometer (2021), "Current world population", available at: https://www.worldometers.info/world-population/ (6 March 2021)
47. Wu, X. Y., Han, L. H., Zhang, J. H., Luo, S., Hu, J. W., Sun, K. (2017), "The influence of physical activity, sedentary behavior on health-related quality of life among the general population of children and adolescents: A systematic review", PLoS One, Vol. 12 No. 11, pp. 1-29.
48. Zhao, D., Wei, L., Wang, Z., Du., Y. (2015), "Modeling and analysis in marine big data: advandes and challenges", Mathematical Problems in Engineering, Vol. 15 No. 2, pp. 1-15.

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Customer-Centric Sales Forecasting Model: RFM-ARIMA Approach

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Abstract

Background: Decision makers use the process of determining the best course of action by processing, analysing & interpreting the data to gain insights, known as Business Intelligence. Some decision support systems use sales figures to predict future expansion, but few consider the effect of customer data. **Objectives:** The main objective of this study is to build a model that will give a forecast based on fine-tuned sales numbers using some customer-centric features. **Methods/Approach:** We first use the RFM model to segment the customers into distinct segments based on customer buying characteristics and then discard the segments that are irrelevant to the business. Then we use the ARIMA model to do the sales forecasting for the remainder of the data. **Results:** Using this model, we were able to achieve a better fitment of the data for the prediction model and achieved a better accuracy when used after RFM analysis. **Conclusions:** We tried to merge two different concepts to do a cross-functional analysis for better decision-making. We were able to present the RFM-ARIMA model as a better metric or approach to fine-tune the sales analysis.

Keywords: Business Intelligence; Customer Analysis; Sales Forecasting; Exploratory Analysis; Segmentation; Decision Support System; Recency, Frequency & Monetary Value (RFM); Auto-Regressive Integrated Moving Averages (ARIMA); Long short-term memory (LSTM)
JEL classification: C53, E30, E37
Paper type: Research paper

Received: 29 Dec 2021
Accepted: 08 May 2022

Citation: Londhe, S.T., Palwe, S. (2022), "Customer-Centric Sales Forecasting Model: RFM-ARIMA Approach", Business Systems Research, Vol. 13 No. 1, pp.35-45.
DOI: 10.2478/bsrj-2022-0003

Introduction

In today's data-driven world, it is almost impossible for businesses to operate without an intelligent strategy. With so many data sources accessible, organisations can now leverage data to make informed business decisions, predict future outcomes, and take actionable steps toward reaching their strategic goals. Operating a successful business requires an organisation to have constant visibility into its business performance and the ability to measure key metrics that indicate how well they are doing. Business intelligence (BI) is an analytics-driven process that enables companies to monitor performance indicators. It identifies opportunities for growth by collecting, storing, analysing, and reporting data from various sources (Tomičić Furjan et al., 2020). The digital age has transformed the way businesses operate and compete, as well as how they measure success. In this new era of constant information, organisations must adapt their operations to capture data and drive measurable results. The effective management of operational processes optimises performance based on efficiency and effectiveness. The BI domain has grown to include various activities and processes that increase system performance (Akbar et al., 2020). Data visualisation techniques are critical for analysts to see and make sense of data. These techniques help them extract insights from raw data, construct charts and diagrams, create interactive visualisations, and share the insights with others. Recently, Business Intelligence has been used to bump up sales revenue and improve data security, understand customer purchase intent, build various reach-out strategies, and more (Vinod, 2008). The most common process which helps organisations make informed decisions includes ideas and processes to boost profits, understanding consumer behaviour, competitor analysis, performance analysis, data and process optimisation, success prediction, identifying trends and activities, identifying gaps and taking corrective measures. As companies use more and more data to run their business, they are working on shared data strategies and joint data projects. A business intelligence framework becomes an important part of an enterprise-wide business intelligence strategy (Calzon, 2020).

Problem Statement & Hypothesis

Analysts use the power of BI to improve results and establish competitive benchmarks that make companies more efficient. Analysts use BI to make informed decisions using historical data and its impact on current operations. Analysts leverage the power of BI to improve results and set competitive benchmarks that make companies run smoother. Companies rely only on a small subset of data acquired through customer purchases/transactions (Mirza et al., 2022). This data is primarily related to the products sold and the sales value over time. Any machine learning technique applied to this subset of data may provide some useful insights into the future, but it is not enough. The insights from such analysis are very generalised if a company is catering to a diverse audience. To deal with this issue, it is important to identify the nature of your customers; if the same sales forecasting can be done based on the nature of the diverse customer base, the companies can gain a lot.

We believe that any business has different types of customers with different requirements. They purchase goods at a certain frequency, at different periods, and spend varying amounts based on the offerings and requirements. Over time we can identify various segments of the customers based on this Recency, Frequency and Monetary values and identify these customers. We also may identify some customers who no longer are buying and have churned; these customers act as noise to the whole data and needs to be removed before doing the sales analysis on the rest of the segments.

Customer Analytics

Customer Analytics is the process of mining consumer data for profiling and target market analysis (Pejic Bach et al., 2021). Forbes magazine reported that 81% of companies rely on customer analytics to improve their customer knowledge. These insights help organisations create loyalty programs and expand their business (R. Valero et al., 2017). This analysis, in a way, ensures that customers' specific needs are met or even exceed those needs. These strategies not only help organisations get to know their customer but also help acquire new ones. Companies study why people buy certain products, how they buy them and in what various ways they make the purchase, how frequently they buy their products, and what influences them to buy them (Khedkar et al., 2018). The following reasons stand out as relevant for customer analytics:

o Social media makes consumers more informed, demanding, and tuned to everybody's opinions. Companies need to be up to date with what their customers what and should be in line with the social trends at a given time (Istrefi-Jahja et al., 2020).
o Increase response rates by contacting the right customers. Reduce campaign costs by targeting a suitable audience and sending appropriate marketing messages by segregating the consumers efficiently. Such strategies provide a better insight into the target audience (CMG Consulting, 2020).

The study article by (Anitha et al., 2022) understands customer buying patterns and behaviours using RFM (recency, frequency, and monetary Value) models for segmentation with k-means algorithms. This work presents the RFM protocol for two different values of K (using k-means clustering) and presents the best way to obtain the results using Silhouette Score ("It is a metric used to calculate the goodness of a cluster. Its value ranges from -1 to 1"). In their study, the Silhouette Score for K= 3 was 0.3621, while for K=5, it was 0.3491.

Sales Forecasting

Sales forecasting is the process of predicting sales growth in the future using relevant data. Sales forecasting usually uses historic sales data and economic trends of sales. The sales forecasting model allows organisations to predict short-term and long-term performance (Vijayaraghavan, 2019). Time series forecasting is one of the core concepts in making forecasts and analysing trends based on past values. There are different techniques for making predictions based on the nature of the data (Le, 2019). Sales forecasting enables organisations to manage resources like inventory, billings, and workforce. It also helps companies allocate the right resources to the right tasks without creating an overhead on the budget (Skyword Staff, 2020). Sales forecasting allows companies to predict sales growth and help set an achievable benchmark; effectively allocate company resources; Build an action plan for the coming future. The following reasons stand out the importance of predictive analytics:

o Predictive Analytics offers businesses a unique opportunity to identify various insights into the data and use these patterns to build a plan to act upon them. The surge of data demands more AI and machine learning approaches, which would offer organisations valuable insights (Sas, 2020).
o Some predictive techniques identify customer responses to a service and their purchase behaviour. Such studies help build offers around the products and services and promote cross-sell opportunities (Sas, 2020).

A paper by (Hu et al., 2020) used a combination of the LSTM (long short-term memory) model, ARIMA (autoregressive integrated moving average) model, and wavelet denoising on hydrological time series data. The Hydrological data contains values related to water flow, and this data is nonstationary and contains a lot of noise. This noise makes it very difficult to process and subsequently predict. The authors (Hu et al., 2020) first denoise the data using wavelet denoising, then fitted it to a model using

his ARIMA to make predictions. An LSTM network is trained using the residual values from the ARIMA results. They then used this as feedback to improve the predictions of the ARIMA model. The results in the paper (Hu et al., 2020) show that the predicted values of the proposed model based on Denoising-ARIMA-LSTM are fairly close to the observed values.

The goal of the paper

In this paper, we perform a set of experiments driven by business intelligence concepts discussed above which will help organisations get a realistic idea regarding their business growth. This two-step process includes segmentation of customers who are relevant to the business growth using the RFM model and then forecasting the growth based on the sales numbers of these segmented customers using the ARIMA model. This will not only help organisations identify the customers who are going to churn and technically act as noise, but they will also get a realistic view of the growth of their sales figures.

Methodology

Hybrid Customer-centric Approach

We implemented a hybrid multi-step model based on traditional sales forecasting models, aiming to keep the whole prediction model customer-centric. We divided the work into two key parts 1. Customer Analysis using RFM Model and 2. Sales Forecasting using ARIMA Model. For this study, we use Tableau's Global Superstore data set. These extensive datasets provide a basis for exploring data processing details and examples for performing data transformations. The dataset contains data on the sales of multiple products a business sells along with additional features like customer segments, categories of products, purchase geographies, revenue generated, profit made, etc. The data is also customer-centric, which is suitable given the context of the problem we intend to solve. The data contains details of the orders by each customer between the years 2011 through 2015. Fig 1. Shows the implementation approach:

Figure 1
Proposed Model
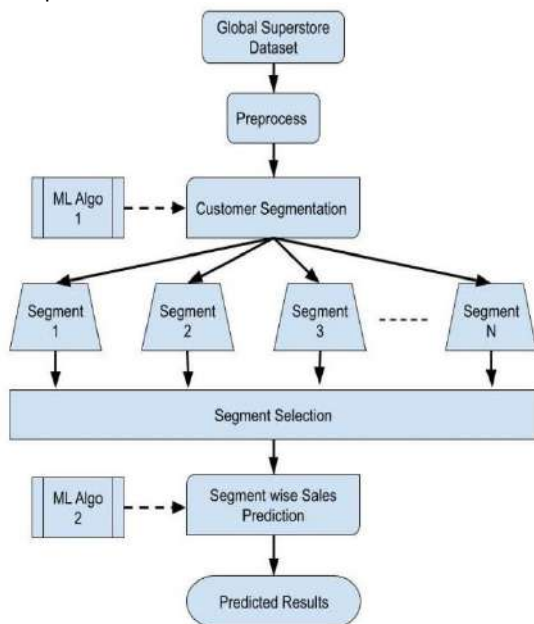
Source: Author's illustration

Customer Analysis using RFM Model

RFM is mainly used for campaign targeting to reach out to relevant customers. These customers are segregated from the data based on recency, frequency and monetary values (RFM). RFM analysis helps understand the type of customer and helps organisations answer questions like who are my top paying customers? Who is about to churn? Who must the business retain?

Using the transactional data to devise a metric that will divide the customer into certain groups based on their current purchase behaviour and potential Value to the business.

The RFM scores are calculated using the quantile regression model. The quantile regression equation is given as:

$$u_i = v_i'\beta_q + c_i \qquad (1)$$

where β_q Is vector associated with qth quantile (0 < q < 1), c_i is the prediction error.

Based on the RFM scores, the customers are segmented into four categories per their current and potential values (Figure 2).

Figure 2
Customer Segmentation Matrix
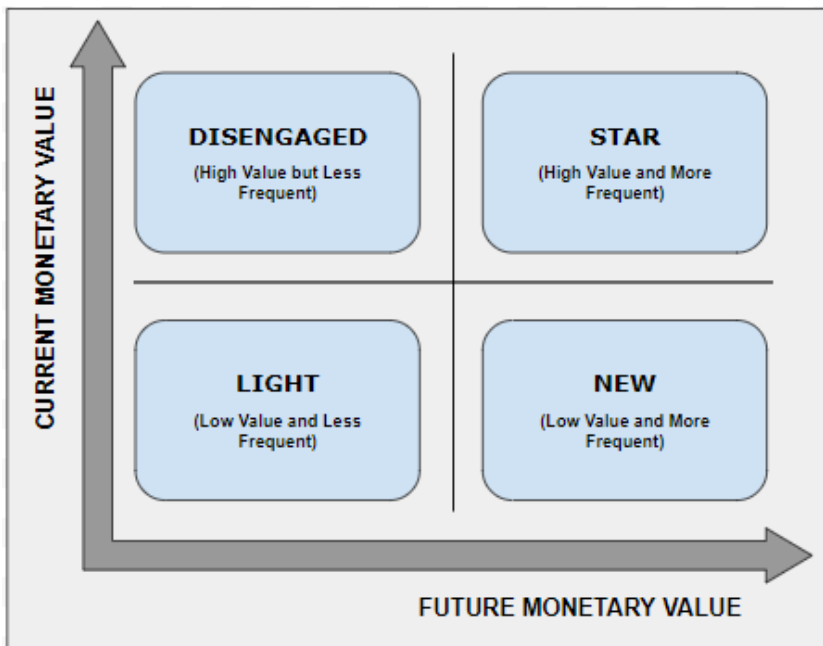
Source: Adapted from Smartkarrot.com (2020)

We pre-processed the data and aggregated the same at the customer level. We then built each customer's RFM (Recency, Frequency & Monetary-value) features. We used the 80% quantile regression model for Recency and Monetary-value to automate the segmentation. We then calculated the RM score and sorted the customers. Finally, we visualised the results to explore some key numbers.

Figure 3 shows the Value matrix by **(a) Avg. Monetary Value**, **(b) Number of Customers** and **(c) Recency**.

Figure 4 shows a Segment interpretation of the same.

Figure 3
Customer Segmentation Matrix

		R				R				R	
		1	2			1	2			1	2
M	2	2189	2378	M	2	423	3061	M	2	1136	301
	1	279	330		1	3059	10872		1	1147	360
(a) Avg. Monetary Value				**(b) Number of Customers**				**(c) Recency**			

Source: Author's illustration

Figure 4
Value Matrix Interpretation

Disengaged		Star	
$ Value	**2189**	$ Value	**2378**
# Cust	**423**	# Cust	**3061**
# Days	**1136**	# Days	**301**
Light		New	
$ Value	**279**	$ Value	**330**
# Cust	**3059**	# Cust	**10872**
# Days	**1147**	# Days	**360**

Source: Author's illustration

Based on the combination of RM Scores calculated, we have divided customers into 4 groups.

- o **Disengaged** – There are 423 customers with an average dollar value of $2189 and have last purchased approximately 1136 days ago. These customers are highly valued but have purchased less frequently.
- o **Star** – There are 3061 customers with an average dollar value of $2378 who purchased approximately 301 days ago. These customers are highly valued and frequent.
- o **New** – There are 10872 customers with an average dollar value of $330 who purchased approximately 360 days ago. These customers are relatively new and have started to make purchases. Low dollar value but frequent purchasers.
- o **Light** – There are 3059 customers with an average dollar value of $279 who purchased approximately 1147 days ago. These customers are low-valued and less frequent.

We observed that a subset of Light customers with low RM value (R=1 & M=1) is likely to churn. We will discard these values before we move on to forecasting, as these customers made their last purchase long ago. These values are likely to skew our analysis and must be processed from the forecast.

Sales Prediction using ARIMA model

Once we had removed the Light/churn-able customers, we moved on to the next step and analysed the remaining customers independently. We used ARIMA to do the time series forecasting. ARIMA is a time-series forecasting model that explicitly works well with nonstationary time series. Auto-Regressive Integrated Moving Averages (ARIMA) has three key terms: **AR** – Lags of series which is made stationary; **I** – Used to make the series stationary using the order of differencing; **MA** – Lag of the error of forecast.

Consider X, which refers to a time series. The expression for ARIMA can be given as:

$$X_t = c + e_t + \sum_{i=1}^{n} \varphi_i X_{t-i} + \sum_{i=1}^{m} \theta_i e_{t-i} \qquad (2)$$

where X_t Is the original time series, X_{t-i} is the lag i in the time series and e_{t-i} is the lag i forecast error.

Results

Since we wanted to present the impact of customer data on sales prediction accuracy, we implemented the ARIMA Model on the data without pre-processing the data with the RFM model. Secondly, we implemented the ARIMA model after pre-processing it with the RFM model.

We compared the results in terms of data's feasibility and usefulness of features for predicting by looking at the Adjusted R-squared Value. Secondly, we compared the actual vs predicted sales values on visual plots.

Table 1 shows the Adjusted R-squared values for two ARIMA models derived from OLS (Ordinary Least Square) values. The RFM-ARIMA model shows a better fit for the prediction compared to the standalone ARIMA.

Table 1
Data Feasibility Comparison

Model	Adjusted RS
RFM-ARIMA model	0.71
ARIMA	0.67

The following figures show the prediction output on visual plots. Figure 5a shows the sales prediction using the standalone ARIMA model. The model initially showed s good fit but then deviated a lot. However, in the RFM-ARIMA model, the model fit improved due to reduced noise by eliminating churned customers, as shown in Figure 5b.

Figure 5a
Sales Prediction using standalone ARIMA Model
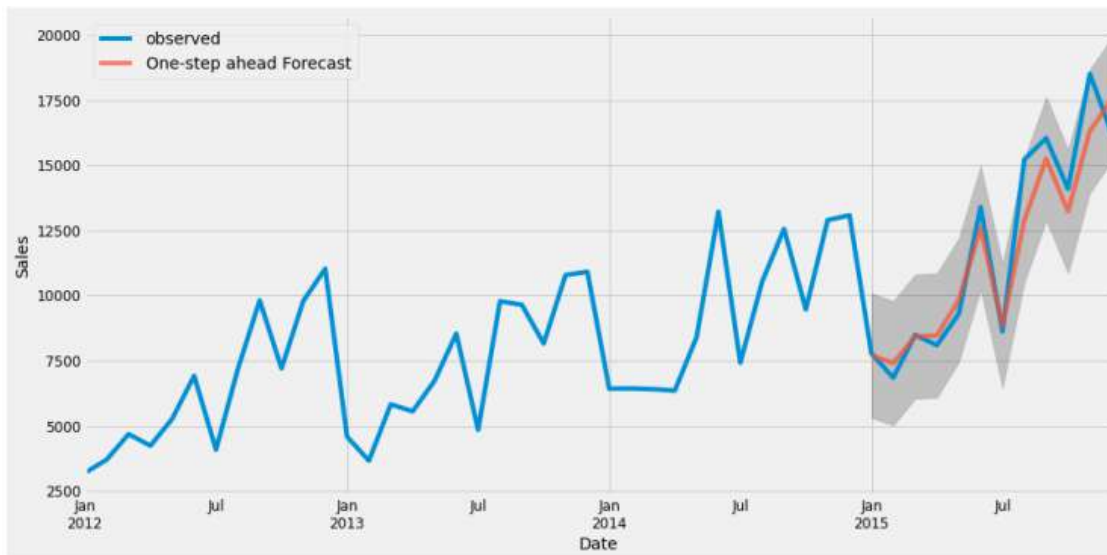
Source: Author's illustration

Figure 5b
Sales Prediction using RFM-ARIMA Model
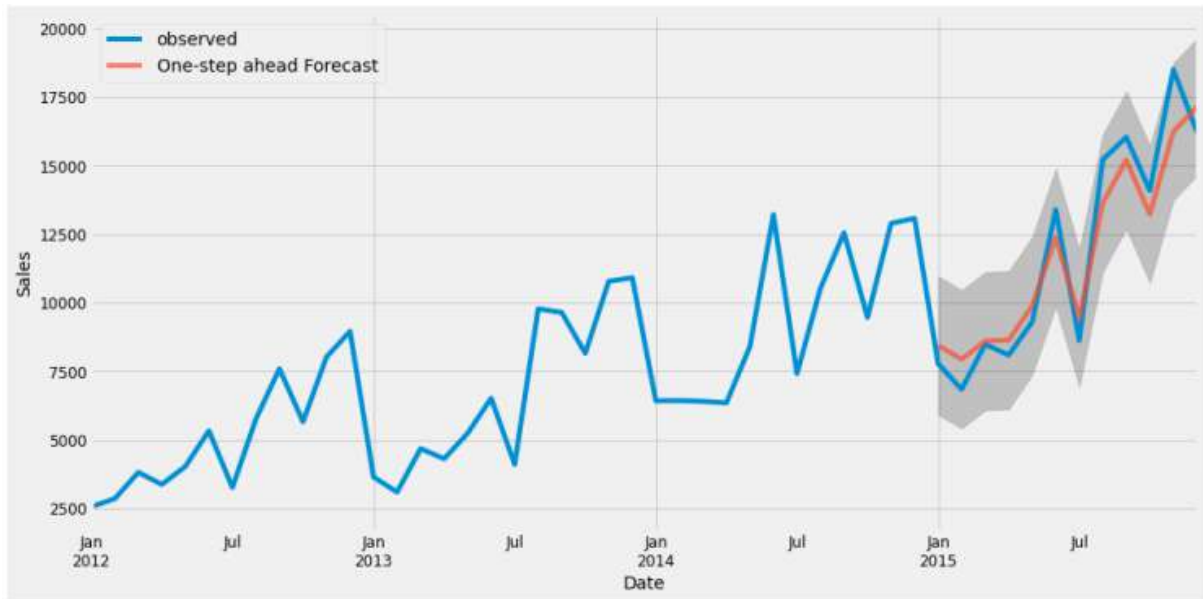
Source: Author's illustration

We evaluated the model's accuracy using statistical methods. **Root mean squared error (RMSE)** is an error metric that indicates how well the predicted and observed values match based on the data range. The lower the RMSE, the better the model fit, and RMSE is popularly used to evaluate predicted and observed values. **The Root Mean Square Error (RMSE)** is the error index that shows how closely the predicted and observed values match, based on the range of data. Lower is the RMSE better if the fit of the model.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n}(O_i - P_i)^2} \qquad (3)$$

where O_i = observed discharges, P_i = simulated discharges at time t, and n = total number of observations. Table 2. shows the MSE and RMSE Values for the two models.

Table 2
Model Accuracy Comparison

Model	MSE	RMSE
RFM-ARIMA model	1762925.07	1327.75
ARIMA	2219903.64	1498.93

Table 2 contains the MSE and RMSE estimates for forecast models. As can be observed, the RFM-ARIMA model has a lower prediction error rate than the standalone His ARIMA model, confirming the higher efficiency of the RFM-ARIMA model than the generalised model for revenue forecasting. Another observation from the Figures 5(a) and 5(b) is that, for the RFM-ARIMA model, the forecast values are fairly close to the actual values. And towards the end, the predicted model is inclined toward the actual Value for the RFM-ARIMA model while it is deviating in the case of the standalone ARIMA model, which is a positive sign.

Conclusion

Summary of results

This research merges two concepts to do a cross-functional analysis for better decision-making. Our Customer-centric Sales Forecasting model using a combination of RFM and ARIMA model was able to provide results with better accuracy, as shown by the RMSE Value of 1327.75 compared to 1498.93 for the standalone ARIMA model.

The analysis of actual and predicted data shows that implementing the RFM model on customer data before Sales Forecasting using ARIMA model is a better approach to identify business gaps and create an actionable plan. We were able to present the RFM model as a better metric or approach to fine-tune the sales analysis. The main advantage of using the RFM model is that it not only gives an insight into the customer behaviour towards organisation offerings but also identifies the churnable customers. They should be discarded from the data as they act as noise. This, in turn, reduces the data's size and subsequently improves the model's performance. While the scope of this research is limited to a small amount of data with only marginal improvements in the results, future studies can expand this scope. This research highlights the importance of understanding consumer purchase intent and applying the same not only to market to the target audience but also to predict sales revenue accurately and gain important insights.

Results show that the Hybrid Customer-centric approach for Sales Forecasting is more refined and targeted than standalone Sales Forecasting. Even the change is marginal but is significant in terms of the value-added insights from the RFM analysis. Results also indicate that the RFM-ARIMA model is more accurate. The overall observation indicates that this Hybrid approach has some promising scope in BI applications.

Implications

In this research, we used two models, RFM and ARIMA models, and applied them in series to get the results. The RFM model can give companies insight into their customer behaviour and how they react to various offerings, and this model indirectly provides customer purchase efficiency. This approach allows businesses to understand how diverse their customers are and can even target each of them through targeted marketing campaigns and making their products and services more lucrative. Conversely, the ARIMA model can help companies see growth opportunities. Models like ARIMA help businesses understand what is working for them and what isn't. These two models together form a business intelligence framework for customer-centric sales analysis to get actionable insights.

Limitations & Scope for Future Work

The specificity of the model itself is one of its limitations. There are many techniques which may prove to give a better analysis. This research also lacks concepts of Artificial Intelligence. While we can work with Machine Learning models on Time Series data, AI can bring a lot on how the data is structured and provide some hidden insights that could be a game changer. It can also help automate the process of predicting how businesses grow in different areas. Hence, there is a lot to be explored in this area.

References

1. Akbar, R., Silvana, M., Hersyah, M. H., Jannah, M. (2020), "Implementation of Business Intelligence for Sales Data Management Using Interactive Dashboard Visualization in XYZ Stores", in 2020 International Conference on Information Technology Systems and Innovation (ICITSI), pp. 242-249.
2. Anitha, P., Patil, M. (2022), "RFM model for Customer Purchase Behavior using K-Means Algorithm", Journal of King Saud University - Computer and Information Sciences, Vol. 34, No. 5, pp. 1785-1792.
3. Calzon, B. (2021), "See Top 10 Analytics & Business Intelligence Trends For 2021", available at https://www.datapine.com/blog/business-intelligence-trends/ (12 December 2020)
4. CMG Consulting (2020), "What is Customer Analysis? Explaining one of the critical components of any business plan", available at https://www.cmgconsulting.com/post/what-is-customer-analysis (12 December 2020)
5. Hu, X., Shi, Z., Yang, Y., Chen, L. (2020), "Classification Method of Internet Catering Customer Based on Improved RFM Model and Cluster Analysis", in 2020 IEEE 5th International Conference on Cloud Computing and Big Data Analytics (ICCCBDA), pp. 28-31.
6. Istrefi-Jahja, A., Zeqiri, J. (2021), "The Impact of Digital Marketing and Digital Transformation on Brand Promotion and Brand Positioning in Kosovo's Enterprises", in IRENET - Society for Advancing Innovation and Research in Economy, Zagreb, pp. 244-255,
7. Khedkar, S. A., Shinde, S. K. (2018), "Customer Review Analytics for Business Intelligence", in 2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2018, pp. 1-5.
8. Le, X. H., Hung, V. H., Giha, L., Sungho, J. (2019), "Application of Long Short-Term Memory (LSTM) Neural Network for Flood Forecasting", Water, Vol. 11 No. 7, pp. 1-19.
9. Mirza, S., Mahmood, A., Waqar, H. (2022). "The interplay of open innovation and strategic innovation: Unpacking the role of organisational learning ability and absorptive capacity", International Journal of Engineering Business Management, Vol. 14, pp. 1-15.
10. Pejic Bach, M., Pivar, J., Jaković, B. (2021), "Churn Management in Telecommunications: Hybrid Approach Using Cluster Analysis and Decision Trees", Journal of Risk and Financial Management, Vol. 14 No. 11, pp. 1-25.
11. Sas (2020), "Predictive Analytics: What it is and why it matters", available at https://www.sas.com/en_in/insights/analytics/predictive-analytics.html (14 December 2020)
12. Skyword Staff (2020), "Sales Forecasting", available at https://www.skyword.com/marketing-dictionary/sales-forecasting/ (14 December 2020)
13. Smarkarrot.com (2020), "Win the new game of Intelligent Customer Success", available at https://www.smartkarrot.com/ (14 December 2020).
14. Tomičić Furjan, M., Tomičić-Pupek, K., Pihir, I. (2020), "Understanding digital transformation initiatives: case studies analysis", Business Systems Research, Vol. 11 No. 1, pp.125-141.
15. Valero, R., Collins, D., Rigby, C., Bailey, J. (2017), "Towards Accurate Predictions of Customer Purchasing Patterns", in IEEE International Conference on Computer and Information Technology (CIT), Helsinki, 2017, pp. 157-161.
16. Vijayaraghavan (2019), "How Sales Forecasting can help your online Business Growth?", available at https://productimize.com/blog/how-sales-forecasting-can-help-your-online-business-growth/#:~:text=Sales%20forecasting%20is%20the%20process,wide%20comparisons%2C%20and%20economic%20trends (14 December 2020)
17. Vinod, B. (2008), "The continuing evolution: Customer-centric revenue management", Journal of Revenue and Pricing Management, Vol. 7, pp. 27-39.

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Technological Innovation in Colombian Small Firms: A Gender Multi-Group Analysis

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Abstract

Background: Studies on innovations have been focused on teams, institutions, and organisations without accounting for the role of the executive's gender. **Objectives:** This research aims to analyse how small Colombian firms manage technological innovation from the perspective of the gender of executives. **Methods/Approach:** A quantitative approach and cross-sectional, non-experimental design through Structural Equation Models with PLS-SEM was used. We self-administered a survey randomly to gather data from 145 small firms' owners or managers in the department of Bogota, Colombia. **Results:** The results obtained from multi-group analysis evidence that process innovation has a strong and significant positive impact on the innovation of products, and no significant differences were found when comparing the performance of male executives versus female executives. However, descriptive statistics showed that female executives give more importance to the process and product innovation activities, and they demonstrated to manage a better product innovation performance than male executives. **Conclusions:** The evidence reveals that female executives are more committed to developing new products and choose to acquire new skills or equipment to develop products and processes. It is, therefore, essential to eliminate organisations' cultural stereotypes and take advantage of women's potential in management leadership.

Introduction

According to the literature, Innovation is considered one of the key strategies to boost economic growth and thus develop wealthy countries (Cuevas-Vargas et al., 2021; Fagerberg et al., 2005; Verspagen, 2009). Moreover, since innovation is seen as a critical element of an organisation's success and survival (Damanpour et al., 2001), innovation management should not only be a responsibility but an obligation for current business managers (Christensen, 1999). Proper innovation management can help enterprises adapt swiftly to current market changes (Khazanchi et al., 2007). Additionally, Alsos et al. (2013) contend that more attention should be paid to incremental innovation processes and process-oriented innovations that are undertaken at the lowest levels of organisations.

Studies on innovation processes often focus on teams, institutions, and organisations without accounting for the role of gender. Ranga et al. (2010) argue that gender is generally seen as a peripheral component of innovation. However, during the last few years, greater attention has been paid in practice and academia to the differences between men and women in business management. As a result, studies based on gender in innovation have recently gained momentum among management and entrepreneurship researchers (Arun et al., 2020; Ranga et al., 2010; Vafaei et al., 2021). Still, as stated by Alsos et al. (2013), Arun et al. (2020), and Ranga et al. (2010), the role of innovative female executives in technological change and innovation is underestimated due to the implicit and socially construed belief that men are more innovative than female entrepreneurs as per traditional gender roles. Yet it is not women who are incapable of innovating but organisational practices that condition or inhibit female innovation.

Scientific evidence shows that, as a sociodemographic feature of enterprise executives, gender influences the executives' decisions and, therefore, the actions taken by the organisations led by them (Hambrick et al., 2013). Hence, enterprises need to consider and incorporate gender-related features into their operations (Selvarajan et al., 2015). As Charlo Molina et al. (2012) show, both men and women contribute their values to the transformation and management of organisations through governance and leadership. Besides, the representation of women in managerial positions is positively linked with innovation (Vafaei et al., 2021).

The technology sector offers a historical framework for exploring gender practices in networks. As one of the earliest researchers of the role of the gender of executives in technological innovation, Rothschild (1983) contended that technological development was more linked to men since boards of directors were chiefly male, with women who did not understand the contents and the management of technological change; also, technology has been predominantly male, that is to say, technological devices are created with male values without considering female needs. Feminist technological research has shown that men make the key decisions related to technological development (Berger et al., 2015). In part, this can be explained because, after university, women have difficulties getting majors in information technology courses (Zhang et al., 2021).

The participation of women in innovation activities has mostly remained unchanged in the last few decades. However, some authors like Danilda et al. (2011), Expósito et al. (2021), Østergaard et al. (2011), Vafaei et al. (2021), and Woodman et al. (1993) have shown the relationship between innovation and gender. They argue that gender diversity is fundamental and beneficial to problem resolution; therefore, teams should have balanced participation of men and women. This balance—reinforced by gender diversity—substantially increases innovation in creating new things. As a result, the relationship between the incorporation of women into senior

management positions and an organisation's financial performance can now be accounted for.

In that sense, the gender of executives can influence process innovation and, therefore, product innovation. For example, Vafaei et al. (2021) found a significant relationship between women's participation in managerial positions and firms' innovation activities. This finding supports calls for more diversity since the higher the participation of women on boards, the higher the levels of investment in innovation. On the other hand, Alsos et al. (2013) conclude the roles of men and women in the innovation pipeline are different: male executives are overwhelmingly active in technology start-ups and venture capital firms, while female executives are most active in technological transfer offices. Furthermore, Arun et al. (2020) found in their research on gender and innovation in India that organisational and marketing innovation is greater than product and process innovation in SMEs where women are in charge.

We conducted several searches in the Scopus and Web of Science databases. It was found that there are many results for the term "gender" because many subject areas study this term. However, results within the subject areas of business and/or management are significantly fewer. The contrary applies to the term "innovation," which shows more results in the subject areas of business and/or management. Nevertheless, few studies support the relevant role of females as owners or executives in the innovation creation process (Zastempowski et al., 2021), such as Na et al. (2019), Teruel et al. (2017), Wu et al. (2021) who studied the gender effect on innovation activities.

Our research contemplates three key contributions. The first is to provide empirical evidence for the relationship between process and product innovation—using the gender of executives as the moderating variable—in Colombian MSMEs. The second contribution is to apply a methodology that is different from the ones used in previous research: proving the theoretical model through construct validation by confirmatory factor analysis (CFA) and testing the hypotheses through multi-group analysis (MGA) using variance-based structural equations modelling (PLS-SEM). The third contribution is to provide empirical evidence for the importance and performance of the variables used to measure process innovation on product innovation through a map analysis (IPMA).

Our empirical study aims to determine how this kind of enterprise manages technological innovation and how process innovation influences product innovation from the standpoint of the gender of executives. Researchers need to ask themselves if the gender of executives substantially impacts technological innovation in Colombian MSMEs and what the implications are. Following this question, our quantitative research was undertaken in Bogota (Colombia) between February and April of 2018, with a sample of 145 MSMEs, of which 96 were run by men and 49 by women.

The present article is arranged as follows: After (1) the introduction, (2). A literature review of the relationship between process and product innovation. After that, (3) the methodology is presented, including sample design, reliability and validity of the scales. (4) Results and hypotheses tests are provided in this part. (5) research results are discussed from a theoretical and managerial perspective. Finally, (6) the conclusions, which include the implications, limitations, and recommendations for future studies, are outlined.

Literature review

An enterprise's interest in process and product innovation lies mainly in the perceived attributes of each innovation; the adoption of product innovations receives more attention since these are more visible than process innovations—while innovations in processes are associated with the production process, and to the supply and operations, innovations in products are the results themselves (Oke, 2007). Dwivedi et al. (2021) suggest that firms that can innovate rapidly need to realise the critical success factors of new product development to achieve competitive advantages. Ul Hassan et al. (2013) found that the four types of innovation (process, product, organisational, and marketing) are linked, and process innovation positively affects product innovation. In turn, an empirical study involving 159 industrial enterprises in Spain by Camisón et al. (2014) evidenced the relationship between product and process innovation and found that this relationship significantly influences organisations. Expósito et al. (2021) obtained data from 1,425 Spanish SMEs, of which they found complementarities among process, product and organisational innovations. Based on the arguments, we propose the following hypothesis:

- o *H$_1$: Process innovation positively influences product innovation in Colombian small enterprises.*

Innovation contemplates knowledge and learning at every stage—this propitiates invention and leads the participants (men and women) to obtain innovative capacities (Robledo et al., 2010). Consequently, the participants are a fundamental part of the innovation process since men and women have different personal and professional experiences that shape their strategic innovation methods (Manolova et al., 2007). It has been shown that enterprises that have a greater absorption capacity—which allows them to exploit internal knowledge through learning and interaction—are the ones that have a greater variety of knowledge, skills, and experiences among their employees (Van der Vegt et al., 2003). Therefore gender turns out to be a factor that benefits innovation in enterprises since it implies an increase in knowledge and a higher probability of new ideas (Østergaard et al., 2011). Considering specifically product and process innovation, an empirical study with 205 technological SMEs in Spain by Ruiz-Jiménez et al. (2016) confirmed that gender positively influences product and process innovation. However, Expósito et al. (2021) and Foss et al. (2013) argue that both men and women can innovate within different types of innovation, but women make executive decisions in small-sized enterprises. Mendonça et al. (2020) evidence that gender negatively affects the probability of innovating, with women being 30 percent less likely to develop products or services for personal use. Olson et al. (2003) state that men who own enterprises have a better business performance than women in terms of the financial measures used to create innovation.

Furthermore, Díaz-García et al. (2013) stress that these two kinds of innovation (product and process) are positively related and the capacities of individuals, with the link mediated by gender being the stronger one; they also contend that the attributes of men make them swifter in terms of decision-making than women. Expósito et al. (2021) observe that the gender of executives influences process innovations. Based on the above arguments, we propose the following hypothesis:

- o *H$_2$: Process innovation positively influences product innovation in Colombian small enterprises run by men.*

On the other hand, female executives can contribute to organisations with perspectives, workstyles, and experiences that are exclusive to them (Huse et al., 2006), thereby helping attain better knowledge management to foster innovation (Attah-Boakye et al., 2020; Torchia et al., 2011; Zouaghi et al., 2020). However, female

executives frequently have a close male presence that persuades them; when there are more men than women, women face the unanimous opinion of a group and tend to abide by it (Attah-Boakye et al., 2020; Torchia et al., 2011). Women tend to innovate more in the organisational sphere when independent of men but are not completely from technological innovation in products and processes (Zouaghi et al., 2020). They also participate in product and service innovation by innovating everywhere, from supplies to processes (Idris, 2009). Vafaei et al. (2021) found in their research in Australia that the participation and proportion of women on boards are related to several measures of firms' innovation activity. Based on these arguments, we propose the following hypothesis:

- o H_3: *Process innovation positively influences product innovation in Colombian small enterprises run by women.*

Figure 1 shows the theoretical research model that leads to formulating the three hypotheses.

Figure 1
Theoretical model
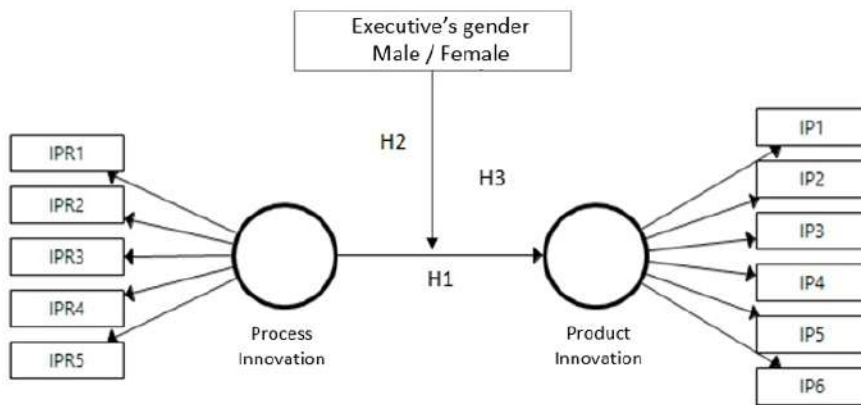
Source: Author's illustration

Methodology

We undertook an empirical study of the explanatory kind—with predictive, no experimental, cross-sectional, descriptive design, and a quantitative approach—through variance-based structural equation modelling (PLS-SEM) using the Smart PLS 3.3.3 statistics software (Ringle et al., 2015) since this statistical technique allows solving problems related to the lack of data normality because it uses nonparametric testing (Hair et al., 2017). It is important to note that first, we evaluated the measurement model and then the structural model was evaluated with the total sample; then, the multi-group analysis technique was performed to demonstrate the capacity of gender as a moderating variable in PLS-SEM. Lastly, we used partial least squares multi-group analysis (PLS-MGA) (Henseler et al., 2009) to assess whether there are significant differences in the gender of executives regarding the management of technological innovation in Colombian small enterprises.

Sample design and data gathering

This study took as reference the database of the Bogota Chamber of Commerce (2018), considering the population of the registered firms in the department of Bogota (Colombia) that have between 1 and 200 workers. A total of 740,069 micro-sized, small-sized, and medium-sized enterprises are registered. After estimating the sample

with a 95 per cent confidence interval and a six per cent margin of error, we obtained a sample of 267 enterprises.

Using the simple random sampling technique, we gave a survey between February and April of 2018 to the owners or managers of the enterprises that were selected from the sample, obtaining in the end only 145 valid surveys—which represent the definitive sample for this research.

It should be clarified that, according to the sample's distribution, 47.6 per cent of enterprises are micro-enterprises, 47.6 per cent are small enterprises, and only 4.8 per cent are medium-sized enterprises. Additionally, 53.2 per cent are not family enterprises while 46.9 per cent are family enterprises; moreover, 66.2 per cent are run by men and only 33.8 per cent are run by women; and the sector with the highest representation is services (55.2 per cent), while the remaining belong to the manufacturing (production) sector.

Variables

To measure process innovation, we used the latent variable as the technological innovation construct, a scale used by Cuevas-Vargas (2016) as adapted from Liao et al. (2007).

To measure product innovation, we used a reflective latent variable as the technological innovation construct, taken from the scale used by Cuevas-Vargas (2016) as adapted from Liao et al. (2007). This is measured using six indicators with a Likert scale from one to five—ranging from strongly disagree to agree strongly.

To measure the control variable gender, a dummy variable was used to identify the business owner or executive gender, such that 1 indicated male and 2 represented female.

Reliability and validity of the constructs

To assess the reliability and validity of the constructs, we estimated the measurement model using the algorithm of PLS-SEM with the Smart PLS 3.3.3 statistics software (Ringle et al., 2015).

The results of this study (Table 1) reveal that both constructs have high internal consistency—the composite reliability (CR) is above the 0.708 value mentioned by Hair et al. (2017); likewise, for each of the constructs, Cronbach's Alpha (CA) (Cronbach, 1951) is greater than 0.7, as recommended by Hair et al. (2017), and Nunnally et al. (1994), and it is also higher than the 0.5 average variances extracted (AVE) (Fornell et al., 1981; Hair et al., 2012). Moreover, we found that the standardised factor loadings of the indicators are higher than 0.708 (Hair et al., 2017), and they are significant (p<0.001), which ensures the commonality of each item; and, since the AVE values are above 0.5, all the used scales have convergent validity (Hair et al., 2017).

Table 1
Assessment of the measurement model for the total sample and the two subsamples based on the executive's gender

Constructs	Indicator	Convergent Validity		Internal Consistency		
					Reliability	
		Factor Loadings	t-value	AVE	CR	CA
		>0.708	>2.57	>0.5	>0.7	>0.7
Process Innovation[1]	IPR1	0.838	27.582	0.770	0.944	0.925
	IPR2	0.910	44.929			
	IPR3	0.903	47.522			
	IPR4	0.837	25.178			
	IPR5	0.896	44.843			

Product Innovation[1]	IP1	0.885	29.329	0.787	0.957	0.946
	IP2	0.819	30.043			
	IP3	0.933	62.672			
	IP4	0.905	32.657			
	IP5	0.876	45.688			
	IP6	0.900	34.005			
Process Innovation[2]	IPR1	0.852	22.318	0.777	0.946	0.928
	IPR2	0.915	36.518			
	IPR3	0.909	48.306			
	IPR4	0.826	19.625			
	IPR5	0.902	45.839			
Product Innovation[2]	IP1	0.900	42.210	0.807	0.962	0.952
	IP2	0.882	27.357			
	IP3	0.927	53.881			
	IP4	0.891	21.180			
	IP5	0.887	29.157			
	IP6	0.903	45.736			
Process Innovation[3]	IPR1	0.813	8.309	0.759	0.940	0.921
	IPR2	0.905	13.902			
	IPR3	0.893	14.090			
	IPR4	0.860	9.709			
	IPR5	0.883	14.068			
Product Innovation[3]	IP1	0.865	11.893	0.752	0.948	0.933
	IP2	0.709	60.14			
	IP3	0.940	13.866			
	IP4	0.903	13.011			
	IP5	0.848	9.137			
	IP6	0.898	13.395			

Note: [1]Total sample N=145; [2]Male executives N=96; [3]Female executives N=49
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

The discriminant validity was calculated using two criteria shown in Table 2. Firstly, above the diagonal, we find the Heterotrait-Monotrait ratio of correlations (HTMT85) test (Henseler et al., 2015), which is considered a well-performing test for assessing the discriminating validity (Cuevas-Vargas et al., 2019, 2022); also, upon computing the complete bootstrapping, we found that the correlation values between the variables are below 0.85 (Clark et al., 1995; Henseler et al., 2015; Kline, 2011). Secondly, the test of Fornell-Larcker was estimated by taking as reference the square root of each of the construct's AVE, whose values—in bold—represent the table's diagonal; and along with this criterion, the values of the correlations are below the value of the square root of the AVE (Fornell et al., 1981), as can be seen below the diagonals.

Table 2
Discriminant validity of the variables for the total sample and the two subsamples based on the executive's gender

Constructs[1]	Process Innovation	Product Innovation
	AVE= 0.770	AVE= 0.787
Process Innovation	**0.877**	0.745
Product Innovation	0.702	**0.887**
Constructs[2]	Process Innovation	Product Innovation
	AVE= 0.777	AVE= 0.807
Process Innovation	**0.881**	0.823
Product Innovation	0.779	**0.898**

Constructs[3]	Process Innovation	Product Innovation
	AVE= 0.759	AVE= 0.752
Process Innovation	**0.871**	0.572
Product Innovation	0.547	**0.867**

Note: [1]Total sample N=145; [2]Male executives N=96; [3]Female executives N=49
NOTE: The numbers on the diagonal (in bold) signify the AVE's square root values.
Source: Authors' work based on Smart PLS 3 outcomes. Ringle et al. (2015)

Based on the criteria evaluated above, we can conclude that the present study's data are valid and reliable for testing the research hypotheses and implementing PLS-MGA.

Results

First, we estimated the descriptive statistics (found in Table 3). These statistics emphasise the observable variables of each of the constructs given more relevance by the executives or owners of micro, small, and medium-sized enterprises in Colombia through each variable's arithmetic mean.

Table 3
Descriptive statistics

ID	Variable	Total N=145		Male Executive N=96		Female Executive N=49	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev
IPR1	Different operations procedures	3.71	*1.37*	**3.73**	*1.36*	3.69	*1.41*
IPR2	Acquisition of new skills or equipment	3.69	*1.37*	3.67	*1.39*	**3.75**	*1.34*
IPR3	Development of manufacturing or operations processes	3.17	*1.30*	**3.17**	*1.39*	3.16	*1.12*
IPR4	Flexible for developing products	3.68	*1.38*	3.64	*1.42*	**3.75**	*1.29*
IPR5	Processes lead to imitation from competitors	3.00	*1.18*	3.00	*1.23*	**3.02**	*1.07*
IP1	Development of new or improved products/services	3.46	*1.34*	3.32	*1.34*	**3.73**	*1.33*
IP2	Profit from new products/services	3.03	*1.36*	**3.04**	*1.32*	3.02	*1.43*
IP3	New products/services lead to imitation from competitors	3.12	*1.21*	3.02	*1.23*	**3.32**	*1.16*
IP4	Launching products/services faster than the competition	2.93	*1.16*	2.86	*1.20*	**3.08**	*1.09*
IP5	More R&D capacities than competitors	2.79	*1.11*	2.71	*1.10*	**2.93**	*1.12*
IP6	Development of novel abilities to transform existing products into new ones	3.18	*1.28*	3.06	*1.25*	**3.42**	*1.30*

Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Regarding process innovation, we found that the women who are the owners or executives of the surveyed enterprises give more importance to process innovation. Three of the five variables used to measure this kind of technological innovation had scores above the mean process innovation score of Colombian small enterprises. Women decide to acquire new abilities or equipment with a 3.75 mean, are flexible in developing products with a 3.75 mean, and their processes lead competitors to imitate them with a 3.02 mean. In turn, male executives focus more on having different

operational procedures with a 3.72 mean; and the development of manufacturing or operations processes with a 3.17 mean.

We found that the women who are the owners or executives of the surveyed enterprises give more importance to product innovation. Five of the six variables used to measure this technological innovation construct had scores above the mean product innovation score of Colombian small enterprises. Women focus more on developing or improving products or services with a 3.73 mean; they develop skills to transform existing products into new ones with a 3.42 mean; they work towards creating new products or services that lead competitors to imitate them with a 3.32 mean; they strive to launch products or services faster than the competition with a 3.08 mean, and their R&D is better than that of their competitors with a 2.93 mean. In turn, male executives' profit from developing new products or services with a 3.04 mean.

To test our research hypotheses, we analysed the structural model using the bootstrapping procedure with 5,000 subsamples (Hair *et al.*, 2017); as seen in Table 4, these outcomes evidence that the structural model has the explanatory capacity and predictive relevance because, in the original model, 49.3 per cent of product innovation can be explained by process innovation in Colombian small enterprises (R^2 = 0.493); in model 2, 60.7 per cent of product innovation can be explained by process innovation in Colombian small enterprises run by men (R^2 = 0.607); and, in model 3, 29.9 per cent of product innovation can be explained by process innovation in Colombian small enterprises run by women (R^2 = 0.299).

Table 4
Structural model results with PLS-SEM

Hypothesis	Path	Standardised coefficient β	t-value	p-value	R^2
H₁: Process innovation positively influences product innovation in Colombian small enterprises.	Process innovation → Product innovation	0.702***	8.797	0.000	0.493
H₂: Process innovation positively influences product innovation in Colombian small enterprises run by men.	Process innovation managed by men → Product innovation	0.779***	9.741	0.000	0.607
H₃: Process innovation positively influences product innovation in Colombian small enterprises run by women.	Process innovation managed by women → Product innovation	0.547***	3.228	0.000	0.299

*Note: Significance: *** = p<0.001; ** = p<0.05; Adjusted R2 values: >0.20 = Weak; >0.33 Moderate; >0.67 = Substantial (Chin, 1998, cited in Cuevas-Vargas et al., 2019, p. 9)*
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

We can infer from the results that product innovation (an endogenous construct in the three models) has explanatory power since the values of R^2 are above 0.2 (Chin, 1998; Hair et al., 2017), and so the model has a good level of quality. Thus, its results allow for business decision-making. Furthermore, the goodness of fit (GoF) test was estimated to assess the model fit (Wetzels et al., 2009) because the GoF is very useful for PLS-MGA when we need to compare PLS-SEM outcomes of different data sets for the same path model (Henseler and Sarstedt, 2013). The GoF index for PLS-SEM is assessed using the average of the AVE values obtained in the first stage of the

measurement model and the average R^2 value through the following equation GoF = $\sqrt{AVE * R^2}$. It is highlighted that according to Wetzels et al. (2009, p. 187), the critical values for measuring the GoF analysis results are: "GoF$_{small}$ (0.1); GoF$_{medium}$ (0.25); GoF$_{large}$ (0.36)". In this regard, our model showed a GoF value of 0.619, considered a very good (GoF$_{large}$) model fit (Wetzels et al., 2009). Additionally, the predictive power of the model was determined, and the standardised root mean square residual (SRMR) composite factor model was assessed with a value of 0.055, which is below the threshold value of 0.08, confirming that the structural model is significant (Hair et al., 2018).

Regarding the first hypothesis (H$_1$), the results in Table 4 (β = 0.702, p <0.001) indicate that process innovation has positive and significant effects on product innovation. Therefore, H$_1$ is supported since we found that process innovation has a 70.2 per cent impact on product innovation in Colombian small enterprises. As for H$_2$, the results indicate that process innovation managed by male executives has positive and significant effects on product innovation (β = 0.779, p <0.001). Thus, H$_2$ is supported because, when managed by men, process innovation has a significant (77.9 per cent) impact on process innovation in Colombian MSMEs. Concerning hypothesis H$_3$, the results indicate that process innovation managed by female executives has positive and significant effects on product innovation (β = 0.547, p <0.001). Thus, H$_3$ is supported, for we found that, when managed by women, process innovation has a 54.7 per cent impact on product innovation in Colombian MSMEs.

Multi-group analysis

According to Hair et al. (2018), a PLS-SEM multi-group analysis needs to be applied when the research aims to explore differences that can be explained by observable characteristics, as in our study is the case of gender. For this reason, assessing PLS-SEM multi-group analysis substantively improves the ability to identify significant differences in multiple relationships through groups. The multi-group analysis comprises the division of the sample according to the categorical variable (gender). Group 1 comprises male executives or owners (96 cases), and group 2 comprises female executives or owners (49 cases). Each group was estimated separately, and the results are presented in Table 5. In this sense, the effect of process innovation on product innovation is much stronger among male executives (p1$^{(1)}$ = 0.779) than female executives (p1$^{(2)}$ = 0.547), for this reason, it is important to note that disregarding heterogeneity may affect the underlying model (Hair et al., 2018; Sarstedt et al., 2009).

In this research, a multi-group comparison was undertaken, as suggested by Henseler and Fassott (2010). It is highlighted that this approach was used to verify the moderating role of executives' gender in the relationship between process and product innovation in small Colombian firms. However, before comparing path estimates across groups, metric invariance of the constructs measures must be ensured. Factor loadings for the same indicators must be invariant between the groups of female and male executives. This means that the effect of gender, in its moderating role, is restricted to the path coefficients of the structural model.

For this reason, it was necessary to perform the permutation-based method for PLS-MGA to the standardised factor loadings (Chin et al., 2010). The results show that only one of the 11 indicators presents significant differences between the groups (IP2, difference = 0.178, Permutation p-value = 0.018). Therefore, there is metric invariance.

Furthermore, to perform the multi-group analysis, Henseler et al. (2016) recommend first check and, consequently, confirming the stability of the invariance using the procedure of the measurement invariance of composite models (MICOM), following the three steps: (1) configurational invariance, (2) compositional invariance (see table

5), and (3) equality of composite mean values and variances (see Table 6). In this regard, the results presented in Tables 5 and 6 demonstrate that all conditions were met. Hence, full measurement invariance is established (Hair et al., 2018). First, according to configurational invariance, both groups (male and female) have equal indicators, handling of data, and algorithm settings; regarding the compositional invariance, when comparing original correlations between the composite values obtained from group 1 (male) and group 2 (female), the value of the original correlation was equal or greater than 5 per cent quantile of the empirical distribution of the correlations between the composite values of group 1 and group 2. Hence, the compositional invariance is established; finally, concerning the equal mean values and invariances, the results indicate that both the mean original difference lies between the bounds of the confidence interval, and the variance of the original differences lies between the confidence interval boundaries; therefore, full measurement invariance is confirmed (Hair et al., 2018; Henseler et al., 2016).

Table 5
Measurement invariance of composite models (MICOM) procedure (steps 1 and 2)

Construct	Configural Invariance	Compositional Invariance Assessment		
		Original Correlation	5.0%	Compositional Invariance
Process innovation	Established	1.000	0.999	Established
Product innovation	Established	0.999	0.999	Established

Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Table 6
Measurement invariance of composite models (MICOM) procedure (step 3)

	Full measurement model invariance assessment					
	Mean - Original Difference	Confidence interval	Equality of means	Variance - Original Difference	Confidence interval	Equality of variances
Process innov.	-0.030	[-0.343, 0.342]	Equal	0.223	[-0.423, 0.516]	Equal
Product innov.	-0.236	[-0.344, 0.348]	Equal	0.090	[-0.416, 0.477]	Equal

Note Results based on a two-tailed permutation test at a 5% confidence level [2.50%, 97.50%]; *Source:* Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

To identify whether there are significant differences between the groups, a multi-group analysis (Sarstedt et al., 2011) was carried out, using the nonparametric test of the PLS-MGA approach that builds on bootstrapping results of each data group (Henseler et al., 2009). However, upon assessing the model through PLS-MGA, with 5,000 subsamples, we found no statistically significant differences in the gender of executives regarding technological innovation management in Colombian small enterprises, as seen in Table 7. According to Sarstedt et al. (2011), a result is significant with a five percent error probability if the p-value is below 0.05 or above 0.95. In this study, we obtained (β = 0.232, p = 0.102) difference. Therefore, there is no statistically significant difference in technological innovation management based on the gender of executives in Colombian small enterprises.

Table 7
Multigroup analysis with PLS-SEM

Path Relation	Path Coefficient Male Group	Path Coefficient Female Group	Path Coefficient Difference	*p-value* Male vs Female
Process innovation → Product innovation	0.779***	0.547***	0.232 N.S.	0.102

*Note: Significance: *** p<0.001; **p<0.05; N.S.= Non-significant*
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

Lastly, to better compare the group-specific results of a PLS-SEM-based multi-group analysis, as suggested by Hair et al. (2017, p. 280), we used the importance-performance map analysis (IPMA) (Hair et al., 2018; Höck et al., 2010; Rigdon et al., 2011), upon carrying out the importance-performance map analysis we found that product innovation had a 52.1 performance and process innovation had a 60.6 performance with a 0.67 importance—as shown in Table 8. This means that for each point that process innovation performance increases, product innovation performance increases by 0.699. That is to say, if Colombian MSMEs improve their process innovation performance from 60.55 to 61.55, then product innovation will improve from 52.12 to 52.79.

Table 8
An importance-performance analysis of exogenous variables on product innovation

Samples	Total N=145			Male Executive N=96			Female Executive N=49		
Value of product innovation performance	**52.1**			**49.8**			**57.2**		
Exogenous variables	Prf.	Imp.	Pred.	Prf.	Imp.	Pred.	Prf.	Imp.	Pred.
(Latent) process innovation	60.6	.67	52.8	60.4	.72	50.6	60.9	.55	57.7
Different operations procedures	67.9	.11	52.2	68.2	.13	49.9	67.3	.07	57.3
Acquisition of new skills or equipment	67.4	.13	52.2	66.7	.14	49.9	68.8	.11	57.3
Development of manufacturing or operations processes	54.3	.14	52.2	54.4	.15	49.9	54.0	.12	57.3
Flexible for developing products	67.0	.12	52.2	64.2	.13	49.9	68.8	.101	57.3
Processes lead to imitation from competitors	50.2	.16	52.2	50.0	.17	50.0	50.5	.13	57.3

Note: Prf. = Performance of exogenous variables; Imp. = Importance of exogenous variables represented by the value of non-typified Beta; Pred. = Prediction for product innovation performance (endogenous variable).
Source: Authors' work based on results obtained with Smart PLS 3. Ringle et al. (2015)

When comparing product innovation performance according to the gender of executives, we found that product innovation managed by female executives had a better performance than when managed by male executives (57.2 vs 49.8, respectively). Nevertheless, the importance of process innovation is greater when managed by men than when managed by women (0.72 vs 0.55). Hence, for each point that process innovation performance increases, product innovation will improve according to the importance value.

Likewise, we determined the importance and the performance of each manifest variable we used to measure process innovation. According to the interpretations of owners or managers, the most important and best-performing variables in product innovation in Colombian MSMEs are the different operations procedures and the development of manufacturing or operations processes when managed by male

executives; moreover, it is noticeable that process innovation is more important when managed by male executives, which means that for each point that the manifest variables used to measure process innovation increase, there will be a higher performance increase or improvement in terms of product innovation. Therefore, executives in Colombian MSMEs need to continue strengthening these variables since every performance increase in any of these indicators (manifest variables) will increase product innovation importance for the value that corresponds to the improved indicator.

Discussion

Regarding the influence of process innovation on product innovation, findings obtained using PLS-SEM show sufficient empirical evidence to demonstrate the significant influence of the process on product innovation in Colombian MSMEs. This is in line with Expósito et al. (2021), who found complementarities among process, product, and organisational innovations. In addition, they investigate the role of gender on the CEO's decision to introduce product, process and organisational innovations concurrently. Moreover, our results confirm Oke's (2007) findings, namely that British service enterprises must develop new processes that guarantee success to attain incremental product or service innovations. Likewise, our results confirm what Li et al. (2007) found in Chinese enterprises: that process innovation is linked to product innovation. They also match results obtained by Gunday et al. (2011) in Turkey, Ul Hassan et al. (2013) in Pakistan, Camisón et al. (2014), and Expósito et al. (2021) in Spain, and since all these studies concluded that innovation in the process has a strong significant influence on product innovation.

As for the influence of process innovation on product innovation when managed by male executives, our findings confirm that gender has a positive influence on product and process innovation, as shown too by Expósito et al. (2021) from a survey on the topic of competitiveness of Spanish SMEs and Ruiz-Jiménez et al. (2016) in their study with technological SMEs in Spain; our findings also match those of Olson et al. (2003), since male enterprise owners tend to have a better business performance than women when it comes to implementing financial measures to innovate. They ratify the positive relationship among process innovation, product innovation, and the capacities of the individuals that manage them. Male executives possess characteristics that orient them towards swifter decision-making than women (Díaz-García et al., 2013; Expósito et al., 2021). In the same vein, Mendonça et al. (2020) results show that females are less likely to innovate and to decide on more technology-oriented fields of study (Zhang et al., 2021).

Lastly, concerning the influence of process innovation on product innovation when managed by female executives, our results match those of Vafaei et al. (2021). Their findings show that gender diversity and innovation measures are positively and significantly related to patents and R&D in the high-tech sector. Idris (2009) found that even though female executives tend to innovate more in the organisational sphere when they are independent of men, they also undertake technological innovations. Moreover, female executives can attain better knowledge management for innovating, as Torchia et al. (2011) shows. Unfortunately, limited access to the financial system becomes an obstacle to creating their firm and inhibits their participation in entrepreneurial activities (Lechman et al., 2020). Our findings also match those of Olson et al. (2003) since male enterprise owners tend to have a better business performance than women when implementing innovative financial measures. Likewise, higher representation of women on boards feel less need to innovate; for this reason, the gender issue is regularly presented as a problem of women's

underperformance because female executives are seen as less innovative than male executives but do not find contradictory evidence (Alsos et al., 2013, p. 248).

Given the impact of this gender gap, it is necessary to design strategies that encourage women to engage in innovation practice (Mendonça et al., 2020), such as risk-taking, self-confidence, greater educational level, proactivity, and R&D cooperative behaviour (Expósito et al., 2021).

In this regard, our findings are an important contribution to the study of the role of gender in technological innovation. On the one hand, the outcomes reveal that small Colombian firms with greater process innovation have better product innovation, which will be reflected in their business performance. On the other hand, technological innovation is higher in firms led by men, and however, companies led by women demonstrated to have better product innovation performance. Hence, the promotion of entrepreneurial orientation among women in which proactivity, innovativeness and risk-taking are favoured will increase the success of their firms in financial results; moreover, overcoming some gender barriers was associated with lower performance when compared with male-owned enterprises (Criado-Gomis et al., 2020).

From the gender perspective, the fostering and involvement of females in management positions, seen as an opportunity for organisations to improve their innovation activities, particularly technological innovation, can be framed within policies for women's economic empowerment. In addition, it is suggested that these actions be included to achieve the effective and equal participation of women in leadership in all spheres, such as political, social, economic, academic, and business, as Criado-Gomis et al. (2020) mention. These initiatives currently result in governmental objectives, such as the gender-related goal 5.5 of the 2030 Agenda for Sustainable Development (United Nations, 2015).

Conclusion

This empirical study involved an in-depth analysis of the relationship between process innovation and product innovation using the gender of executives as a moderator in the context of Colombian MSMEs. The literature we used comprises studies specifically focused on product innovation and process innovation—for example, Ruiz-Jiménez et al. (2016) confirmed that gender positively influences product and process innovation in this kind of firm. We also reviewed works like Expósito et al. (2021), Foss et al. (2013), and Olson et al. (2003), who explains that both males and female can innovate in diverse innovation spheres. However, they show differences in business performance.

On the other hand, the application of a methodology to prove the theoretical model through the validation of constructs by confirmatory factor analysis (CFA) and hypothesis-testing through PLS-SEM, and with partial least squares multi-group analysis (PLS-MGA) to identify whether the differences between the groups are statistically significant. Moreover, the importance-performance matrix analysis (IPMA) allowed us to provide empirical evidence for the importance and performance of variables used to measure process innovation's effect on product innovation. We found that process innovation is higher in Colombian enterprises—and when male executives manage it, it positively and significantly affects product innovation.

Nevertheless, the outcomes indicate that process innovation managed by female executives positively and significantly affects product innovation. The surveyed enterprises run by women give more importance to process innovation. That is to say, they focus more on developing new or improved products/services, are more capable of transforming existing products into new ones, and strive to acquire new skills or equipment to develop products and processes. In turn, enterprises run by men

obtain higher profits from the development of new products/services. Still, we found no significant differences in the gender of executives when it comes to technological innovation management in Colombian small enterprises.

The outcomes may be explained by the fact that the presence of females in enterprises seeking technological innovations is not as big as that of men. According to data from the Women, Science, and Innovation Observatory (2020), women comprise half of the employed population with higher education and half of the employed population that work jobs defined by the OECD as belonging to science and technology (technical, professional, scientific, and intellectual). Nevertheless, female representation in the population directly employed in high and medium-high technology business sectors drops to 26 per cent for general staff and 31 per cent for workers that participate directly in R&D activities.

The main conclusion, therefore, is not that women innovate less but that their participation in enterprises that promote technological innovation is smaller when compared to that of men. This is due to cultural stereotypes, fear of failure, and lack of trust in their potential in the high-technology sector and senior leadership. Thus, senior leaders need to integrate more women, allowing for greater diversification in innovation.

As for its limitations, this research has a low number of respondents, which restricts the generalisation of results. A larger population comprising other regions could help expand our findings in a promising set of new studies. Another limitation is that this is a cross-sectional study—the data was gathered in a single moment. We recommend that future research projects engage in longitudinal studies to identify the relation between process innovation and product innovation using the gender of executives and their level of professionalisation as the moderating variable over time.

Furthermore, this study only contemplated MSMEs from Bogota, leaving aside bigger enterprises and those from other Colombian regions. Thus, we recommend that future studies consider enterprises from other regions and different sizes to assess whether enterprise size and location impact the studied relationships.

Finally, we recommend that future research assess how knowledge management and open innovation management affect technological innovation in these kinds of organisations when they are run by female executives—to contribute to the scientific literature on gender studies.

References

1. Alsos, G. A., Ljunggren, E., Hytti, U. (2013), "Gender and innovation: state of the art and a research agenda", International Journal of Gender and Entrepreneurship, Vol. 5 No. 3, pp. 236-256.
2. Arun, T. M., Joseph, R. P., Akram, M. (2020), "Entrepreneur's gender and firm innovation breadth: An institution-based view of SMEs in an emerging market context", International Journal of Innovation Management, Vol. 24 No. 7, pp. 1-31.
3. Attah-Boakye, R., Adams, K., Kimani, D., Ullah, S. (2020), "The impact of board gender diversity and national culture on corporate innovation: A multi-country analysis of multinational corporations operating in emerging economies", Technological Forecasting and Social Change, Vol. 161.
4. Berger, L., Benschop, Y., van den Brink, M. (2015), "Practising Gender When Networking: The Case of University – Industry Innovation Projects", Gender, Work and Organization, Vol. 22 No. 6, pp. 556-578.
5. Bogotá Chamber of Commerce (2018), "Bases de datos e información empresarial", Cámara de Comercio de Bogotá, available at https://www.ccb.org.co/Fortalezca-su-empresa/Temas-destacados/Bases-de-datos-e-informacion-empresarial (15 August 2022)

6. Camisón, C., Villar-López, A. (2014), "Organisational innovation as an enabler of technological innovation capabilities and fi rm performance", Journal of Business Research, Vol. 67 No. 1, pp. 2891-2902.
7. Charlo Molina, M. J., Núñez Torrado, M. (2012), "La mujer directiva en la gran empresa española: perfil, competencias y estilos de dirección", Estudios Gerenciales, Vol. 28 No. 124, pp. 87-105.
8. Chin, W. W. (1998), "The partial least squares approach to structural equation modeling", in Marcoulides, G. A. (Ed.), Modern Methods for Business Research, Mahwah, Lawrence Erlbaum Associates Publishers, pp. 295-358.
9. Chin, W. W., Dibbern, J. (2010), "An Introduction to a Permutation Based Procedure for Multi-Group PLS Analysis: Results of Tests of Differences on Simulated Data and a Cross Cultural Analysis of the Sourcing of Information System Services Between Germany and the USA", in Esposito Vinzi, V., Chin, W. W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares, Springer-Verlag Berlin Heidelberg, pp. 171-193.
10. Christensen, C. M. (1999), "Innovation and the General Manager", Boston, Irwin/McGraw-Hill.
11. Clark, L. A., Watson, D. (1995), "Constructing validity: Basic issues in objective scale development.", Psychological Assessment, American Psychological Association, Vol. 7 No. 3, pp. 309-319.
12. Criado-Gomis, A., Iniesta-Bonillo, M. A., Cervera-taulet, A., Ribeiro-Soriano, D. (2020), "Women as Key Agents in Sustainable Entrepreneurship: A Gender Multigroup Analysis of the SEO-Performance Relationship", Sustainability, Vol. 12 No. 3, p. 1-17.
13. Cronbach, L. J. (1951), "Coefficient alpha and the internal structure of tests", Psychometrika, Vol. 16 No. 3, pp. 297-334.
14. Cuevas-Vargas, H. (2016), "La Influencia de La Innovación y La Tecnología En La Competitividad de Las Pymes Manufactureras Del Estado de Aguascalientes", Universidad Autónoma de Aguascalientes, available at https://bit.ly/3r8qiDW (15 August 2022)
15. Cuevas-Vargas, H., Aguirre, J., Parga-Montoya, N. (2022), "Impact of ICT adoption on absorptive capacity and open innovation for greater firm performance. The mediating role of ACAP", Journal of Business Research, Vol. 140 No. February 2022, pp. 11-24.
16. Cuevas-Vargas, H., Fernandez-Escobedo, R., Cortes-Palacios, H. A., Ramirez-Lemus, L. (2021), "The Relation Between Adoption of Information and Communication Technologies and Marketing Innovation as a Key Strategy to Improve Business Performance", Journal of Competitiveness, Vol. 13 No. 2, pp. 23-40.
17. Cuevas-Vargas, H., Parga-Montoya, N., Fernández-Escobedo, R. (2019), "Effects of Entrepreneurial Orientation on Business Performance: The Mediating Role of Customer Satisfaction - A Formative - Reflective Model Analysis", SAGE Open, Vol. 9 No. 2, pp. 1-14.
18. Damanpour, F., Gopalakrishnan, R. (2001), "The dynamics of the adoption of product and process innovations in organisations", Journal of Management Studies, Vol. 38 No. 1, pp. 45-65.
19. Danilda, I., Thorslund, J. G. (2011), "Innovation & Gender", Vinnova.
20. Díaz-García, C., González-Moreno, A., Sáez-Martínez, F. J. (2013), "Gender diversity within R&D teams: Its impact on radicalness of innovation", Innovation: Management, Policy and Practice, Vol. 15 No. 2, pp. 149-160.
21. Dwivedi, R., Karim, F. J., Starešinić, B. (2021), "Critical Success Factors of New Product Development: Evidence from Select Cases", Business Systems Research, Vol. 12 No. 1, pp. 34-44.
22. Expósito, A., Sanchis-Llopis, A., Sanchis-Llopis, J. A. (2021), "CEO gender and SMEs innovativeness: evidence for Spanish businesses", International Entrepreneurship and Management Journal, International Entrepreneurship and Management Journal, pp. 1-38.
23. Fagerberg, J., Mowery, D. C., Nelson, R. R. (2005), "The Orford Handbook of Innovation", New York, Oxford University Press.
24. Fornell, C., Larcker, D. F. (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", Journal of Marketing Research, Vol. 18 No. 1, pp. 39-50.

25. Foss, L., Woll, K., Moilanen, M. (2013), "Creativity and implementations of new ideas Do organisational structure , work", International Journal of Gender and Entrepreneurship, Vol. 5 No. 3, pp. 298-322.
26. Gunday, G., Ulusoy, G., Kilic, K., Alpkan, L. (2011), "Effects of innovation types on firm performance", International Journal of Production Economics, Vol. 133 No. 2, pp. 662-676.
27. Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M. (2017), "A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)", 2nd ed., Thousand Oaks, SAGE Publications.
28. Hair, J. F., Sarstedt, M., Ringle, C. M., Gudergan, S. P. (2018), "Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM)", Thousand Oaks, SAGE Publications.
29. Hair, J. F., Sarstedt, M., Ringle, C. M., Mena, J. A. (2012), "An assessment of the use of partial least squares structural equation modeling in marketing research", Journal of the Academy of Marketing Science, Vol. 40 No. 3, pp. 414-433.
30. Hambrick, D. C., Mason, P. A., Mason, P. A. (2013), "Upper Echelons: The organisation as a reflection of its top managers", The Academy of Management Review, Vol. 9 No. 2, pp. 193-206.
31. Henseler, J., Fassott, G. (2010), "Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures", in Esposito Vinzi, V., Chin, W. W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares, Springer-Verlag Berlin Heidelberg, pp. 713-735.
32. Henseler, J., Ringle, C. M., Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", Journal of the Academy of Marketing Science, Vol. 43 No. 1, pp. 115-135.
33. Henseler, J., Ringle, C. M., Sarstedt, M. (2016), "Testing measurement invariance of composites using partial least squares", International Marketing Review, Vol. 33 No. 3, pp. 405-431.
34. Henseler, J., Ringle, C. M., Sinkovics, R. R. (2009), "The use of partial least squares path modeling in international marketing", Advances in International Marketing, Vol. 20 No. 2009, pp. 277-319.
35. Henseler, J., Sarstedt, M. (2013), "Goodness-of-fit indices for partial least squares path modeling", Computational Statistics, Vol. 28, pp. 565-580.
36. Höck, C., Ringle, C. M., Sarstedt, M. (2010), "Management of multi-purpose stadiums: importance and performance measurement of service interfaces", International Journal of Services Technology and Management, Vol. 14 No. 2/3, pp. 188-207.
37. Huse, M., Solberg, A. G. (2006), "Gender-related boardroom dynamics. How Scandinavian women make and can make contributions on corporate boards", Women in Management Review, Vol. 21 No. 2, pp. 113-130.
38. Idris, A. (2009), "Management styles and innovation in women-owned enterprises", African Journal of Business Management, Vol. 3 No. 9, pp. 416-425.
39. Khazanchi, S., Lewis, M. W., Boyer, K. K. (2007), "Innovation-supportive culture: The impact of organisational values on process innovation", Journal of Operations Management, Vol. 25, pp. 871-884.
40. Kline, R. B. (2011), "Principles and Practice of Structural Equation Modeling", New York, Guilford publications.
41. Lechman, E., Popowska, M. (2020), "Enhancing women's engagement in economic activities through information and communication technology deployment: evidence from Central – Eastern European countries", Gender, Technology and Development, Routledge, Vol. 24 No. 3, pp. 314-340.
42. Li, Y., Liu, Y., Ren, F. (2007), "Product innovation and process innovation in SOEs: evidence from the Chinese transition", The Journal of Technology Transfer, Vol. 32 No. 1, pp. 63-85.
43. Liao, S. H., Fei, W. C., Chen, C. C. (2007), "Knowledge sharing, absorptive capacity, and innovation capability: An empirical study of Taiwan's knowledge-intensive industries", Journal of Information Science, Vol. 33 No. 3, pp. 340-359.
44. Manolova, T. S., Carter, N. M., Manev, I. M., Gyoshev, B. S. (2007), "The differential effect of men and women entrepreneurs' human capital and networking on growth expectancies in Bulgaria", Enterpreneurship Theory and Practice, Vol. 31 No. 3, pp. 407- 426.
45. Mendonça, J., Reis, A. (2020), "Exploring the mechanisms of gender effects in user innovation", Technological Forecasting and Social Change, Vol. 155.

46. Na, K., Shin, K. (2019), "The Gender Effect on a Firm's Innovative Activities in the Emerging Economies", Sustainability, Vol. 11, pp. 1-24.
47. Nunnally, J. C., Bernstein, I. H. (1994), "Psychometric Theory", New York, McGraw-Hill.
48. Oke, A. (2007), "Innovation types and innovation management practices in service companies", International Journal of Operations & Production Management, Vol. 27 No. 6, pp. 564-587.
49. Olson, P. D., Zuiker, V. S., Danes, S. M., Stafford, K., Heck, R. K. Z., Duncan, K. A. (2003), "The impact of the family and the business on family business sustainability", Journal of Business Venturing, Vol. 18, pp. 639-666.
50. Østergaard, C. R., Timmermans, B., Kristinsson, K. (2011), "Does a different view create something new? The effect of employee diversity on innovation", Research Policy, Vol. 40, pp. 500-509.
51. Ranga, M., Etzkowitz, H. (2010), "Athena in the World of Techne: The Gender Dimension of Technology , Innovation and Entrepreneurship", Journal of Technology Management and Innovation, Vol. 5 No. 1, pp. 1-12.
52. Rigdon, E. E., Ringle, C. M., Sarstedt, M., Gudergan, S. P. (2011), "Assessing Heterogeneity in Customer Satisfaction Studies: Across Industry Similarities and within Industry Differences", in Sarstedt, M., Schwaiger, M., Taylor, C. R. (Eds.), Advances in International Marketing, Vol. 22, Emerald Group Publishing, pp. 169-194.
53. Ringle, C. M., Wende, S., Becker, J.-M. (2015), "SmartPLS 3", SmartPLS GmbH, Boenningstedt.
54. Robledo, J. V., López, C. G., Zapata, W. L., Pérez, J. D. V. (2010), "Desarrollo de una Metodología de Evaluación de Capacidades de Innovación", Perfil de Coyuntura Económica, No. 15, pp. 133-148.
55. Rothschild, J. (1983), "Machina Ex Dea: Feminist Perspectives on Technology", New York, Pergamon.
56. Ruiz-Jiménez, J. M., Fuentes-Fuentes, M. M. (2016), "Management capabilities, innovation, and gender diversity in the top management team: An empirical analysis in technology-based SMEs", BRQ Business Research Quarterly, ACEDE, Vol. 19 No. 2, pp. 107-121.
57. Sarstedt, M., Henseler, J., Ringle, C. M. (2011), "Multigroup analysis in partial least squares (PLS) path modeling: Alternative methods and empirical results", Advances in International Marketing, Vol. 22, pp. 195-218.
58. Sarstedt, M., Schwaiger, M., Ringle, C. M. (2009), "Do We Fully Understand the Critical Success Factors of Customer Satisfaction with Industrial Goods ? - Extending Festge and Schwaiger' s Model to Account for Unobserved Heterogeneity", Journal of Business Market Management, Vol. 3, pp. 185-206.
59. Selvarajan, T. T., Slattery, J., Stringer, D. Y. (2015), "Relationship between gender and work related attitudes: a study of temporary agency employees", Journal of Business Research, Vol. 68 No. 9, pp. 1919-1927.
60. Teruel, M., Segarra-Blasco, A. (2017), "The Link between Gender Diversity and Innovation: What is the Role of Firm Size?", International Review of Entrepreneurship, Vol. 15 No. 3, pp. 319-340.
61. Torchia, M., Calabro, A., Huse, M. (2011), "Women Directors on Corporate Boards: From Tokenism to Critical Mass", Journal of Business Ethics, Vol. 102, pp. 299-317.
62. Ul Hassan, M., Shaukat, S., Nawaz, M. S., Naz, S. (2013), "Effects of innovation types on firm performance: an empirical study on Pakistan's manufacturing sector", Pakistan Journal of Commerce and Social Sciences, Vol. 7 No. 2, pp. 243-262.
63. United Nations (2015), "THE 17 GOALS | Sustainable Development", Sustainable Development Goals, available at https://sdgs.un.org/goals (30 November 2021)
64. Vafaei, A., Henry, D., Ahmed, K., Alipour, M. (2021), "Board diversity: female director participation and corporate innovation", International Journal of Accounting and Information Management, Vol. 29 No. 2, pp. 247-279.
65. Van der Vegt, G. S., Janssen, O. (2003), "Joint Impact of Interdependence and Group Diversity on Innovation", Journal of Management, Vol. 29 No. 5, pp. 729-751.
66. Verspagen, B. (2009), "Innovation and economic growth", The Oxford Handbook of Innovation, New York, Oxford University Press.

67. Wetzels, M., Odekerken-Schröder, G., van Oppen, C. (2009), "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration", MIS Quarterly, Vol. 33 No. 1, pp. 177-195.
68. Woodman, R. W., Sawyer, J. E., Griffin, R. W. (1993), "Toward a Theory of Organizational Creativity", Academy of Management Review, Vol. 18 No. 2, pp. 293-321.
69. Wu, Q., Dbouk, W., Hasan, I., Kobeissi, N., Zheng, L. (2021), "Does gender affect innovation? Evidence from female chief technology officers", Research Policy, Vol. 50 No. 9.
70. Zastempowski, M., Cyfert, S. (2021), "Impact of entrepreneur's gender on innovation activities. The perspective of small businesses", PLoS ONE, Vol. 16 No. 10, pp. 1-24.
71. Zhang, Y., Gros, T., Mao, E. (2021), "Gender Disparity in Students' Choices of Information Technology Majors", Business Systems Research, Vol. 12 No. 1, pp. 80-95.
72. Zouaghi, F., Garcia-Marco, T., Martinez, M. G. (2020), "The link between R&D team diversity and innovative performance: A mediated moderation model", Technological Forecasting and Social Change, Vol. 161.

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Categorisation of Open Government Data Literature

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Abstract

Background: Due to the emerging global interest in Open Government Data, research papers on various topics in this area have increased. **Objectives:** This paper aims to categorise Open government data research. **Methods/Approach:** A literature review was conducted to provide a complete overview and classification of open government data research. Hierarchical clustering, a cluster analysis method, was used, and a hierarchy of clusters on selected data sets emerged. **Results:** The results of this study suggest that there are two distinct clusters of research, which either focus on government perspectives and policies on OGD, initiatives, and portals or focus on regional studies, adoption of OGD, platforms, and barriers to implementation. Further findings suggest that research gaps could be segmented into many thematic areas, focusing on success factors, best practices, the impact of open government data, barriers/challenges in implementing open government data, etc. **Conclusions:** The extension of the paper, which was first presented at the Entrenova conference, provides a comprehensive overview of research to date on the implementation of OGD and points out that this topic has already received research attention, which focuses on specific segments of the phenomenon and signifies in which direction new research should be made.

Introduction

Organisations must adapt to the environment in which they do business. Organisational development, an activity that utilises research findings further to improve organisations' functioning (Buchanan, 1972), has existed in the organisational ecosystem for quite some time. Therefore, researching organisational changes and development has offered different explanations, research studies and theoretical models. From the point of understanding organisational changes as described by Lewin's three-stage model of changes (Lewin, 1947), establishing change process theories (Van De Ven et al., 1995), improving them with Peters and Watermans' Culture-Excellence approach (1982) or furthermore, applying another dimension of inter-relatedness of individuals in the organisation by Pettigrew (1973). Although different models may not explain every real-world situation, they provide the grounds for designing, planning, and implementing changes (Maxwell et al., 2015). Several authors improved theories and models in the past years to adapt them to the new business environment. Relying on the four change process theories by Van De Ven et al. (1995), authors (Crossan et al., 2009; Weick et al., 1999; Tsoukas et al., 2002) provided another dimension of taking the macroscopic and microscopic level of analysis into account, making microscopic changes to seem less routined and much more agile to changes. Another observation by Weick et al. (1999) states that organisations tend to have small groups of people open to innovations, thus making them the main drivers for adjusting to the always-changing business environment. The latter is also supported by Damanpours et al. (2008) research on the importance of personal characteristics in adopting innovation in public organisations. The challenge of accepting continuous change throughout an organisation to benefit more generally remains.

A generalisation of different theories or models on both private and public sector, routine and bureaucracy seem to be linked to public organisations much more often, making a general belief that public and private management are fundamentally dissimilar (Boyne, 2002). Nevertheless, Boyne's (2002) findings indicate that despite several differences, such as human resource practices, ethical issues and decision processes, there is no support to prove that both managements are different. As private organisations tend to provide services or products to consumers, local governments are very important in delivering services to the public (Walker et al., 2013). Since local governments provide public services on which citizens rely, they need to be open to innovation and organisational changes, likely to continue to some extent (Elliot, 2020). The government sector must ensure the effectiveness of new technological tools, such as e-government, because it requires support and trust from the citizens, who have to be reassured of their financial input - taxes (Nam, 2012) and can, by innovating, contribute to effectiveness in the production of services which increases business performance quality (Marčeta et al., 2020).

Since this paper aims to examine and classify current research on Open Government Data (OGD) in the public sector based on a literature review, we should first examine practices of relatively similar yet strongly related research fields; e-government. E-government can be defined as a construct that uses information technology (IT) to improve communication between governments and other actors (Sprecher, 2000). Because e-government was established after the private sector adopted e-business and e-commerce (Moon, 2002), this pattern is expected to be followed in data gathering and sharing. West's (2004) research on e-government development shows four primary stages of transformation: the billboard stage, the partial-service-delivery stage, the portal stage and interactive democracy with public outreach. We could assume that today's open government data development stage

is in the third or the portal stage of transformation since there are many different OGD portals worldwide without being used in a broader context (Lourenço, 2015). In their research, Tolbert et al. (2006) found out that with the frequency of e-government services, usage does not correlate with the enjoyment of greater trust among citizens on a federal government level. This gap could be filled by opening government data to the broader public since it represents the considerable potential for improvement and transparency, thus making it substantial for e-government services (Bertot et al., 2014). Nevertheless, we should not perceive those two terms as equal since the main difference is that open government is represented as one of the main parts of e-government, differentiating with its ultimate goals and promises in politically based agenda (Kassen, 2013; Harrison et al., 2011).

The problem addressed in this paper is that OGD has received a lot of research attention in the past ten years since open data is a prerequisite for companies and public administration to innovate (Jetzek et al., 2013; Vetrò et al., 2016; Welle Donker et al., 2017) successfully. Nevertheless, the research has been widely fragmented into many different areas. There is no extensive summary of the current state of research, future research recommendations, and categorisation of research, which could lead to new ideas and knowledge discovery in this field. For this purpose, we conducted a systematic review of the literature to determine what authors were focusing on, the latest research gaps and in what areas of interest we can classify current research on OGD.

Methodology

In this section, the review scope and selection of papers are presented. We used a Systematic literature review (SLR), the primary purpose of which is to either identify gaps in current research or to point out possible future research areas (Kitchenham, 2004; Webster et al., 2002). Webster et al. (2002) described that reviewing existing literature is essential for further academic research and knowledge advancement. To examine the current state of research, we created a meta-review or overview of existing literature reviews on OGD implementation and categorised and examined their findings. The papers included were peer-reviewed conference and journal articles from Scopus and Web of Science databases. Our search targets were existing literature reviews in open data implementation using "open government data" AND "literature review" in the article title, abstract, and keywords.

Since investigating the implementation of OGD manifests in many different forms of research, our primary criteria for selecting the papers were:

1. We only included existing literature reviews on OGD implementation.
2. Literature reviews were done on at least 25 referencing articles.
3. Each literature review had to examine OGD implementation on either international or country level, and their objective either had to: (i) Examine the implementation of OGD; (ii) Analyse the dissemination of OGD and (iii) Compare and break down OGD initiatives, their policy-making, along with barriers and their adoption.

Examination of the papers showed that the topic "OGD implementation" can be found under the following phrases: OGD initiatives, barriers or challenges of OGD, use of OGD, dimensions of OGD, adoption of OGD, barriers of OGD, OGD policy, development of OGD, conditions of OGD implementation, OGD perspectives, OGD initiatives, OGD ecosystems, and OGD dissemination.

Twenty-two initial papers for this literature review are presented in Table 1, where each article is defined by its author, year of publishing and corresponding title.

Table 1
Selected previous research.

Nr.	Author	Year	Title	Cluster
1	Ali Hassan, M. & Twinomurinzi, H.	2018	A Systematic Literature Review of Open Government Data Research: Challenges, Opportunities and Gaps	B
2	Attard, J., Orlandi, F., Scerri, S. & Auer, S.	2015	A Systematic Review of Open Government Data Initiatives	A
3	Chatfield, A., Reddick, C. & Al-Zubaidi, W.	2015	Capability Challenges in Transforming Government through Open and Big Data: Tales of Two Cities	A
4	Crusoe J. & Melin, U.	2018	Investigating Open Government Data Barriers: A Literature Review and Conceptualization	B
5	Csáki, C. & Kő, A.	2018	Open Data Research Challenges in the EU	A
6	De Oliveira, E. F. & Silveira, M. S.	2018	Open Government Data in Brazil: A Systematic Review of its Uses and Issues	A
7	Gil-Garcia, J., Gasco, M. & Pardo, T.	2020	Beyond Transparency, Participation, and Collaboration? A Reflection on the Dimensions of Open Government	A
8	Haini, S., Rahim, N. &	2019	Adoption of Open Government Data in Local Government Context: Conceptual Model Development	A
9	Hossain, M., Dwivedi, Y. & Rana, N.	2015	State-of-the-art in Open Data Research: Insights from Existing Literature and a Research Agenda	A
10	Huang, R., Lai, T. & Zhou, L.	2017	Proposing a Framework of Barriers to Opening Government Data in China: A Critical Literature Review	B
11	Ingrams, A.	2016	An Analytic Framework for Open Government Policy Design Processes	A
12	Kalampokis, E., Tambouris, E. & Tarabanis, K.	2011	A Classification Scheme for Open Government Data: Towards Linking Decentralised Data	B
13	Katbi, A.-K. & Al-Ammary, J.	2019	Open Government Data in the Kingdom of Bahrain: Towards an Effective Implementation Framework	B
14	Nugroho, R, Zuiderwijk, A. Janssen, M. & de Jong, M.	2015	A Comparison of National Open Data Policies: Lessons Learned	A
15	Roa, H., Loza-Aguirre, E. & Flores, P.	2019	A Survey on the Problems Affecting the Development of Open Government Data Initiatives	A
16	Safarov, I., Meijer, A. & Grimmelikhuijsen, S.	2017	The utilisation of Open Government Data: A Systematic Literature Review of Types, Conditions, Effects and Users	B
17	Saxena, S.	2018	Summarising the Decadal Literature in Open Government Data (OGD) Research: A Systematic Review	B
18	Susha, I., Johannesson, P. & Juell-Skielse, G.	2016	Open Data Research in the Nordic Region: Towards a Scandinavian Approach?	A
19	Wirtz, B., Piehler, R., Thomas, M. & Daiser, P.	2015	Resistance of Public Personnel to Open Government: A Cognitive Theory View of	A

			Implementation Barriers Towards Open Government Data	
20	Yuan, Q.	2019	Co-production of Public Service and Information Technology: A Literature Review	**A**
21	Zuiderwijk, A. & Hinnant, C.	2019	Open Data Policy-making: A Review of the State-of-the-art and an Emerging Research Agenda	**A**
22	Zuiderwijk, A., Janssen, M. & Davis, C.	2014	Innovation with Open Data: Essential Elements of Open Data Ecosystems	**A**

Source: Own

Since selected papers are different in geographical outreach, year of publication and approach to researching OGD initiatives, we seek to find out how existing literature reviews are similar or how they differ from one another. We performed hierarchical clustering on our corpus to determine which papers are similar. We used an open-sourced framework called Orange that is component-based and suitable for machine learning and data mining operations (Demšar et al., 2004). The hierarchical clustering results are presented in the last column of Table 1, which indicates the cluster in which each article was classified.

To perform hierarchical clustering in Orange, we had to preprocess our data. Since Orange can accept many different file formats as input, we decided to prepare our data in Tab-separated values (.tab). Preparing such a file was to export every research paper from the original PDF to plain text and then copy its content to a plain text editor and structure the features with a tabulator. We prepared four features; title, abstract, references and article content. Content that we copied from the selected articles did not include headers of the publication and other formal data such as copyrights, correspondence addresses and organisations. We also did not include any graphical material in our corpus due to the inability to transform it into plain text. We also decided to cluster abstracts rather than the content since abstracts provide a more precise definition of an article's research scope.

Another step in preprocessing the data was eliminating all the stop words using the Preprocess Text widget in Orange. Removing stop words is an often-used procedure to reduce the noise of textual data by using pre-compiled lists of stop words such as "in", "and" "the", etc. (Saif et al., 2014). To group the data and display it accordingly, we also need to measure the elements and their relative distances, which helps us decide which elements belong to a specific group (Murtagh et al., 2011). The computation can be performed with similarity/dissimilarity measurement or a more complex distance metric. Since one of our limitations is the distances provided in Orange, we used the metric recommended in the literature. The cosine metric was applied to our corpus since it is one of the most used and well-resulting distance measures in text classification problems (Al-Anzi et al., 2017; Lin et al., 2014). We used Ward linkage for cluster distance.

The result of the hierarchical clustering process is presented with a dendrogram in Figure 1, where we can distinguish between two clusters of research papers (cluster A (blue) and cluster B (red)).

Figure 1
Initial clusters of research papers
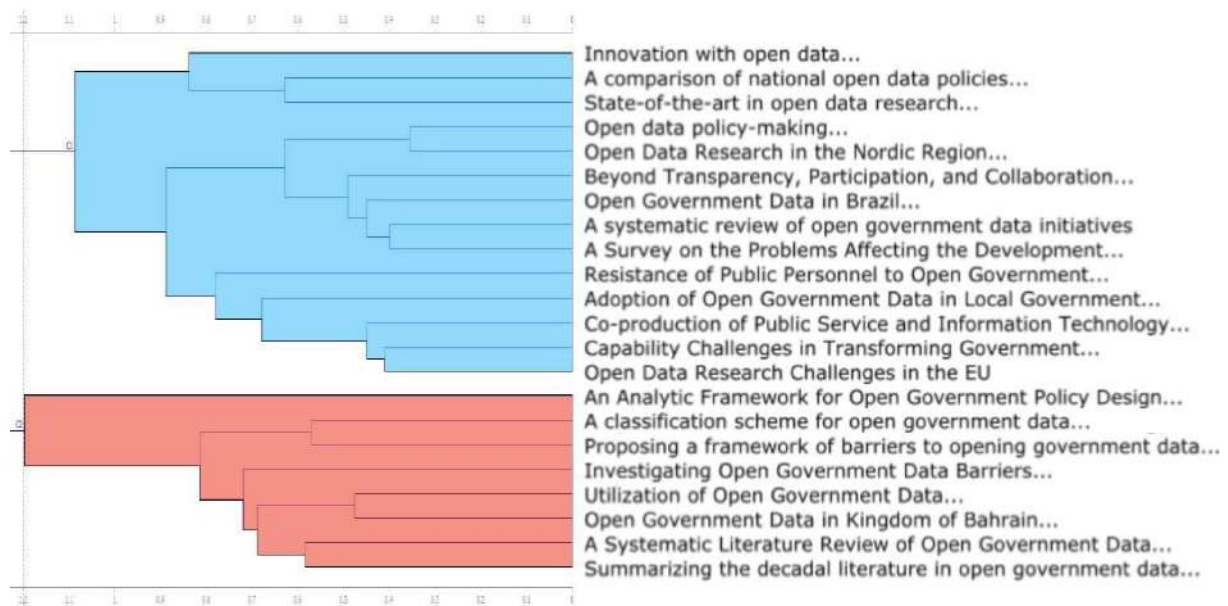
Source: Author's illustration

After the data preparation and analysis phase, we grouped the articles in two clusters, A and B. Groups of articles are presented in the fifth column in Table 1.

We compiled another data set to validate the initial clusters and put them in the broader research context. We retrieved the data from the ScienceDirect service with the keywords "open government data, OGD initiatives, barriers of OGD, challenges of OGD, use of OGD, dimensions of OGD, adoption of OGD, implementation of OGD, OGD policy, development of OGD, OGD perspectives, OGD initiatives, OGD ecosystems, or OGD dissemination" appearing anywhere in the title, content or abstract of the paper. We used ScienceDirect because it provides programmatic access to structured content in a .xml format. The search resulted in 54 additional papers, one of which appeared in the original cluster and was discarded.

By segregating our corpus, we intended to distinguish articles from one another and provide a classification scheme that could help us identify similarities in the discovered clusters. The second corpus served as a validation of the findings.

We used the same preprocessing with added lemmatisation to enable a more precise topic comparison. Next, we mapped the following data set to the same document space as the original corpus, which enabled a more precise definition of found clusters and elaboration of identified topics. Document maps were computed with t-SNE (van der Maaten et al., 2008), an embedding technique that optimises the instance neighbourhood. Finally, we used the YAKE keyword extraction algorithm to explain the clusters and local neighbourhoods in t-SNE (Campos et al., 2020). We manually extracted words or concepts common to instance locality.

The following two chapters present the literature review and cluster validation with the second corpus.

Results

Findings from the literature review are presented as short summaries of articles from each cluster, followed by cluster validation with the second dataset in the section "Cluster validation", and finally, a conclusion of this research paper and recommendations for future research in the section "Discussion and conclusions".

Cluster A

Ali Hassan et al. (2018) first research in cluster A captured the status of OGD research from 2012 – 2018. The primary objective was to identify opportunities, obstacles, and gaps to determine what has been researched in OGD. Their findings suggest that most research has been done in developed countries and that there is a lack of research on OGD for business benefit. Regarding the type of research, some theoretical papers explained the OGD initiative, yet many more Case Studies and Surveys were conducted in this field. Considering the practical implications of OGD, most research focused on proposing different frameworks and less on developing platforms. The main obstacles are related to the security and privacy of opening government data, government data formats, and the legal implications of opening up the data, such as copyright and licensing.

Addressing different types of OGD research, Haini et al. (2019) researched the shortcomings of empirical studies on adopting OGD in the local government context. Influencing factors of OGD adoption were identified, analysed, and reviewed by five selected experts from local governments. Experts validated and individually ranked sixteen influential factors as relevant, but only eleven were selected as strongly influential. Among those, top management was perceived as the most influential factor. As a result of this study, the authors proposed a conceptual model of OGD adoption for local government, classifying influential factors in three independent variables - technological, organisational and environmental.

Another comprehensive research on OGD initiatives assessment was made by Attard et al. (2015). The study's main research question addressed existing approaches for publishing and consuming government data. Research provides an explanation and types of OGD implementation, defines motivation for governments to open their data based on democracy and economics and introduces the OGD life cycle with the conclusion that several open data life cycles already exist. However, none of them is adjusted to the needs of OGD. Since government initiatives are usually evaluated according to their compliance with the law and not by their usefulness, authors also debate and classify different assessment frameworks and initiative evaluations. Finally, an overview of success factors has been made, and aspects of publishing and consuming OGD were investigated. Challenges or barriers to OGD implementation were classified based on the nature of the challenge into five major groups; technical, policy/legal, economic/financial, organisational, and cultural. With all the aspects considered, Attard et al. (2015) research managed to become one of the highest-cited research papers on the subject.

Hossain et al. (2015) also reviewed current research on OGD and presented findings for 11 types of analyses. Authors first classified the context of research on either government or the public, then they also classified different ways to explain open data movement. Another field of investigation was the level of analysis, where the aim was to distinguish whether analysis was made on individual cognition of open data, organisational/societal level or if analysis dealt with open data on an abstract level. Regarding the research methods, the authors' findings indicate that the majority, or almost fifty percent of the studies, applied a qualitative approach, followed by conceptual and quantitative papers. Drivers of OGD implementation are primarily

perceived in terms of political leadership, institutional pressure, or technology development, whereas barriers are primarily present at institutional, legal, economic, and technological levels. The latter is recognised as one of the most important due to its frequency of appearance in various research papers.

Zuiderwijk et al. (2014) overviewed the most important elements of open data ecosystems for simple publication and use of open data. Twenty essential elements of open data ecosystems were identified where the focus was either on the data producer or data user. Four essential elements were also identified: releasing and publishing data on the internet, searching and viewing the data, analysing, enriching, and visualising the data, and finally, discussing the data by providing sufficient feedback to data providers and other stakeholders. In addition to the four key elements of open data ecosystems, three elements were identified to integrate the other twenty ecosystem elements as a whole, and those are; different pathways on how to use open data, a quality management system that provides dataset satisfaction for users and finally the use of metadata that would offer interoperability and connection of the elements.

Gil-Garcia et al. (2020) researched open government dimensions to understand the term in a socio-technical context. Articles that were selected included a mix of conceptual or methodological research methods such as literature reviews, case studies, comparative analysis, etc., indicating the phenomena' importance. Five dimensions of open government were identified that provide different concepts related to transparency, participation, information availability, collaboration, and information technologies. The same concepts are sometimes identified as dimensions of open government or drivers of open government initiatives. The information availability dimension can be perceived as the most important since it discusses the intentions of the governments to make information publicly available and is, along with transparency, the most debated topic among researchers.

Csáki et al. (2018) focused on the relevant studies to review the research area of OGD in a more specific context of the European Union (EU). Open data and related challenges are debated mainly from a policy or technical point of view. Therefore, the authors conclude that a holistic view of OGD is missing. Authors further classify research areas of open data into nineteen different topics. The most often researched are policy and regulation, organisation and management, participants and roles (stakeholders), and technology and infrastructure.

Narrowing the scope of open data research in the EU, Susha et al. (2016) addressed the problem of the non-existing systematic overview of open data research in Nordic countries. Forty-four research papers were included in this literature review, examining research perspectives and topics. The main topics of Nordic open data research include open innovation, open data adoption, evaluation, benefits and barriers, etc.. In contrast, perspectives of OGD were adopted from Zuiderwijk et al. (2014). The authors' findings indicate that Nordic countries' social and economic research perspectives dominate. Innovation-related topics such as open innovation, open data entrepreneurship, service innovation, and innovation contests were the most popular research topics.

With a more specific focus on the case of Brazil, De Oliveira et al. (2018) intended to seek out what initiatives are being conducted there, how OGD is being used, and what prevents its effective use through presented challenges. Their findings indicate that transparency is the most popular aspect of OGD research in Brazil. In contrast, other research topics include the benefits of OGD in crime investigation, election data, biodiversity data sharing, and education. Finally, the authors conclude that the

challenges of OGD are considering the quality and format of the datasets, thus making the technical aspect of OGD important once more.

The following two papers focus more on barriers or the main problems affecting open government data initiatives. Starting with Roa et al. (2019), the authors used a literature review of the past sixty-nine OGD initiatives from 2012-2018. They identified six problem categories: citizen participation, data quality, economic and financial, organisational, policy and legal-related, and finally, technical. Out of all problem groups, data quality and policy-related problems are most commonly reported, whereas citizen-related and economic problems are least represented. Authors also discovered that most reported problems occur during the post-adoption stage, whereas during the adoption of open data, the report of problems of any group is relatively low. Policy and legal problems are most common in the pre-adoption stage.

Focusing on perceived barriers to introducing OGD, Wirtz et al. (2015) summarised factors that prevent successful implementation of open government data or resistance, as the authors define it, in a model based on cognitive theory and literature review. Since cognitive theory distinguishes perceived barriers on individual internal, organisational, and external, the final research model is also classified as such. Perceived legal barriers were classified as external, whereas internal organisational barriers consist of perceived bureaucratic decision culture, organisational transparency, and hierarchical barriers. Finally, a perceived risk related to administrative employees' attitudes is the only internal barrier. After the classification, a survey was conducted on thirty-five public authorities, resulting in 265 responses. The results of factor analysis indicate that the perceived risk-related attitude of the administrative employees turned out to be the most influential in connection with the open government data resistance, primarily due to the protective mechanism of individuals.

One of the often-debated subjects regarding OGD implementation barriers dealt with regulatory issues surrounding the release of government data. Nugroho et al. (2015) compared national open data policies from five countries, focusing on policy-making aspects. The comparison revealed that open data should become the default option instead of governments waiting for various requests to open data. The authors identified two waves of policy-making. The first wave proposes adapting the legal framework that would regulate and stimulate the continuous release of data. The second wave of policy-making focuses on how data providers and users interact to stimulate OGD usage. The authors suggested that there might be a third wave emerging where public forums and other participatory medians are created, enabling data users to provide feedback on quality and usability.

Regarding open data policy-making, Zuiderwijk et al. (2019) conducted an overview of the latest open data policy-making research. Their findings indicate that literature reviews concerning open data research are limited and those investigating policy-making are even rarer. Nevertheless, after analysing eight selected studies, three main topics of open data policy-making research agenda emerged. The first topic is open data policy-making and theory development, where an efficient evaluation of early practices and frameworks has been made, which indicates that the research topic of OGD is relatively new. The next topic is open data policy-making effects, which can be divided as direct and indirect and should be further examined in terms of policy formation and implementation to test their long-term behaviour. The last topic considers a multi-actor open data policy-making, where impacts on different stakeholders are examined, and comparisons of policies are presented.

Furthermore, Ingrams (2016) proposed an analytical framework for open government policy design processes by conducting a systematic literature review and

categorising open data policies. A theoretical framework rooted in open government, structuration, and policy design theory organised previous empirical findings. A conceptual model based on these theoretical guidelines was developed and tested in a case of e-participation. Prior literature already proposed conceptual models with similar factors, but none addressed open government for policy design processes in organisational theory. Eleven topics of open government research were identified in the past thirty-five years, where the most often discussed were open data, general open government, transparency, and citizen participation.

Chatfield et al. (2015) explored organisational capability challenges in transforming government through open and big data use. Four categories of big data capability challenges were identified: analytical, technical, strategical (strategic change) and socio-political, in descending order of importance. The most critical challenge is analytical capability, which describes a lack of knowledge to deal with open or big data and a shortage of analytical skills. Relatively high costs as another challenge should also not be ignored since the main aim of using big data is to minimise them. To do that, costly computational power must be provided first. Based on their classification, the authors proposed a conceptual framework for big data capability challenges, which suggests that innovative organisational culture can positively impact the alleviation of proposed challenge categories.

Yuan (2019) investigated public service co-production through citizen engagement. The author's literature review focuses on the role of information and communication technologies (ICT) in the process of co-production and its potential outcomes. Various ICT tools are used to engage citizens for co-production. Current studies show three models of ICT co-production; citizen-sourcing, automatic co-production, and government as an open platform.

Cluster B

Continuing with the second cluster and a summary of the decadal literature review of OGD by Saxena (2018), the author's findings indicate that existing literature mainly focused on theoretical and conceptual research of OGD, applied/contextual or user-focused research. Theoretical and conceptual research was primarily done on effects, barriers, comparison of initiatives, policies, and conceptual model development of OGD. In contrast, applied research focused on specific case studies in different countries and regions. Some effort was also dedicated to benchmarking different OGD initiatives and focusing on OGD portals in human interaction.

Further, Safarov et al. (2017) made a comprehensive literature review on four factors of OGD utilisation. Types, effects, conditions, and users of OGD were discussed. The authors identified eight different types of OGD utilisation, six notable effects of OGD, several conditions for implementing OGD such as quality and availability of data. Finally, users of OGD were systematically classified into different groups. The paper revealed some research gaps on OGD utilisation, principally considering the lack of empirical testing of its effects.

A research-in-progress on a case of effective implementation of OGD in the Kingdom of Bahrain (Katbi et al., 2019) explored benefits, impediments, and different assessment tools that could help governments successfully implement OGD. Their findings state that various assessment tools exist, and they vary significantly in terms of focus, scope, and area of investigation. Based on Katbi et al. (2019), it is essential to use different assessment tools as much as it is to develop new ones, where the focus should be dedicated not only to the supply but also to the demand side of OGD. Research revealed that most OGD assessment frameworks carried out had a broader

focus at the country level. Specific research focuses on a micro investigation at the level of different governmental agencies still lacks and should be further examined.

On the other hand, Huang et al. (2017) conducted a critical literature review on identifying and understanding barriers to OGD release in China. While suggesting that almost all researchers have a favourable view of OGD, their findings also indicate that barriers exist and could be classified into three main themes; institutional barriers, data integrity & quality barriers, and user participation barriers. Authors identified institutional barriers as most influential in China, where conflicts between the closed traditional and bureaucratic system of China and the OGD requirement emerged, which cannot be successfully implemented with the current system and culture remaining unchanged.

Crusoe et al. (2018) also conducted a literature review on OGD barriers from 34 articles with the purpose of better understanding the phenomenon. Their findings indicate that most barriers are rooted in technical, legal, or organisational issues, followed by participation and data-related issues. The authors proposed systematising OGD barriers in an organisational context with five distinct processes. The first three processes are identifying whether data is suitable for publishing, deciding to release the data, and publishing the data. Once the data is published, it has to be used and evaluated in terms of its impact as a fourth and fifth process.

Lastly, with a more specific scope of research, OGD initiatives, Kalampokis et al. (2011) proposed a classification scheme of OGD initiatives with two dimensions. The first dimension considers the technological aspects of OGD initiatives, and the second is domain-specific or organisational-oriented. The technological aspect is associated mainly with publishing, downloading, and processing linked data, whereas the organisational aspect considers two different approaches to data publication; direct or centralised data provision and indirect or decentralised data provision. The authors then classified twenty-four different OGD initiatives and developed a technical architecture that relies on indirect data provision.

Cluster validation

To validate clusters and topics from the previous section, we performed a second round of analysis with the ScienceDirect corpus.

We used a similar preprocessing pipeline as before. A crucial addition was lemmatising the words with a UDPipe lemmatiser to compare clusters easily. Lemmatization mildly affected the original clustering, with only two papers changing cluster membership. Initial clusters were visualised with a t-SNE projection, representing a document map, where similar documents lie closer together than those that are different. We added the documents from the second corpus into the same space to compare them to the initial clusters (Figure 2).

t-SNE shows well-defined cluster regions, with the papers from the second corpus mapping to both clusters proportionally. If the new documents were entirely dissimilar to the original ones, they would be placed away from the two clusters and form a separate group.

Figure 2
Re-implementation of hierarchical clustering with added lemmatisation.
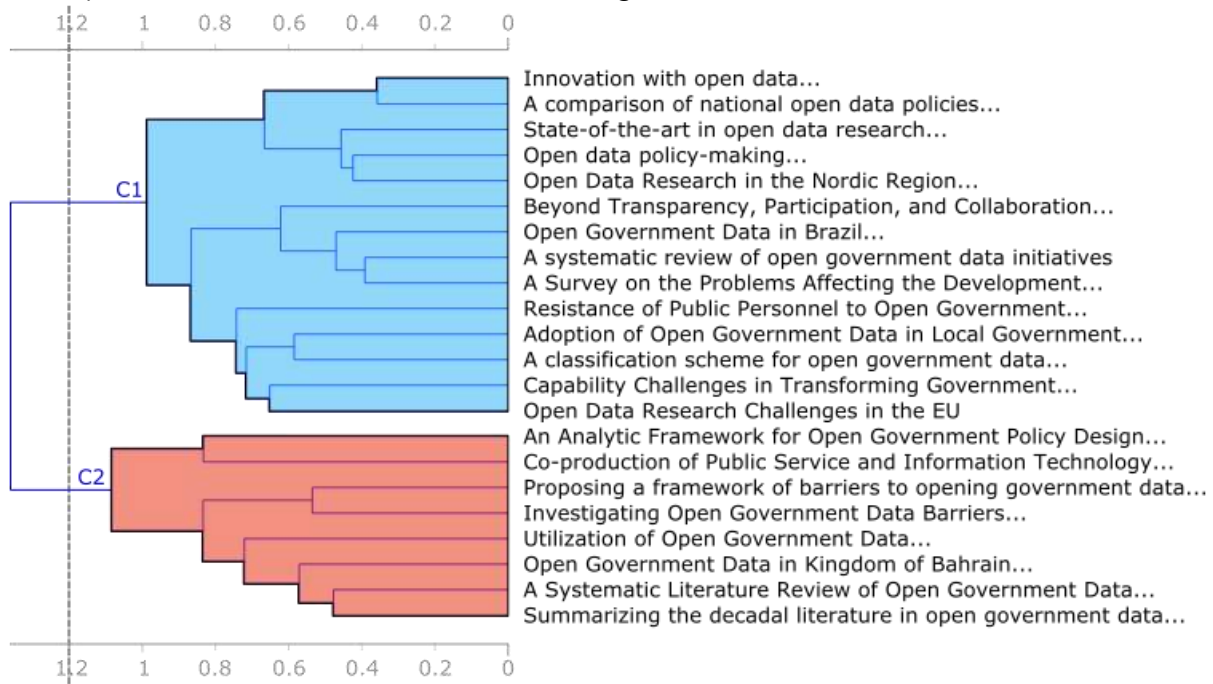
Source: Author's illustration

We defined topic regions based on the YAKE keywords (Figure 3). The blue region (cluster A) contains papers addressing government perspectives and policies on OGD, initiatives, and portals. Portals and platforms are positioned closer to the concepts of linked data, web, and models, which refer to the practical implementation of OGD. The red region (cluster B) contains papers describing regional studies, adoption of ODG, platforms, and barriers to implementation. Barriers to OGD are a slight outlier positioned closest to the research papers about OGD. This could be interpreted as barriers to ODG still being studied only at the theoretical level. To compare YAKE's topic regions with manual literature review, we can say that research topics mostly overlap with manually identified research topics, except for regional studies, which are mainly categorised into cluster A instead of cluster B. In the case of cluster A, the following research topics were identified: "Holistic approach on OGD research", "Regional context of OGD research", "OGD barriers", "OGD policy-making", "OGD and big data", and "Service co-production". The same applies to the second cluster (cluster B), where the following research topics were identified: "Research types on OGD", "OGD Utilization", "Assessment tools", and to some extent "OGD barriers".

Keyword mapping and comparison of the two corpora revealed a more intricate landscape of topics in OGD literature. In Figure 1, two papers (Yuan, 2019, Kalampokis et al., 2011) changed their clusters concerning the original clustering. Yuan's paper on the co-production of public services is an outlier, demonstrated by its position at the edge of the t-SNE landscape. Kalampokis et al. (2011) paper, on the other hand, is deeply embedded in the documents from the new corpus. Upon closer observation, the neighbourhood of documents describes linked data, portals, frameworks, and websites. This topic was not evident from the first round of clustering, proving the usefulness of an additional calibration level. The topic focuses on the practical implementation of OGD, data infrastructures, and public access to the data, all of which are essential aspects of OGD research.

Figure 3
Topic regions
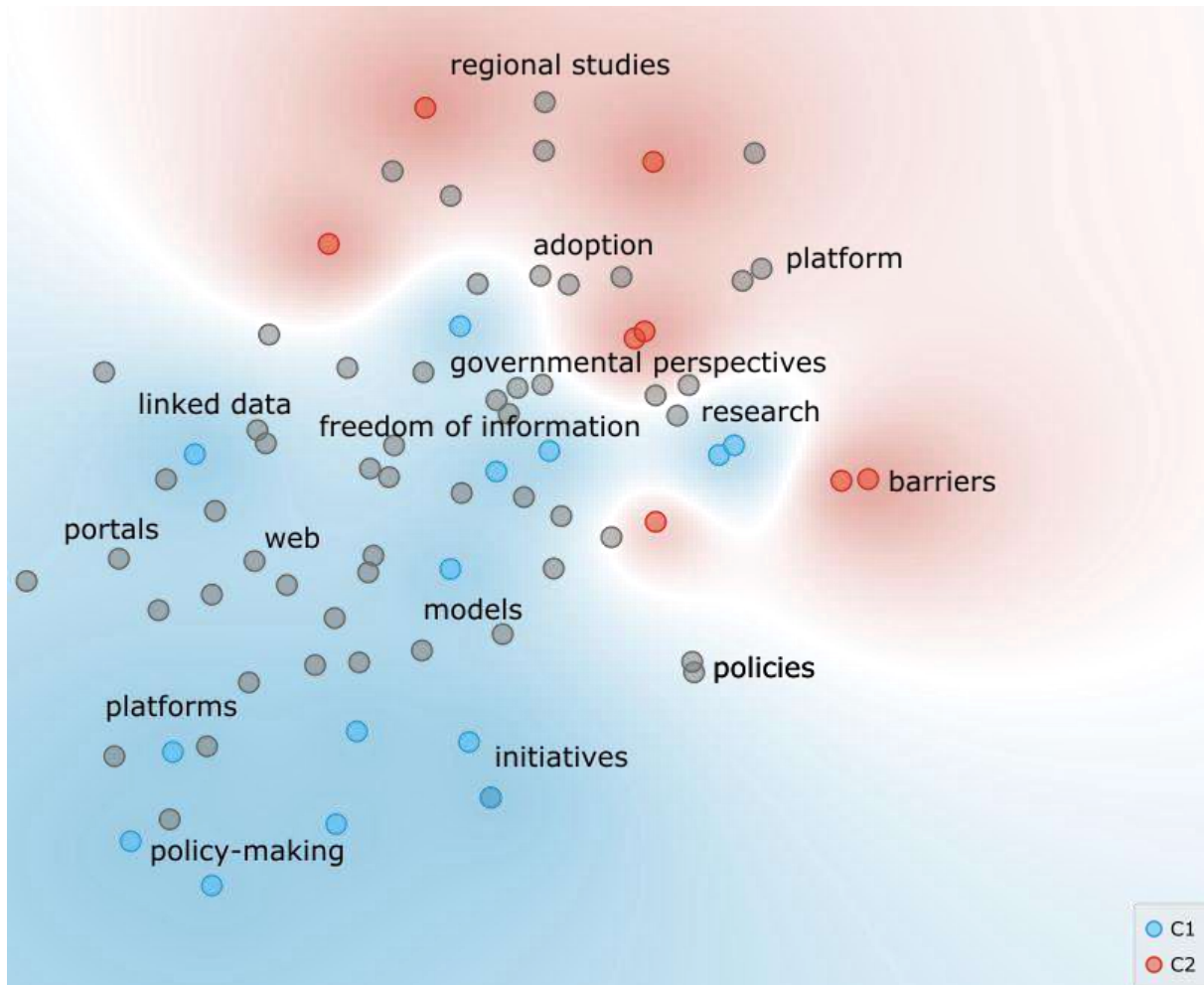
Notes: Blue (cluster A) and red points (cluster B) represent papers from the original clustering. Gray points are papers from the second corpus. Points with higher similarity lie closer together. Annotations were added with the YAKE! Keyword extraction algorithm.
Source: Author's illustration

There is much overlap between approaches to OGD research in mapping the initial clusters to the landscape. Regional studies (Csáki et al., 2018; Susha et al., 2016, De Oliviera et al., 2018) are deeply embedded in a general (holistic) overview of OGD research and conducted research types, showing strong entanglement of use cases with theoretical frameworks. Barriers to OGD implementation remain one of the few distinct clusters. Keyword analysis also shows how vital societal and governmental perceptions of OGD are in implementation. In other words, barriers are intimately linked to the interplay between the benefits and risks of OGD implementation. Policy-making also forms a separate cluster at the edge of the plot, making this a distinct yet not highly represented topic. Policy-making is also closely connected to OGD frameworks; manual analysis reveals that an evaluation of early practices enables and stimulates policy-making based on open government data. Finally, the spiral intertwining blue and red cluster signify closely related topics. These documents refer to the public's vital role in accepting OGD initiatives and how public agencies implementing OGD frameworks must ensure accountability and transparency, practical and quality datasets, and uphold social values if these frameworks succeed.

Discussion and conclusions

The purpose of this study was to conduct a literature review on OGD implementation with an emphasis on previous literature reviews. As perceived in the literature, the topic is emerging and important, especially when debating transparent governance and public service innovation. We based our research on a decadal research activity between 2011 and 2020 that varies in geographical outreach and approach to research initiatives.

In the previous two sections of this research, we classified 22 articles into three different clusters with hierarchical clustering. Articles were manually reviewed to justify hierarchical clustering process categorisation and further validated with 54 articles retrieved from the ScienceDirect service. In this section, we elaborate on the findings from the literature review, interpret our results and provide a response to our intention for making this research.

The main motivation for carrying out this research was to classify existing research on open government data initiatives in terms of literature reviews to provide new and recent findings on the topic. The main research questions were: (i) RQ1: What is the main research scope of the authors?; (ii) RQ2: What are the commonalities of the various literature reviews on the subject?; (iii) RQ3: What are the latest research gaps?; and (iv) RQ4: To which groups can research on OGD implementation be classified?

As far as our research questions are concerned, we can state that a lot of research has been made;. However, not many empirical studies or design science approaches were used, most research focused on proposing different frameworks and some less on developing the platforms.

To explain the commonalities of different literature reviews on this topic and how to classify them, we used hierarchical clustering, which helped us to manually analyse articles and later either confirm the clusters created by the Orange software or make necessary corrections. As shown in Figure 1, two distinct clusters emerged, where the research focus was either on a general and general regional approach to OGD research, as presented in cluster A or on different research types on OGD, its utilisation and assessment tools, as presented in cluster B.

This study suggests that open government data received a lot of research attention and has so far been focused on many different segments of the phenomena such as impact, barriers, comparison, explanation, and benchmarking of OGD initiatives, policy-making, citizen/user interaction or participation, and the development of conceptual models for OGD development. Nevertheless, further research is needed to gain a more holistic understanding of the phenomena. These findings are also the main practical and theoretical implications of this research. Some of the proposed research directions are as follows: (i) Quantitative research to develop theories on OGD and design science research as a methodology; (ii) Holistic approach in research areas such as policy making, organisational aspects, technology and data, reuse, end users and theoretical foundations; (iii) Research on how to improve the data published by governments, open data behavioural models, and economic success factors; (iv) Research investigating legal and ethical dilemmas around open data, since the existing legal frameworks don't encourage public data use; (v) Research on the benchmarking of OGD initiatives to identify best practices for replication by others; and (vi) Research on the indirect provision of linked data in the public sector.

This study pointed out the latest research gaps and provided a comprehensive overview and classification of the topic using a method thatwasn't previously used On top of that, we validated initial clusters and put them in a wider research context by

adding another data set. While the research provided the intended results, some limitations still have to be considered. The first of these is our sample size, consisting of 22 existing literature review papers and 54 research papers. The second limitation was Orange software, which provided the intended results, but was limited by built-in similarity/dissimilarity measurements such as cosine distance measurements. As recommended in the literature (Huang, 2008), future distances for clustering text could be tested to validate our clusters, such as averaged Kullback-Leibler divergence.

References

1. Al-Anzi, F. S., AbuZeina, D. (2017), "Toward an enhanced Arabic text classification using cosine similarity and Latent Semantic Indexing", Journal of King Saud University - Computer and Information Sciences, Vol. 29 No. 2, pp. 189-195.
2. Ali Hassan, M. I., Twinomurinzi, H. (2018), "A Systematic Literature Review of Open Government Data Research: Challenges, Opportunities and Gaps", 2018 Open Innovations Conference (OI), pp. 299–304 .
3. Attard, J., Orlandi, F., Scerri, S., Auer, S. (2015), "A systematic review of open government data initiatives", Government Information Quarterly, Vol. 32 No. 4, pp. 399–418.
4. Bertot, J. C., Gorham, U., Jaeger, P. T., Sarin, L. C., Choi, H. (2014), "Big data, open government and e-government: Issues, policies and recommendations", Information Polity, Vol. 19 No. 1, pp. 5-16.
5. Boyne, G. A. (2002), "Public and Private Management: What's the Difference?" Journal of Management Studies, Vol. 39 No. 1, pp. 97-122.
6. Buchanan, C. P. (1972), "Organizational Development as a Process Strategy for Change", Educational Technology, Vol. 12 No. 10, pp. 10-14.
7. Campos, R., Mangaravite, V., Pasquali, A., Jatowt, A., Jorge, A., Nunes, C., Jatowt, A. (2020), "YAKE! Keyword Extraction from Single Documents using Multiple Local Features", Information Sciences Journal, Vol. 509, pp. 257-289.
8. Chatfield, A., Reddick, C. Al-Zubaidi, W. (2015), "Capability Challenges in Transforming Government through Open and Big Data: Tales of Two Cities", Published in ICIS 2015, available at https://pdfs.semanticscholar.org/4558/e6a25bbb045dbe0f8f9c23bc75eb20e49f4e.pdf (Mar 15 2022)
9. Crossan, M. M., Apaydin, M. (2009), "A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature", Journal of Management Studies, Vol. 47 No. 6, pp. 1154-1191.
10. Crusoe, J. Melin, U. (2018), "Investigating Open Government Data Barriers: A Literature Review and Conceptualization", Published in International Conference on Electronic Government (EGOV 2018), pp. 169-183.
11. Csáki, C., Kő, A. (2018), "Open Data Research Challenges in the EU", Lecture Notes in Computer Science, pp. 192-204.
12. Damanpour, F., Schneider, M. (2008), "Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers", Journal of Public Administration Research and Theory, Vol. 19 No. 3, pp. 495-522.
13. De Oliveira, E. F., Silveira, M. S. (2018), "Open government data in Brazil a systematic review of its uses and issues", Proceedings of the 19th Annual International Conference on Digital Government Research Governance in the Data Age - Dgo '18, pp. 1-9.
14. Demšar, J., Zupan, B., Leban, G., Curk, T. (2004), "Orange: From Experimental Machine Learning to Interactive Data Mining", Knowledge Discovery in Databases: PKDD 2004, pp. 537-539.
15. Elliott, I. C. (2020), "Organisational learning and change in a public sector context", Teaching Public Administration, Vol. 38 No. 3, pp. 270-283.
16. Gil-Garcia, J. R., Gasco-Hernandez, M., Pardo, T. A. (2020), "Beyond Transparency, Participation, and Collaboration? A Reflection on the Dimensions of Open Government", Public Performance Management Review, pp. 1-20.

17. Haini, S. I., Rahim, N. Z. A., Zainuddin, N. M. M. (2019), "Adoption of Open Government Data in Local Government Context: Conceptual Model Development", Proceedings of the 2019 5th International Conference on Computer and Technology Applications - ICCTA 2019, pp. 193-198.

18. Harrison, T. M., Guerrero, S., Burke, G. B., Cook, M., Cresswell, A., Helbig, N., … Pardo, T. (2011), "Open Government and e-government: Democratic Challenges From a Public Value Perspective", in Proceedings of the 12th Annual International Digital Government Research Conference on Digital Government Innovation in Challenging Times - Dg.o '11, pp. 83-97.

19. Hossain, M. A., Dwivedi, Y. K., Rana, N. P. (2015), "State-of-the-art in open data research: Insights from existing literature and a research agenda", Journal of Organizational Computing and Electronic Commerce, Vol. 26 No. 1-2, pp. 14-40.

20. Huang, A. (2008), "Similarity Measures for Text Document Clustering", Proceedings of the New Zealand Computer Science Research Student Conference (NZCSRSC) 2008, pp. 49-56.

21. Huang, R., Lai, T., Zhou, L. (2017), "Proposing a Framework of Barriers to Opening Government Data in China: A Critical Literature Review", Library Hi Tech, Vol. 35 No. 3, pp. 421-438.

22. Ingrams, A. (2016), "An Analytic Framework for Open Government Policy Design Processes", in Proceedings of 15th IFIP WG 8.5 International Conference, pp. 203-214.

23. Jetzek, T., Avital, M. Bjørn-Andersen, N. (2013), "Generating value from open government data", in Proceedings of International Conference on Information Systems (ICIS 2013): Reshaping Society Through Information Systems Design, available at https://dblp.org/db/conf/icis/icis2013.html (Feb 1 2022)

24. Kalampokis, E., Tambouris, E., Tarabanis, K. (2011), "A classification scheme for open government data: towards linking decentralised data", International Journal of Web Engineering and Technology, Vol. 6 No. 3, pp. 266-285.

25. Kassen, M. (2013), "Globalisation of e-government: open government as a global agenda; benefits, limitations and ways forward", Information Development, Vol. 30 No. 1, pp. 51-58.

26. Katbi, A.-K., Al-Ammary, J. (2019), "Open Government Data in Kingdom of Bahrain: Towards an Effective Implementation Framework", New Knowledge in Information Systems and Technologies, pp. 699-715.

27. Kitchenham, B. (2004), "Procedures for performing systematic reviews", Keele, UK, Keele University, Vol. 33, pp. 1-26.

28. Lewin, K. (1947), "Group decision and social change", in Newcomb T. M., Hartley E. L. (Eds.), Readings in Social Psychology, New York, Henry Holt, pp. 330-344.

29. Lin, Y.-S., Jiang, J.-Y., Lee, S.-J. (2014), "A Similarity Measure for Text Classification and Clustering", IEEE Transactions on Knowledge and Data Engineering, Vol. 26 No. 7, pp. 1575-1590.

30. Lourenço, R. P. (2015), "An analysis of open government portals: A perspective of transparency for accountability", Government Information Quarterly, Vol. 32 No. 3, pp. 323-332.

31. Marčeta, M. Bojnec, Š. (2020), "Drivers of Global Competitiveness in the European Union Countries in 2014 and 2017", Organizacija Journal, Vol. 53 No. 1, pp. 37-52.

32. Maxwell, A., Osae-Larbi, A. J. (2015), "Organization Development Models: A Critical Review and Implications for Creating Learning Organizations", European Journal of Training and Development Studies, Vol. 2 No. 3, pp. 29-43.

33. Moon, M. J. (2002), "The Evolution of E-Government among Municipalities: Rhetoric or Reality?", Public Administration Review, Vol. 62 No. 4, pp. 424-433.

34. Murtagh, F., Contreras, P. (2011), "Algorithms for hierarchical clustering: an overview", Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, Vol. 2 No. 1, pp. 86-97.

35. Nam, T. (2012), "Citizens' attitudes toward Open Government and Government 2.0", International Review of Administrative Sciences, Vol. 78 No. 2, pp. 346-368.

36. Nugroho, R., Zuiderwijk, A., Janssen, M. de Jong, M. (2015), "A comparison of national open data policies: lessons learned", Transforming Government: People, Process and Policy, Vol. 9 No. 3, pp. 286-308.

37. Peters, T., Watterman, H. R. (1982), In Search of Excellence, HarperCollins Publishers.
38. Pettigrew, A. M. (1973), The Politics of Organisational Decision Making, London, Tavistock.
39. Roa, H. N., Loza-Aguirre, E., Flores, P. (2019), "A Survey on the Problems Affecting the Development of Open Government Data Initiatives", in 2019 Sixth International Conference on eDemocracy eGovernment (ICEDEG), pp. 157-163.
40. Safarov, I., Meijer, A., Grimmelikhuijsen, S. (2017), "Utilisation of open government data: A systematic literature review of types, conditions, effects and users", Information Polity, Vol. 22 No. 1, pp. 1-24.
41. Saif, H., Fernández, M., He, Y. Alani, H. (2014), "On stopwords, filtering and data sparsity for sentiment analysis of Twitter", in LREC 2014, Ninth International Conference on Language Resources and Evaluation, Proceedings, pp. 810-817.
42. Saxena, S. (2018), "Summarising the decadal literature in open government data (OGD) research: a systematic review", Foresight, Vol. 20 No. 6, pp. 648-664.
43. Sprecher, M. H. (2000), "Racing to E-government: Using the Internet for Citizen Service Delivery", Government Finance Review, Vol. 16, pp. 21-22.
44. Susha, I., Johannesson, P., Juell-Skielse, G. (2016), "Open Data Research in the Nordic Region: Towards a Scandinavian Approach?", Electronic Government, pp. 61-73.
45. Tolbert, C. J., Mossberger, K. (2006), "The effects of E-government on trust and confidence in government", Public administration review, Vol. 66 No. 3, pp. 354-369.
46. Tsoukas, H. Chia, R. (2002), "On Organizational Becoming: Rethinking Organizational Change", Organization Science, Vol. 13 No. 5, pp. 567-582.
47. Van de Ven, A. H., Poole, M. S. (1995), "Explaining Development and Change in Organisations", The Academy of Management Review, Vol. 20 No. 3, pp. 510-540.
48. Van der Maaten, L. Hinton G. (2008), "Visualizing Data using t-SNE", Journal of Machine Learning Research, Vol. 9 No. 86, pp. 2579-2605.
49. Vetrò, A., Canova, L., Torchiano, Orozco Minotas, C., Iemma, R., Morando, F. (2016), "Open data quality measurement framework: Definition and application to Open Government Data", Government Information Quarterly, Vol. 33 No. 2, pp. 325-337.
50. Walker, R. M., Andrews, R. (2013), "Local Government Management and Performance: A Review of Evidence", Journal of Public Administration Research and Theory, Vol. 25 No. 1, pp. 101-133.
51. Webster, J., Watson, R. T. (2002), "Analysing the past to prepare for the future: writing a literature review", MIS Quarterly, Vol. 26 No. 2, pp. 13-23.
52. Weick, K. E., Quinn, R. E. (1999), "Organizational Change and Development", Annual Review of Psychology, Vol. 50 No. 1, pp. 361-386.
53. Welle Donker, F., van Loenen, B. (2017), "How to assess the success of the open data ecosystem?", International Journal of Digital Earth, Vol. 10 No. 3, pp. 284-306.
54. West, D. M. (2004), "E-Government and the Transformation of Service Delivery and Citizen Attitudes", Public Administration Review, Vol. 64 No. 1, pp. 15-27.
55. Wirtz, B. W., Piehler, R., Thomas, M.-J., Daiser, P. (2015), "Resistance of Public Personnel to Open Government: A cognitive theory view of implementation barriers towards open government data", Public Management Review, Vol. 18 No. 9, pp. 1335-1364.
56. Yuan, Q. (2019), "Co-production of Public Service and Information Technology", in Proceedings of the 20th Annual International Conference on Digital Government Research (dg.o 2019), pp. 123-132.
57. Zuiderwijk, A., Hinnant, C. C. (2019), "Open data policy-making: A review of the state-of-the-art and an emerging research agenda", Information Polity, Vol. 24, No. 2, pp. 1-13.
58. Zuiderwijk, A., Janssen, M., Davis, C. (2014), "Innovation with open data: Essential elements of open data ecosystems", Information Polity, Vol. 19 No. 1, pp. 17-33.

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A Framework of Information Systems Development Concepts

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Abstract

Background: Information Systems Development (ISD) is responsible for designing and implementing information systems that support organizational strategy, leveraging business models and processes. Several perspectives on this activity can be found in the literature, addressing – often in an undifferentiated manner – approaches, lifecycles, methodologies, and process models, among others. **Objectives:** The vast diversity of ideas and concepts surrounding ISD and the multiple underlying views on the subject make it harder for researchers and practitioners to understand the relevant aspects of this important activity. This article aims to systematize and organize ISD's main concepts to create a coherent perspective. **Methods/Approach:** We conducted a literature review and thematic analysis of ISD's main concepts. **Results:** To contribute to filling the research gap, this article proposes a new framework that addresses the key aspects related to ISD. **Conclusions:** The framework comprises ISD's core concepts, such as lifecycles, process models, deployment approaches, and methodologies.

Keywords: Information Systems Development; Digital Transformation; ISD; Information Systems; Lifecycle; Process Model; Approach; Deployment; Methodology; Method; Framework.

Introduction

Information Technologies (IT) and Information Systems (IS) are fundamental for improving organizational performance (Bulchand-Gidumal et al., 2011, Pejić Bach et al., 2018). Organizations need to continuously evolve and adopt new, improved and modern ways of doing things (Ngereja et al., 2021) – IT has become essential to this end and inseparable from IS endeavours (Pearlson et al., 2016).

Several authors point out the impact resulting from the adoption of IT when organizations improve their IS. Such impact can be organized into four main categories (Alavi et al., 2015): efficiency improvement in business processes and transactions; communication improvement and centralized access to information, facilitating the decision-making process; modification of the basis of competition and the industry structure, leading to competitive advantages; and exploring new business models.

Given IT's wide diversity, it is not always easy for organizations to determine the most suitable technologies to adopt in a specific organizational context, nor how they can be operated (Dasgupta et al., 1999). This is usually done through implementing Information Systems Development (ISD) projects, often called digital transformation projects (Kääriäinen et al., 2020). The underlying objectives of these projects are, for example, to improve business models, products, services, processes, communication channels (Haffke et al., 2016), specific practices (e.g., fraud detection (Pejić Bach et al., 2020)), or the relationship with clients or suppliers (Bharadwaj et al., 2013).

Several perspectives and concepts can be found in the scientific literature and the practitioners' lexicon regarding ISD, such as lifecycles, process models, deployment approaches, methodologies, methods, etc. However, the inexistence of a shared understanding of the concepts results in messy vocabulary use and a sort of conceptual chaos. This article aims to contribute to solving this issue by proposing a framework to address and organize the main ISD concepts. The main contribution is both theoretical and practical. On the one hand, the framework provides an organized perspective on the relevant concepts of ISD; on the other hand, it can be used by practitioners to raise their awareness of the different alternatives to be followed in their projects – for instance, regarding deployment approaches.

The document is structured as follows: section 2 presents the background; section 3 describes the research framework; section 4 addresses the research method; section 5 presents the results, and section 6 discusses the results; finally, section 7 presents the conclusions, limitations, and proposals for further work.

Background

An IS is "a combination of intelligent agents (human and/or artificial), processes, and IT (hardware, software, and infrastructure) related to the dissemination and use of data, information, and knowledge in an organization" (Varajão et al., 2021). Accordingly, an IS project can be defined as "a temporary endeavour undertaken to improve organizational IS, and can take on many forms" (Varajão et al., 2020), from the development of a software artefact to the implantation of a commercial-off-the-shelf application (Varajão et al., 2018). As a result, the term ISD can also be defined from different points of view (Hirschheim et al., 1996).

For Laudon et al. (2007), ISD is characterized by the activities involved in creating an IS, and its origin can be traced back to organizational problems or opportunities. Carvalho (1996) stated that ISD processes are triggered when organizations become aware of the necessity to improve their IS, which results from the continuous monitoring

of their performance. According to Varajão (2002), ISD interventions emerge from the necessity of achieving the change devised (or planned) at the time of IS planning.

Authors such as Hirschheim et al. (1996) mention that ISD results from combining a major influx of activities, specifically, IS analysis, design, construction, and deployment. On the other hand, Welke (1983) defines ISD as a change process regarding a system of objects whose purpose is to meet the proposed goals and improve IS performance.

Hirschheim et al. (1996) view ISD from a social action theory perspective and define ISD as "the purposeful crafting and construction of artefacts", including "hardware configurations, design and analysis documents, code, user documentation, organizational structures and procedures, etc.". The same authors mention that technology, organization, and language are the main points of change in ISD.

Different proposals for systems development (Laudon et al., 2007) vary according to the type and dimension of the system being developed. Carvalho (1996) proposes several scenarios based on the different IS interpretations, which illustrate the "path" of the development process based on two dimensions: (i) phases of the development process (perception, conception, and implementation); (ii) object of intervention (organization, information system, and computer system). He also states that even though any scenario can be associated with the term information systems development, only one of them can make better use of that designation. In such a scenario, ISD is conceived as an organizational intervention to improve IS (Carvalho, 1996).

ISD's inherent complexity can be easily overlooked (Varajão, 2002). Since organizations increasingly depend on IS to perform their activity and evolve, continuous efforts are required (Pereira et al., 2022). This, in turn, introduces more complexity into the process (Morcov et al., 2020), which is then reflected in projects (Xia et al., 2005), requiring a comprehensive understanding of all ISD-relevant aspects.

Research Framework

As a complex activity, ISD can be approached from multiple perspectives. On the one hand, it is possible to recognize several lifecycles in an ISD intervention, which are related to the project as a whole (Wong et al., 2018), its execution (PMI, 2017), and also to the products or services resulting from it (Varajão, 2018b, Varajão et al., 2022b).

On the other hand, given the distinct nature of each intervention, it is necessary to adopt different process models closely related to the development lifecycles (Avison et al., 2006b, Ozturk, 2013). Since there are several process models for ISD (Singh et al., 2019), to foster the project's success, it is necessary to analyze which is the most appropriate for a given context (Boehm, 1988), taking into account not only the nature of the project, its application, the methods and tools to be used, but also the specific conjuncture, type of control and expected results (Pressman, 1997). IT adoption and implementation is one of the most important activities of the ISD process. In this case, ISD is perceived as improving an organization by adopting IT (Spohrer, 2016, Varajão et al., 2022a). As with process models, it is important to assess and select an adequate deployment approach by analyzing each option's associated costs, risks, and benefits (O'Leary, 2000).

Another important aspect of an ISD intervention is the methodology used to support such activity, whose primary purpose is not limited to providing a solution to some of the difficulties inherent to the development process (by systematizing and organizing it) (De Leoz, 2017), but also to deal with the complexity of ISD projects (Avison et al., 1999). Methodologies can be grouped into three categories: open methodologies (e.g., SSADM (Ashworth, 1988)); general proprietary methodologies, which are developed by major organizations in the IS arena and made available to their partners

(e.g., SAP Activate (SAP, 2017)); and custom implementation methodologies created only for internal use of organizations (e.g., companies such as Accenture have their proprietary methodologies).

All of the abovementioned aspects comprise the research framework depicted in Figure 1, which will be further detailed in the ensuing sections.

Figure 1
Research Framework
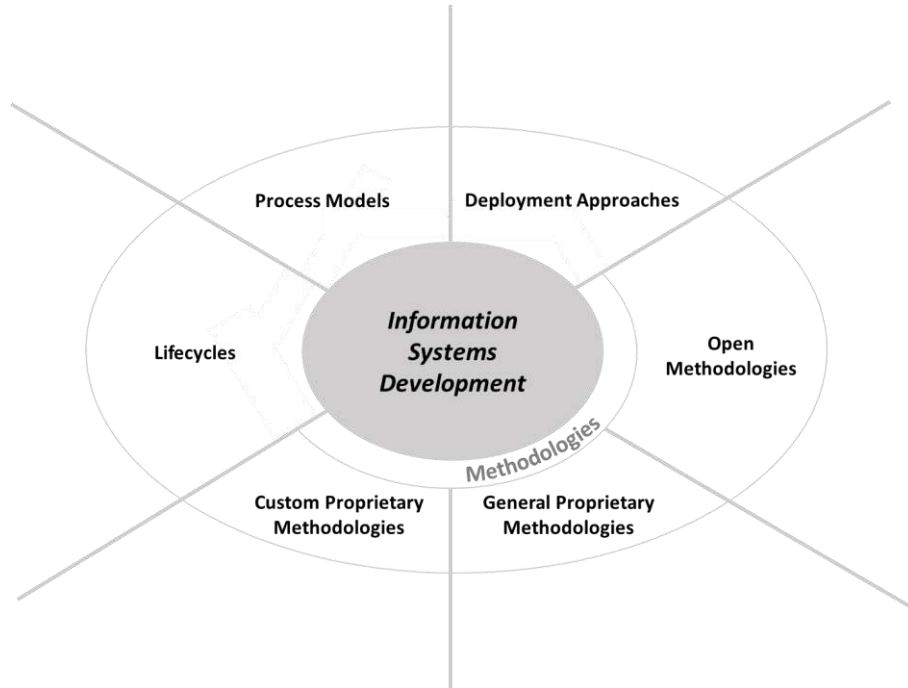
Source: Author's illustration

Research Method

This section describes the literature review that was carried out to support the concepts identified in the research framework.

Regarding data sources, the research focused on two of the most recognizable platforms in the academic and scientific context: Scopus and Web of Science. It is important to note that the results were often redirected to other data sources, although these two were the most used sources. Therefore, the following platforms were also used: AIS eLibrary, ScienceDirect, Research Gate, SpringerLink, IEEE Electronic Library, and Google Scholar.

Before conducting the research, it was necessary to define the key concepts, and so the following terms were used, considering the research framework:

- "information system* development", "ISD";
- "life cycle*", "lifecycle*";
- "process model*";
- "implementation strateg*", "deployment strateg*", "implementation of enterprise system*";
- "method*".

The search queries were formulated through logic statements defined based on the previously mentioned terms. Some restrictions were imposed: (1) regarding source type – only journals and conference proceedings were considered; (2) regarding the area of study – the selected areas were computer science, engineering, social

sciences, business management and accountancy, and decision science (as well as similar areas, depending on the search engine that was used). It should be noted that no restrictions were defined regarding the period.

In the first step, only one research expression was used, including all of the terms mentioned. However, a preliminary analysis of the results obtained first verified that they were ambiguous and did not explore the key concepts in detail. Therefore a phased search was subsequently conducted. Given the large number of articles obtained from applying some research terms, it was decided that, in such cases, only the titles would be analyzed, rather than the combination of title, abstract, and keywords (often, the title is enough to assess whether the article fits the purpose of the analysis or not (Kraus et al., 2020)). The obtained results are presented in Table 1.

Table 1
Results from search

	Scopus	Web of Science	Selected articles
	Results	Results	
(TITLE ("information system* development" OR "ISD"))	1,407	945	22
(TITLE ("information system*" OR "information technolog*") AND TITLE-ABS-KEY ("implementation strateg*" OR "deployment strateg*" OR "implementation of enterprise system*"))	114	39	20
(TITLE ("information system*" OR "information technolog*") AND TITLE ("process model*"))	66	32	21
(TITLE ("information system*" OR "information technolog*") AND TITLE ("life cycle" OR "lifecycle"))	90	52	28
(TITLE ("information system*" OR "information system* development") AND TITLE ("method*"))	1,771	685	35

Source: Author's work

The resulting literature list was compiled in an Excel file. Preliminary filtering was carried out to eliminate repeated articles. For selection purposes, the articles were evaluated and filtered in multiple stages to assess their relevance. The first stage was conducted based on the articles' titles (in such a way that any title failing to match the scope of the research would be automatically excluded, and the more doubtful cases would move on to the next stage). The second evaluation consisted of reading the articles' abstracts, and if any of them failed to mention the keywords related to the study, they would be similarly excluded. Nevertheless, whenever the information contained in the abstract was considered insufficient to analyze the article's relevance, a full reading was required, with particular emphasis on the introduction and conclusion. At the third and final evaluation stage, the articles were fully read, resulting in the total number of selected articles identified in the last column of Table 1, which includes all the articles that address the topic in a more detailed analysis.

It is important to note that, during the detailed analysis of the articles, it was found that many of them included references to other articles. So the cases of repeatedly quoted references, or references considered relevant, were added to the list of articles for further reading.

Results

ISD Lifecycles

Lifecycle models supply an orientation basis when developing and evaluating complex systems (McConnell, 1996, Hoffer et al., 2007). Therefore, it is relevant to approach three different but intimately connected lifecycles (Varajão, 2018b, Varajão et al., 2022b): the system development lifecycle (SLDC), the project's lifecycle, and the product's lifecycle.

System Development Lifecycle

The System Development Lifecycle (SDLC) plays a crucial role In the IS area (Avison et al., 2006a) because, as the name suggests, it is a powerful basis for IS development (Hedman et al., 2009, Oz, 2009), and it provides a set of necessary guidelines for IS implementation.

Although there are other distinct classifications and possibilities when it comes to structuring the phases, simply put, the lifecycle of the traditional systems development implies the existence of five phases – planning and problem identification, analysis, design, development, and, lastly, operation and maintenance (Hedman et al., 2009). Laudon et al. (2007) use a metaphor to highlight that, as with any human or living organism, a system's lifecycle can be broken down into three distinct moments: a beginning, a middle, and an end. Using a different approach than previously mentioned, these authors organized the system development lifecycle into six phases: project definition, system study, project, programming, installation, and post-implementation. Another example of the system development lifecycle comes from Avison and Fitzgerald (2006a), who divided it into the feasibility study, system investigation, system analysis, system conception, implementation, revision, and maintenance.

Avison et al. (2006a) pointed out some inherent benefits of using SDLC. They highlight its simplicity and ease of understanding and the existence of a methodological basis with specific documentation, deliveries, tools, and guidelines that support each phase. The typical progression in a lifecycle model is a linear sequence that follows a particular order in which every phase is related to the other. The outputs from one phase are used as inputs for the following phase (Van de Ven et al., 1995). Another lifecycle characteristic was noted by Avison et al. (2006a), which focused on the formal task division between the different specialists on a business and technical level. The traditional approach to the system development lifecycle has been gradually replaced by alternatives that also boost IS development, aiming at dealing with the limitations of the classic lifecycle by organizing activities in a waterfall format. For Laudon et al. (2007), the waterfall lifecycle is rigid and inflexible when reviewing requirements and specifications.

Similarly, Griffin et al. (2010) mentioned that a change made in one of the phases might result in modifications in the other phases as well, given their sequential nature, which assumes that one phase must be finished so that the next one can proceed. Also, Avison et al. (2006a) pointed out some flaws in responding to management needs and the excessive emphasis on the technical component, which tends to cause client dissatisfaction. Other aspects, such as time or financial constraints, can occasionally impact determine a different approach for systems development (Oz, 2009).

Project Lifecycle

The system development lifecycle (without the post-implementation operation/maintenance phases) is typically integrated into another cycle, the

project's lifecycle. The project's lifecycle comprises the phases that describe a project's lifespan, from start to finish (PMI, 2017, 2021).

Authors such as Pinto et al. (1988) and Thamhain et al. (1975) stated that a project's lifecycle is crucial in determining its successful implementation. Phases can be sequential, iterative, or overlapped, and the designation, number, and duration of each phase are directly related to the organization's need for management and control, as well as the project's nature and application field (PMI, 2017). Although differences may occur according to the business sector and the project itself, particularly in terms of dimension and complexity, in PMI (2021)'s point of view, four phases describe a project's life cycle: project start, organization and preparation, work execution and, finally, project closure. Monitoring and control are required along these four phases.

It should be noted that it is generally during the first phase that the system development lifecycle is defined. Consequently, SLDC can be considered an integral part of a project's lifecycle, as it fits in the work execution phase.

Product Lifecycle

Since the expected result of an ISD project is the introduction of one or more IT artefacts in the organization that lead to modifications (outcomes), it is necessary to consider another lifecycle, the product's lifecycle (PLC). The product lifecycle perspective is commonly related to its market introduction and evolution in the literature. According to Buzzell (1966), the PLC represents the unit sales line of a product, depicting the evolution of the market's attributes and characteristics (Polli, 1968) from the moment it is introduced in the market until its removal. Authors such as Levitt (1965) considered that a product should go through certain phases to be successful. Even though the literature presents different considerations regarding these phases, a well-accepted example is suggested by Levitt (1965), who referred to them as development, growth, maturity, and market downturn, thus stressing the importance for organizations to outline strategies compatible with each phase (Dean, 1950, Clifford, 1965). The product's lifecycle can support production planning and control (Forrester, 1958, Cox Jr, 1967, Cao et al., 2011).

Within the scope of this work, it is pertinent to analyze the perspective of adopting and introducing a product into an organization, which follows the same reasoning as a product introduced in the market (Varajão, 2018b). In this case, an IT product is developed and adopted by an organization to respond to previously identified business problems or opportunities. Maintenance activities should be untaken to ensure permanent alignment with business needs and product suitability for as long as possible. However, given that the changes in the internal and external business environment happen all the time, the organization may have to adopt a different solution in the future so it can evolve, which could mean replacing the product, thus resulting in its decline and removal. Consequently, a new IT product will have to be created, and the ISD process will be repeated.

ISD Process Models

Related to the system's lifecycles, there are process models. To better understand the term "process model", it is important to clarify the different interpretations of this concept.

According to Van de Ven (1992), a process can be seen from three perspectives: (i) a series of events that describe evolution through time; (ii) a category of concepts or variables related to actions undertaken by individuals or organizations; (iii) a logic that explains a causal link between variables, whether these are dependent or

independent. In this way, process models are projected to create sequences of events or stages to obtain a given result (Mohr, 1982), making clear how and why a process evolves in a specific way to achieve certain results (Mohr, 1982, Newman et al., 1992, Van de Ven et al., 1995, Langley, 1999, Cule et al., 2004). Process models are commonly associated with a particular type of ISD, which involves software development (creation). A software process model consists of a series of activities needed to develop a software product. Pressman (1997) defended that the process model selection should be based on the project's nature, the type of methods and tools to be used, and the need to make frequent deliveries and controls. Process models are closely connected to lifecycles and can also be used to ease and/or restrain the deployment approach.

The main models are described hereafter: Waterfall Model, Prototyping Model, Spiral Model, RAD Model, V-Shaped Model, Incremental Model, and Agile Models.

Waterfall Model (1970)

The waterfall model, also known as the classic lifecycle model (Pressman, 1997), is one of the most widespread models. As this model is sequential, it is impossible to proceed to the following phase if the previous one is not finished. According to Royce (1970), this model comprises the following phases: requirements definition, system design, unit implementation and testing, and operation. At the end of each phase, the project will be reviewed to ensure it is evolving as intended.

Prototyping Model (1970)

Clients frequently define a set of overall goals for a software project while not fully specifying the set of requirements to be checked, thus hindering the work of the development team (Pressman, 1997). The prototyping model is suitable for dealing with this kind of situation, as it begins with the preliminary gathering of requirements together with the client. Based on these requirements, an initial draft of the solution is then created, featuring only the representation of the visible aspects of the software for the client (Pressman, 1997), which will subsequently lead to the prototype construction. The prototype is cyclically used and evaluated by the client, so the requirements can be built and perfected until the final product is achieved.

Spiral Model (1988)

The main feature of the spiral model, originally proposed by Boehm, sets it apart from other models. It includes the notion of risk, which solves many existing difficulties (Boehm, 1988). The spiral shape, so typical of this model, represents the phases that comprise it, and risk assessment should be made in each one. Every "lap" of the spiral is divided into four sections: goals definition; risks identification, evaluation, and respective mitigation; development and validation; and planning of the upcoming iteration. A software project will go through each phase sequentially and repeatedly, and each resulting spiral is based on the baseline spiral. The spiral model is divided into activities, including analysis, design, implementation, testing, and deployment.

Rapid Application Development (1991)

Rapid Application Development (RAD) is a model proposed by James Martin based on rapid prototyping approaches. This incremental model prioritizes short, rapid, iterative, and low-cost development cycles and quality enhancement and the enrollment of the development team and the clients throughout the entire process. It should be noted that a prototype that is being created can undergo changes, and therefore any modifications regarding the requirements can be easily incorporated into the final solution. The RAD model also covers the following phases: business, data

and process modelling, application generation, and testing and re-use (Pressman, 1997).

V-Shaped Model (1991)

The V-Shaped model comprises two major moments: the decomposition and definition moment and the integration and verification moment. The model starts by answering the user's requirements and finishes with a system that the user properly validates. As with the waterfall model, the V-Shaped model also aims to implement each phase sequentially so that the previous phase must be completed for the next. More specifically, one side of the V-model, which comprises the development life cycle phases (requirements definition, analysis, design, and coding), goes down as the waterfall model. In contrast, the other side, where the testing phases are performed (unit test, integration test, system test, acceptance test) flows upwards, as a successive progression takes place regarding assemblies, units, and subsystems, with the respective checking, ending at the system level (Forsberg et al., 1992). These same authors claimed that the respective testing stage could be conducted in parallel and in a corresponding way for every phase of the development cycle.

Incremental Model (n.d.)

The incremental model combines elements from the linear sequential and iterative prototyping models (Pressman, 1997). Unlike the waterfall model, where the development takes place all at once, in this model, software increments are produced at each linear sequence. As a first increment, some emphasis is given to the main product (Pressman, 1997) since the goal is to attend to the necessities and requirements to ensure operations continuity. Each increment goes through the requirements, project, implementation, and testing phases. Before moving on to the following increment, a plan is developed to deal with the multiple modifications to the main product (Pressman, 1997). As each increment is finished, an operational product is delivered to the client. This process is repeated until a new product is completely produced.

Agile Models (2001)

Because previously detailed models are usually considered rigid, agile models emerged to make software development more efficient and effective. Generally speaking, the agile models are characterized by the following attributes (Abrahamsson et al., 2002): incremental (by creating "small" versions of the target product(s) with fast development cycles), cooperative (with constant communication between the client and the development team), simple (the created models are easy to learn and modify), and adaptable (there is the capacity to adapt to unpredictability and requirements modification). Agile models have become accepted as a way for organizations to create new products (Durbin et al., 2021).

ISD Deployment Approaches

The ISD activity, as a "project", typically ends with implementing all the modifications designed for the organization, including IT implantation. As this is a critical activity for achieving success and deeply impacts the organization, the organization must choose the right deployment approach, considering the new IS solution coverage and suitability. In addition, according to O'Leary (2000), defining a deployment approach should not only be based on cost and risk analysis but also the benefits stemming from each option. Regarding the organization of ISD deployment activities, the big-bang and the phased approaches are the most commonly used (Robinson,

2010). Besides the mentioned approaches, others are also used, such as the parallel and pilot approaches.

Big-Bang Approach

As the name implies, during the big-bang approach, the deployment is straightforward. It happens all at once, so every application and project modification is implemented simultaneously in the entire organization and during the same period. This approach implies higher risk because the legacy system is immediately disabled and makes room for a new system. The failure of only one component may jeopardize the entire system. Deployment time can be shorter when choosing the big bang approach, so the time required for employees to become acquainted with the new system also tends to be shorter. From the employees' perspective can be beneficial and advantageous, as it is not necessary to use two different systems simultaneously for the work to be implemented (O'Leary, 2000).

Phased Approach

Implementing the phased approach, also known as the incremental approach, implies the existence of several stages for a specific period. It can be operationalized in three ways (O'Leary, 2000): (1) IT modules or module grouping, in which greater emphasis is placed on the IT main modules to be implemented first, and in a limited number of organizational units, following the implementation of the remaining modules; (2) business unit, where the implementation is made in one or more business units at a time; (3) geographic area, which occurs in organizations distributed by several locations. Compared to the big-bang approach, the phased approach presents a lower risk in case of implementation failures, as the organization can resort to the legacy system until the problems are solved (O'Leary, 2000), even though this tends to incur more costs. According to Robinson (2010), this approach is more complex due to the common existence of dependencies between the different modules and business units. The phased approach, characterized as being slower, allows the introduction of significant and continuous improvements between phases and better management. Because this approach takes longer, an organisation's employees can acquire the necessary skills and expertise to use the new system. However, this same reason can result in a disadvantage, as the top management's and team's engagement may diminish over time, even before the project is fully completed (O'Leary, 2000).

Parallel Approach

The parallel approach implies the simultaneous execution of the legacy and new systems, resulting in a safer implementation. This way, users can learn to operate the new system while performing their daily tasks on the legacy system. When the new system is properly implemented and at the most appropriate time, the integral transition to the new system takes place (Leon, 2009), and the previous one is abandoned. Since this is an intermediary approach to the deployment mentioned above, the total failure risk is reduced. However, the parallel execution of two systems can be expensive, require more resources, and may reduce the new system's potential due to scattered attention (O'Leary, 2000).

Pilot Approach

In the pilot approach, firstly, only part of the organization uses the new system; later, to implement the other parts, it is necessary to use either the big-bang approach or the parallel approach (O'Brien et al., 2010). The major advantage associated with this type of implementation is to find and solve potential problems at the pilot site without

having a widespread impact on the organization (Xu, 2019). This way, the use of a new system will only be extended to other sites when the pilot test is properly evaluated and successfully concluded. One disadvantage of this approach is that each site's singularities may differ from the pilot site's (O'Brien et al., 2010).

Hybrid Approach

Additionally, several authors, such as Leon (2009), consider another deployment approach: the hybrid approach. This approach combines different types of implementations, which, for instance, allows organizations to use a big-bang approach for smaller business units, and the phased approach for the others. Therefore, as two cycles are required to conduct the deployment, fewer resources are needed compared to the pure big-bang approach, and the deployment time is also reduced. However, the possibility of returning to a previous phase may affect the associated deployment costs (Elizabeth et al., 2015).

Agile Approach

Another approach for ISD deployment that has not been explored in-depth in the research literature outside the software development field is the agile approach. According to Moran (2015), agile allows obtaining independent, simple, and partially functional increments, forming the full product together. The project's product is gradually enhanced by implementing successive iterations of a typically fixed duration. With each iteration, the development team not only benefits from the lessons learned with the previous iteration and reflects on the modifications required by the client but also integrates new functionalities. Therefore, a new usable product increment is created and delivered for the client to use it and provide subsequent feedback (Abbas et al., 2008). These same authors also highlight a major advantage of adopting this approach – the ability to adapt to the uncertainty of the development environment.

ISD Methodologies

According to Avison et al. (1998), ISD methodologies consist of crucial structures that can be used during the definition and development process. Conventional approaches tend to overly emphasize the technical part, which is insufficient to support the entire ISD process. Therefore, it is important to encourage the balance between technical rationality and the social aspects that are part of the ISD process. Methodologies typically have particular life cycles (Mittermeir, 1992), process models (Verhage, 2009), and deployment approaches.

Open Methodologies

Overall, methodologies are designed to improve existing approaches or propose new forms of ISD (Avison et al., 2006b). A set of public domain methodologies can be found in the scientific literature, so there is no restriction on their access and use. For this reason, they are referred to here as open methodologies. Some of the main ISD open methodologies are presented next: Information Engineering, Soft Systems Methodology, MERISE, SSADM, Multiview, and Yourdon Systems Method.

Information Engineering (IE) (1981)

The Information Engineering methodology identifies a set of activities and techniques concerning ISD. It comprises several phases (Richmond, 1991): information strategy planning, business area analysis, system analysis and representation, construction, transition, and production.

Soft Systems Methodology (SSM) (1981)
The Soft Systems Methodology is a systemic methodology that optimizes continuous learning about a complex real-world situation, providing a structure that overcomes the lack of a consistent definition of the problem (Checkland, 1989).

MERISE (1983)
The MERISE relies on three cycles: the decision cycle, which is related to the multiple decision mechanisms; the lifecycle, which reflects the chronological IS progress; and the abstraction cycle, which is the focal point of this methodology that portrays the different processes and data models through several stages (conceptual, logical, and physical) (Avison, 1991), contrary to what happens in other methodologies, which were not designed to equally emphasize each phase.

SSADM (1988)
Considered the "modern" version of the traditional approach to the ISD lifecycle, SSADM divides a project into structured tasks that fit into a sequence of seven phases. This methodology combines three principles bearing the same degree of relevance: method structure, structured techniques and their respective correlation, and documents and forms created (Ashworth, 1988). Each of these principles provides a different vision of the same system, contributing to the final projection of the system's model.

Multiview (1990)
Multiview is seen as a hybrid process involving the development team and the final users of the system (Avison et al., 1998), thus ensuring that a special focus is given to the social and technical side throughout the whole ISD process. It should be noted that this method includes five development phases.

Yourdon Systems Method (YSM) (1993)
This method consists in breaking down a problem into functional units. This method comprises three main phases (Avison et al., 2006a): feasibility study, construction of the main model, and deployment model.

Additionally, we can mention the Unified Process (UP) (Jacobson et al., 1999), which is focused on software development. Moreover, three additional proposals were found – engIS (Carvalho, 2017), agilIS (Varajão, 2018a), and AgileMIP (Soares, 2020) – but they are currently restricted to teaching activities. Overall, based on the literature review, an apparent stagnation of the proposal and evolution of ISD open methodologies stand out.

8.2. ISD General Proprietary Methodologies
Some of the major organizations in the IS arena develop their methodologies to be used by themselves and their business partners. For this reason, they are called here *general proprietary methodologies*. These methodologies supply the tools and guidance for ISD project management, including the phases of the IT business solutions implantation process. Just three examples are mentioned next to avoid presenting an extensive list: Oracle Unified Method, Microsoft Dynamics Sure Step Methodology, and SAP Activate.

The Oracle Unified Method is a methodology proposed by Oracle based on the Unified Process. According to Oracle (2016), this methodology provides organizations with a quick, flexible, business-oriented approach that is also easily adaptable to a wide range of specific organizational situations. OUM also includes an operational structure that allows anticipating a project's needs and critical points. This methodology covers the entire deployment process by organizing it into six phases – initiation, conception, construction, transition, and production – and includes the optimization and updating phases.

Microsoft Dynamics Sure Step Methodology (2007)
Microsoft Dynamics Sure Step Methodology integrates project management tools and recommended practices to assist the implementation of Microsoft business solutions. It comprises six main phases (diagnosis, analysis, design, development, deployment, and operation) and two additional phases (optimization and updating). Sure Step comprises eight processes (business processes analysis, configuration, data migration, infrastructure, installation, integration, testing, and training) carried out during the different phases (Microsoft, 2014, 2021).

SAP Activate (2015)
SAP Activate is a methodology featuring a modular and agile structure developed by SAP, designed to implement SAP S/4HANA and other SAP solutions. SAP Activate provides a wide set of specific and structured tools, practices, models, and processes tailored to the specific business needs of the organizations. This methodology comprises six phases: discovering, preparing, exploring, performing, implementing, and executing. Systematically, there are quality checkpoints throughout the different phases, which are decisive for the project's success (SAP, 2017).

ISD Custom Proprietary Methodologies
Some of the major organizations with a strong component in the IS field developed their implementation methodologies. Contrary to the general proprietary methodologies addressed in the previous section, these methodologies are restricted to the owner organizations. Only those organizations can use them internally, so they are designated as *custom proprietary methodologies*. As with the general proprietary methodologies, custom proprietary methodologies can also provide the necessary tools and guidelines for project management and, more precisely, for all the phases of the business solutions development process. Deloitte & Touche, Accenture, and PricewaterhouseCoopers are examples of organizations that have developed their methodologies, which are not in the public domain.

ISD Framework and Discussion
Framework
Figure 2 summarizes the main results by presenting a framework of ISD concepts.

Figure 2
The framework of Information Systems Development Concepts
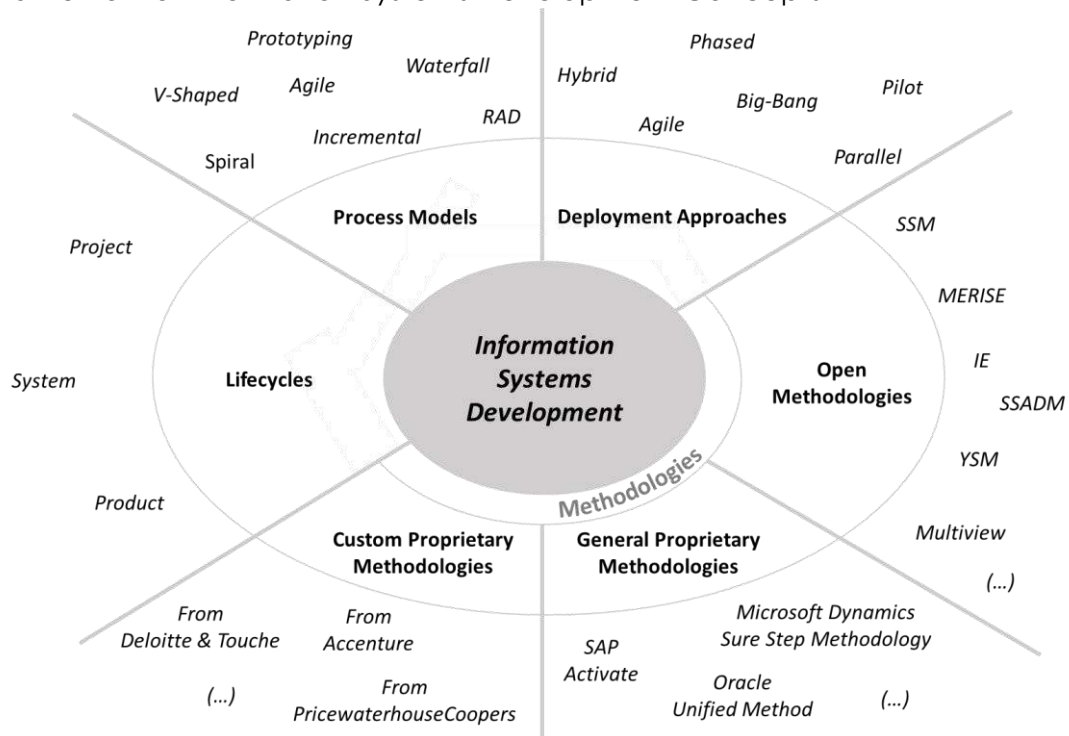
Source: Author's illustration

Considering all the concepts, ISD endeavours can be identified as three lifecycles: project, system development, and product. The project lifecycle comprises the initiation, planning, execution, and closing phases. In the initiation and planning phases, it is important to consider the process model (e.g., Waterfall) and the deployment approach (e.g., Big-Bang) to be adopted since they influence how project activities are organized. The system development lifecycle globally regards the execution activities of the project lifecycle, which can be organized according to different process models (e.g., Waterfall). One important set of process model activities is the deployment of project outputs, which can also be conducted following different approaches (e.g., Big-Bang). When the outputs are made available to the organization, then the product lifecycle starts. The methodologies may comprise all the lifecycles and typically have an implicit process model and preferred deployment approach, whether open, general proprietary, or custom proprietary.

Contributions to Theory

As described in the previous sections, there are different aspects and related concepts that should be considered regarding ISD, which are so deeply intertwined that they are frequently addressed in an undifferentiated manner and create confusion and give rise to misconceptions. The framework presented here contributes to the ISD body of knowledge, aiming to provide an integrated perspective on ISD concepts by identifying, describing, and relating four major conceptual dimensions: lifecycles, process models, deployment approaches, and methodologies.

Implications for Practice

Many aspects must be considered in an ISD project. For instance, it is important to recognize the different lifecycles to define success evaluation milestones, addressing the project management success and the business impact (Varajão, 2018b, Varajão

et al., 2022b). The process model and the deployment approach should also be defined by considering the project's characteristics and context (e.g., the need for frequent deliveries). Furthermore, it is important to adopt suitable methodologies because they provide detailed guidelines on the activities to be carried out and the artefacts to be produced. Our framework provides practitioners with guidance on these aspects and promotes awareness of the different alternatives to be followed in projects.

Also, of note is the relevance of the proposed framework for teaching since it provides a structured perspective on the relevant concepts and is described progressively (from lifecycles to methodologies).

Conclusion

On the one hand, the wide range of ideas and concepts surrounding ISD and the multiple underlying views on the subject make it harder for researchers and practitioners to understand the relevant aspects of this important activity. On the other hand, extant research is typically focused on different aspects of ISD (e.g., a particular process model). The same expressions are often used to refer to different ISD aspects, or different expressions refer to the same ISD aspects. The ISD framework presented here systematizes and organizes the main concepts of ISD to create a coherent perspective regarding lifecycles, process models, deployment approaches, and methodologies.

Limitations

As a major limitation of this study, we identify the superficial exploration of ISD's proprietary methodologies. This is partially due to the article's length restrictions and the restricted access to those methodologies since they are not in the public domain. Another limitation is related to the methodology's coverage since the main goal here was to classify them and not to provide a complete list of extant methodologies. These limitations open avenues for further research.

Future Research Directions

Stagnation is noted regarding ISD open methodologies, at least apparently, since we could not find recent proposals in the research literature on this matter. On the one hand, software development has been fertile in recent years. It has shown high dynamism by proposing several frameworks, process models, and methodologies, mainly related to the agile approach (e.g., Scrum, XP, Crystal, etc.). On the other hand, in the case of ISD, it seems that this kind of effort has been limited to private companies. The agile approach emerged to fill some of the existing gaps in classical models and has been widely adopted in software development. However, to the best of our knowledge, there is no research literature focused on agile ISD processes or methodologies, and this can be an opportunity for future work. It would be an interesting avenue to develop a comparative study on proprietary methodologies, aiming at identifying similarities, differences, improvement opportunities, and good practices.

A final message is addressed to companies to disclose their proprietary methodologies to the public domain. Making the methodologies accessible to the public domain would contribute to research and education in this field, and therefore their disclosure (even if partial) is strongly encouraged.

References

1. Abbas, N., Gravell, A. M., Wills, G. B. (2008), „Historical Roots of Agile Methods: Where Did "Agile Thinking" Come From?", in Abrahamsson, P. et al. (Eds.), Agile Processes in Software Engineering and Extreme Programming. Lecture Notes in Business Information Processing. Berlin, Heidelberg, Springer, pp. 94-103.
2. Abrahamsson, P., Salo, O., Ronkainen, J., Warsta, J. (2002), „Agile Software Development Methods: Review and Analysis", Espoo, Finland, VTT Technical Research Centre of Finland, VTT Publications.
3. Alavi, M., Yoo, Y. (2015), „Use Information Technology for Organizational Change", in Locke, E. A. (Ed.), Handbook of Principles of Organizational Behavior, Chichester, Wiley, pp. 595-614.
4. Ashworth, C. M. (1988), „Structured systems analysis and design method (SSADM)", Information and Software Technology, Vol. 30 No. 3, pp. 153-163.
5. Avison, D. E. (1991), „MERISE: A European methodology for developing information systems", European Journal of Information Systems, Vol. 1 No. 3, pp. 183-191.
6. Avison, D. E., Fitzgerald, G. (1999), „Information Systems Development", in Currie, W., Galliers, B. (Eds.), Rethinking Management Information Systems: An Interdisciplinary Perspective, Oxford, Oxford University Press, pp. 136-155.
7. Avison, D. E., Fitzgerald, G. (2006a), Information Systems Development: Methodologies,Techniques, and Tools, 4th ed., New York, McGraw-Hill Education.
8. Avison, D. E., Fitzgerald, G. (2006b), „Methodologies for Developing Information Systems: A Historical Perspective", in Avison, D., Elliot, S., Krogstie, J., Pries-Heje, J. (Eds.), The Past and Future of Information Systems: 1976–2006 and Beyond, IFIP WCC TC8 2006, IFIP International Federation for Information Processing, Boston, MA, Springer.
9. Avison, D. E., Wood-Harper, A. T., Vidgen, R. T., Wood, J. R. G. (1998), „A further exploration into information systems development: the evolution of Multiview2", Information Technology & People, Vol. 11 No. 2, pp. 124-139.
10. Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., Venkatraman, N. V. (2013), „Digital business strategy: Toward a next generation of insights", MIS Quarterly, Vol. 37 No. 2, pp. 471-482.
11. Boehm, B. W. (1988), „A spiral model of software development and enhancement", Computer, Vol. 21 No. 5, pp. 61-72.
12. Bulchand-Gidumal, J. Melián-González, S. (2011), „Maximizing the positive influence of IT for improving organizational performance", The Journal of Strategic Information Systems, Vol. 20 No. 4, pp. 461-478.
13. Buzzell, R. D. (1966), „Competitive behavior and product life cycles", in Wright, J., Goldstucker, J. (Eds.), New Ideas for Successful Marketing, Chicago, American Marketing Association, pp. 46-67.
14. Cao, H., Folan, P. (2011), „Product life cycle: the evolution of a paradigm and literature review from 1950–2009", Production Planning & Control, Vol. 23 No. 8, pp. 641-662.
15. Carvalho, J. Á. (1996), „Information Systems Development: From Computer Systems Construction to Organizational Reengineering", Guimarães, Portugal, Department of Information Systems, University of Minho.
16. Carvalho, J. Á. (2017), „engIS (v3)", Guimarães, Portugal, Department of Information Systems, University of Minho.
17. Checkland, P. B. (1989), „Soft Systems Methodology", Human Systems Management, Vol. 8 No. 4, pp. 273-289.
18. Clifford, D. K. (1965), „Leverage in the Product Life Cycle", Duns Review of Modern Industry, Vol. 85 No. 5, pp. 62-70.
19. Cox Jr, W. E. (1967), „Product life cycles as marketing models", Journal of Business, Vol. 40 No. 4, pp. 375-384.
20. Cule, P.E., Robey, D. (2004), „A dual-motor, constructive process model of organizational transition", Organization Studies, Vol. 25 No. 2, pp. 229-260.
21. Dasgupta, S., Agarwal, D., Ioannidis, A., Gopalakrishnan, S. (1999), „Determinants of information technology adoption: an extension of existing models to firms in a developing country", Journal of Global Information Management, Vol. 7 No. 3, pp. 30-40.

22. De Leoz, G. M. (2017), Exploring the impacts of development methodologies on the collective action of information systems development project teams, Doctoral dissertation, Baylor University.
23. Dean, J. (1950), „Pricing Policies for New Products", Harvard Business Review, Vol. 28, pp. 45-53.
24. Durbin, M., Niederman, F. (2021), „Bringing templates to life: overcoming obstacles to the organizational implementation of Agile methods", International Journal of Information Systems and Project Management, Vol. 9 No. 3, pp. 5-18.
25. Elizabeth, M., Sanjana, M. R., Nayantara N. V., Sheetal V. A. (2015), „A Survey on ERP Implementation Techniques", International Journal of Emerging Technology and Advanced Engineering, Vol. 5 No. 4, pp. 66-69.
26. Forrester, J. W. (1958), „Industrial dynamics", Harvard Business Review, Vol. 36 No. 4, pp. 37-66.
27. Forsberg, K., Mooz, H. (1992), „The Relationship of System Engineering to the Project Cycle", Engineering Management Journal, Vol. 4 No. 3, pp. 36-43.
28. Griffin, A. Brandyberry, A. (2010), „Systems Development Methodology Usage in Industry: A Review and Analysis", Journal of Information Systems Applied Research, Vol. 3 No. 19, pp. 1-17.
29. Haffke, I., Kalgovas, B. Benlian, A. (2016), „The Role of the CIO and the CDO in an Organization"s Digital Transformation", in Thirty Seventh International Conference on Information Systems, Dublin, Ireland, pp. 1-20.
30. Hedman, J., Lind, M. (2009), „Is There Only One Systems Development Life Cycle?", in Wojtkowski W., W. G., Lang M., Conboy K., Barry C. (Eds.), Information Systems Development: Challenges in Practice, Theory, and Education, Boston, Springer.
31. Hirschheim, R., Klein, H. K., Lyytinen, K. (1996), „Exploring the Intellectual Structures of Information Systems Development: Action Theoretic Analysis", Accounting, Management and Information Technologies, Vol. 6 No. 1-2, pp. 1-64.
32. Hoffer, J. A., George, J. F., Valacich, J. S. (2007), Modern Systems Analysis and Design, 5th ed., Upper Saddle River, NJ, Pearson Prentice Hall.
33. Jacobson, I., Booch, G., Rumbaugh, J. (1999), The Unified Software Development Process, Boston, MA, Addison Wesley.
34. Kääriäinen, J., Pussinen, P., Saari, L., Kuusisto, O., Saarela, M., Hänninen, K. (2020), „Applying the positioning phase of the digital transformation model in practice for SMEs: toward systematic development of digitalization", International Journal of Information Systems and Project Management, Vol. 8 No. 4, pp. 24-43.
35. Kraus, S., Breier, M., Dasí-Rodríguez, S. (2020), „The art of crafting a systematic literature review in entrepreneurship research", International Entrepreneurship and Management Journal, Vol. 16 No. 3, pp. 1023-1042.
36. Langley, A. (1999), „Strategies for theorizing from process data", Academy of Management Review, Vol. 24 No. 4, pp. 691-710.
37. Laudon, K. C., Laudon, J. P. (2007), Management Information Systems: Managing the Digital Firm, 10th ed., Upper Saddle River, NJ, Pearson Prentice-Hall.
38. Leon, A. (2009), Enterprise Resource Planning, 2nd ed., New York, McGraw-Hill Education.
39. Levitt, T. (1965), „Exploit the product life cycle", Harvard Business Review, Vol. 43, pp. 81-94.
40. McConnell, S. (1996), Rapid Development: Taming Wild Software Schedules, Redmond, Washington, Microsoft Press.
41. Microsoft (2014), "Implementation methodology", available at www.docs.microsoft.com (15 August 2022)
42. Microsoft (2021), "Implementation methodology", available at https://docs.microsoft.com/en-us/dynamicsax-2012/appuser-itpro/implementation-methodology (15 August 2022)
43. Mittermeir, R. (1992), „Shifting Paradigms in Software Engineering", in Proceedings of the 7th Joint Conference of the Austrian Computer Society (OCG) and the John von Neumann Society for Computing Sciences (NJSZT), Klagenfurt, Austria.
44. Mohr, L.B. (1982), Explaining organizational behavior, San Francisco, Jossey-Bass.

45. Moran, A. (2015), Managing Agile - Strategy, Implementation, Organisation and People, Switzerland, Springer International Publishing.
46. Morcov, S., Pintelon, L., Kusters, R. (2020), „Definitions, characteristics and measures of IT project complexity - a systematic literature review", International Journal of Information Systems and Project Management, Vol. 8 No. 2, pp. 5-21.
47. Newman, M., Robey, D. (1992), „A social process model of user-analyst relationships", MIS Quarterly, Vol. 16 No. 2, pp. 249-266.
48. Ngereja, B. J., Hussein, B. (2021), „An examination of the preconditions of learning to facilitate innovation in digitalization projects: a project team members perspective", International Journal of Information Systems and Project Management, Vol. 9 No. 2, pp. 23-41.
49. O'Brien, J. A., Marakas, G. M. (2010), Management Information Systems: Managing Information Technology In The Bussiness Enterprise, 10th Edition ed., New York, McGraw-Hill Education.
50. O'Leary, E. D. (2000), Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce and Risk, Cambridge, Cambridge University Press.
51. Oracle (2016), „Oracle Unified Method (OUM) Oracle's Full Lifecycle Method for Deploying Oracle-Based Business Solutions", White paper. Oracle.
52. Oz, E. (2009), Management Information Systems, 6th ed., Great Valley, The Pennsylvania State University, Thomson Course Technology.
53. Ozturk, V. (2013), „Selection of appropriate software development life cycle using fuzzy logic", Journal of Intelligent and Fuzzy Systems, Vol. 25 No. 3, pp. 797-810.
54. Pearlson, K. E., Saunders, C. S., Galletta, D. F. (2016), Managing and Using Information Systems: A Strategic Approach, 6th ed. Hoboken, NJ, Wiley.
55. Pejić Bach, M., Dumičić, K., Žmuk, B., Ćurlin, T., (2020), „Data mining approach to internal fraud in a project-based organization", International Journal of Information Systems and Project Management, Vol. 8 No. 2, pp. 81-101.
56. Pejić Bach, M., Jaklič, J., Vugec, D.S. (2018), „Understanding impact of business intelligence to organizational performance using cluster analysis: does culture matter?", International Journal of Information Systems and Project Management, Vol. 6 No. 3, pp. 63-86.
57. Pereira, J., Varajão, J., Takagi, N. (2022), „Evaluation of Information Systems Project Success – Insights from Practitioners", Information Systems Management, Vol. 39 No. 2, pp. 138-155.
58. Pinto, J. K., Prescott, J. E. (1988), „Variations in critical success factors over the stages in the project life cycle", Journal of Management Information Systems, Vol. 14 No. 1, pp. 5-18.
59. PMI (2017), A Guide to the Project Management Body of Knowledge (PMBOK Guide), 6th ed., Newton Square, Pennsylvania, Project Management Institute.
60. PMI (2021), A Guide to the Project Management Body of Knowledge (PMBOK Guide), 7th ed., Newton Square, Pennsylvania, Project Management Institute.
61. Polli, R. (1968), „A Test of the Classical Product Life Cycle by Means of Actual Sales Histories", Doctoral dissertation, University of Pennsylvania.
62. Pressman, R. (1997), Software Engineering – a practitioner's approach, 5th ed., New York, McGraw-Hill Higher Education.
63. Richmond, K. (1991), „Information engineering methodology: A tool for competitive advantage", Telematics and Informatics, Vol. 8 No. 1-2, pp. 41-57.
64. Robinson, P. (2010), "Should you implement ERP with the BIG BANG or phased approach?", available at http://www.bpic.co.uk/faq/bigbang.html (15 August 2022)
65. Royce, W. W. (1970), „Managing the Development of Large Software Systems", Proceedings of IEEE WESCON, Vol. 26, pp. 328-338.
66. SAP (2017), "Implementing SAP S4HANA, on-premise with SAP Activate", available at https://wiki.scn.sap.com/wiki/display/ATopics/Implementing+SAP+S4HANA,+on-premise+with+SAP+Activate (15 August 2022)
67. Singh, A., Kaur, P. J. (2019), „Analysis of Software Development Life Cycle Models", in Nath,V., Mandal, J. K. (Eds.), Development Life Cycle Models. Proceeding of the Second International Conference on Microelectronics, Computing & Communication Systems, Lecture Notes in Electrical Engineering. Singapore, Springer, pp. 689-699.
68. Soares, J. (2020), „AgileMIP", Master Thesis, University of Minho.

69. Spohrer, K. (2016), Collaborative Quality Assurance in Information Systems Development: The Interaction of Software Development Techniques and Team Cognition, Switzerland, Springer International Publishing.
70. Thamhain, H. J., Wilemon, D. L. (1975), „Conflict management in project life cycles", Sloan Management Review, Vol. 16 No. 3, pp. 31-50.
71. Van de Ven, A. H. (1992), „Suggestions for studying process: A research note", Strategic Management Journal, Vol. 13 No. 1, pp. 169-188.
72. Van de Ven, A. H., Poole, M. S. (1995), „Explaining development and change in organizations", Academy of Management Review, Vol. 20 No. 3, pp. 510-540.
73. Varajão, J. (2002), „Information Systems Function: Contributions to the successful adoption of information technologies and development of information systems in organizations", Doctoral dissertation, University of Minho.
74. Varajão, J. (2018a), „agilIS – agile Information systems", Guimarães, Portugal, Department of Information Systems, University of Minho.
75. Varajão, J. (2018b), „The many facets of information systems (+projects) success", International Journal of Information Systems and Project Management, Vol. 6 No. 4, pp. 5-13.
76. Varajão, J., Carvalho, J. (2018), „Evaluating the Success of IS/IT Projects: How Are Companies Doing It?", in International Research Workshop on IT Project Management, a13.
77. Varajão, J., Carvalho, J.Á., Silva, T., Pereira, J. (2022a), „ Lack of Awareness of IT Adoption and Use Theories by IT/IS Project Managers: Poor Relevance, Unfocused Research or Deficient Education?", Information, Vol. 13 No. 2, pp. a48.
78. Varajão, J., Fernandes, G., Silva, H. (2020), „Most used project management tools and techniques in information systems projects", Journal of Systems and Information Technology, Vol. 22 No. 3, pp. 225-242.
79. Varajão, J., Magalhães, L., Freitas, L., Rocha, P. (2022b), „Success Management – From theory to practice". International Journal of Project Management, Vol. 4 No. 5, pp. 481-498.
80. Varajão, J., Trigo, A., Pereira, J. L., Moura, I. (2021), „Information systems project management success", International Journal of Information Systems and Project Management, Vol. 9 No. 4, pp. 62-74.
81. Verhage, L. (2009), Management Methodology for Enterprise Systems Implementation, Delft, Eburon Academic Publishers.
82. Welke, R. J. (1983), „IS/DSS: DBMS Support for Information Systems Development", in Holsapple, C. W., Whinston, A. B. (Eds.) Data Base Management: Theory and Applications, Dordrecht, Springer, pp. 195-250.
83. Wong, W. Y., Yu, S. W., Too, C. W. (2018), „A Systematic Approach to Software Quality Assurance: The Relationship of Project Activities within Project Life Cycle and System Development Life Cycle", in 2018 IEEE Conference on Systems, Process and Control, Melaka, Malaysia, IEEE, pp.123-128.
84. Xia, W., Lee, G. (2005), „Complexity of Information Systems Development Projects: Conceptualization and Measurement Development", Journal of Management Information Systems, Vol. 22 No. 1, pp. 45-84.
85. Xu, J. (2019), Essential Topics Of Managing Information Systems, Singapore, World Scientific Publishing Company.

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Employers' Revelation of Decision-making Keys for Employing People with Visual Impairment: Mixed-method Analysis of Employers' Motivations

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Abstract

Background: People with visual impairment or blindness (PWVIB) face many barriers related to employment. Although literature explores employers' concerns regarding the employment of PWVIB, stating the concern and developing a solution are different. **Objectives:** Employers' solutions to concerns regarding hiring PWVIB have not been surveyed. This study addresses the gap by surveying employers to determine practical solutions and developing the Solutions for Improving Employment of People with Visual Disabilities (SIEPVD) model. **Methods:** We employed a mixed-method design based on the 975 completed surveys from employers with hiring authority. We also identified and tagged major themes and developed an empirical model. Structural Equation Modelling (SEM) was employed to test the model's goodness of fit. **Results:** Findings highlight the need for evidence of job capabilities such as financial incentives, information provision, and adequate job vacancies. Evidence or financial incentives directly and positively affect employers' attitudes toward hiring PWVIB. Financial incentives also mediate information provision and job match with employers' attitudes toward hiring PWVIB. **Conclusions:** This is the first study to perform employers' integration by creating solutions to increase PWVIB's employment rate. Results may help PWVIB in its employment efforts. Thus, the approach when applying for jobs or attending interviews should be reviewed. Practical contributions are discussed.

Introduction

People with visual impairment or blindness (PWVIB) have many barriers to employment (Zapata, 2020). In the marketing field, the best practice of marketers is to ask customers not only about their current experience but also about how to improve the product (Williams, 1993) or even ask them to create and submit ideas (Leimeister et al., 2009). Employers acknowledge that the best way toward productivity and profitability is the commitment of the workforce (Ijiola, 2018). However, PWVIB experience work discrimination (Victor et al., 2017) and low employment rates (Taylor et al., 2006).

McDonnall et al. (2019) investigated employment rates of people who are blind or visually impaired, using estimates from multiple sources between 1994 – 2017. They report that employment rates for people with visual impairments have not significantly increased over time and that only 44% of the U.S. population with a visual impairment is employed; these findings underline the serious problem of PWVIB. Previous studies explored employers' concerns regarding the employment of PWVIB (e.g. Kaye et al., 2011), but understanding the concerns is only the first step. Moreover, no study has yet surveyed employers for solutions to their concerns about hiring PWVIB. That is, similar to the customer integration in the value creation process (Leimeister et al., 2009), we perform employers' integration by creating solutions to increase PWVIB's employment rate. In this study, we address the gap by conducting surveys with employers and asking them for solutions that may reduce the concerns and elevate the employment rate of PWVIB.

Productivity and profitability are the two key metrics for measuring the efficiency of a business firm (Grover, 2020) and are, therefore, primary business goals. Employers want employees that can get the job done. Therefore, when considering PWVIB candidates, the first concern is if the disability will become an obstacle to productivity. Such a concern will not be diminished by measures such as legal obligations for equal employment (Harpur, 2012) or even by governmental financial incentives for employers hiring persons with disabilities (Gröschl, 2007). Anti-discrimination legislation has not yet improved the hiring practices of workers with disabilities but has increased employers' concerns about their financial and/or legal obligations (Kuznetsova et al., 2017). Although these proactive measures are valuable and important to fight PWVIB employment discrimination, in this study, we highlight another approach to directly encounter employers' concerns and improve their motivation to employ PWVIB. We will investigate direct and possible mediation effects on the employers' attitude to employing PWVIB, and specifically, the effect of the requirement for evidence and financial incentives.

We employ a mixed-method design, incorporating qualitative and quantitative methods. Thus, offering more robust research with rich support. We present an empirical model comprising a system of relationships and assessed using Path Analysis (Lleras, 2005).

The first part of the manuscript presents the theoretical background. The second part describes the methodology used and the techniques employed for both the qualitative and quantitative analysis. The third part holds qualitative examples from the respondents, presented to offer richer support for the research findings. The fourth part presents the results, followed by the discussion chapter, which discusses the findings as well as practical implications. The final part comprises the limitation and future extensions to this research.

Hypothesis development

For this research, we develop the solutions for increasing employment of people with visual disabilities (SIEPVD) research model (Figure 1), which elements will be presented in this part of the paper.

Figure 1
SIEPVD research model
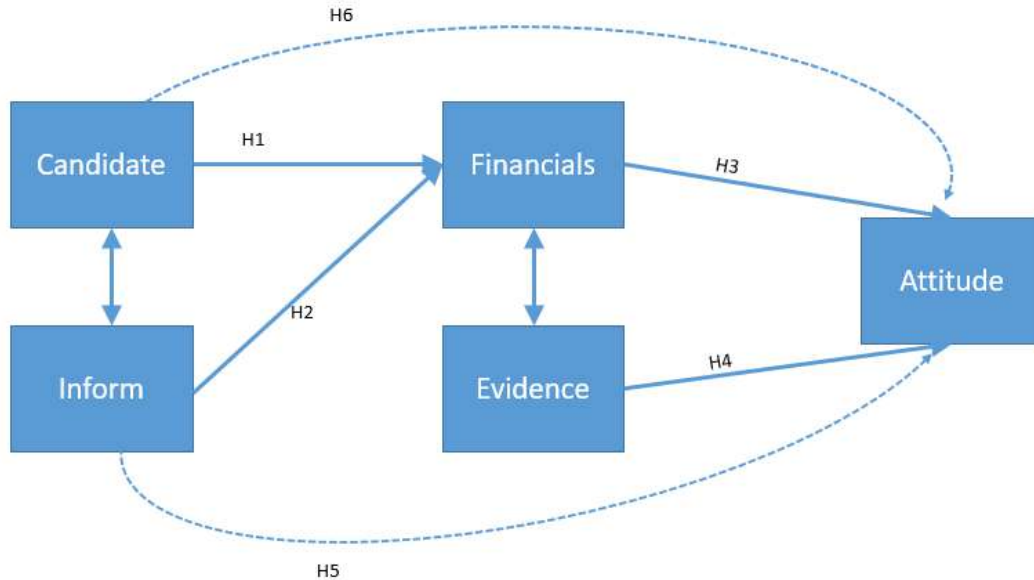
Source: Authors' work

Need of evidence

Work Capability Assessment (WCA) for people with disabilities may be performed using three forms (Geiger, 2018): Expert assessments, which are common and have some degree of legitimacy. Demonstrated assessments, where the employer looks at people's actual experiences in the labor market. Structured assessments match people's capacities to the functional demands that are required in existing jobs.
As employers do not know the employee's marginal productivity of labor at the time of hiring, nor the employee's value over time, many uncertainties are expected (Perufo et al., 2018). Therefore, employers try to evaluate the ability of a candidate to perform the job.

Prior experience in a corporate context is typically advantageous for job candidates (Rivera, 2011). However, in many countries, large companies are forced by the law to recruit people with disabilities (Tamako, 2007; Carvalho-Freitas et al., 2015). Research showed that generic work experience does not lead to superior firm performance (Grilli, 2011), and even specific work experience does not always affect performance (Rosita et al., 2019). Therefore, prior work experience may not be indicative of work capability and may not be sufficient evidence for the employer as a measure of the ability of a person with visual impairment disabilities (VID) to perform the job adequately.

Similarly, employers use prior salary information as an indication of a candidate's worth (Farrell et al., 2017). According to Marginal Productivity Theory, each individual gets paid based on his or her contribution to the employer's revenue (Pressman, 2014). This case may be true, except for significant income inequalities (Klees, 2017). Specifically, people with disabilities are often underpaid and overworked (Drew et al., 2011), thereby eliminating prior salary as an indication of job capability.

Specifically for PWVIB, employers' concerns for job capability resulted throughout history in a much lower employment rate than people with other disabilities (Taylor, 2011). Therefore, we can hypothesize that the ability to provide employers with any kind of proof or evidence that PWVIB can perform the job may be a key to improving employers' attitudes toward employing them.

- o *H1. Evidence for the ability to employ PWVIB positively affects the attitude to employ them.*

Financial incentives

Typical financial incentives include (Lunt et al., 1994): work subsidies paid to either employers or employees to make up for lost productivity, wage subsidies, which can take the alternative form of a tax credit, and one-off grants payable to employers when they take on a disabled people. Worldwide examples include wage subsidies in Norway and tax incentives in India (Chhabra, 2021).

According to the Conservation of Resources theory (Hobfoll, 1989), stress arises when an individual loses resources or fails to gain resources. A manager would, therefore, naturally try to avoid any risks. Furthermore, according to the expected value and expected utility theories, people rationally decide to derive the best possible outcome (Soh, 2010). Hence, when hiring an employee, the company pays non-recurring costs related to activities, such as recruitment, selection, hiring, medical assessment, and contracts (Perufo et al., 2018). As the desired level of education and experience increases, the process becomes more expensive (Perufo et al., 2018). Expenses are often higher regarding people with disabilities, specifically with VID, because the employer needs to implement proper accommodations at the workplace (Rumrill Jr et al., 1997). Accommodations refer to the need to modify, adjust, and change the workplace to hire PWVIB (McDonnall et al., 2014). Hiring PWVIB will also incur expenses regarding assistive technology required for PWVIB (Amurani, 2019), including screen enlargers, speech synthesizers, screen readers, text scanners, Braille displays, Braille digital converter, and speech browsers (Stirbens et al., 2010). Finally, studies showed that financial incentives have a positive effect on employing people with disabilities (Wuellrich, 2010). In addition, a focus on financial incentives may cause additional variables, such as information on VID or job match, to be redundant, and vice versa. We, therefore, hypothesize the following:

- o *H2. Financial incentives to employ PWVIB positively affect the attitude to employ them.*
- o *H3. Information about VID negatively affects financial incentives to employ PWVIB.*
- o *H4. Job match of PWVIB negatively affects financial incentives to employ PWVIB.*

Financial incentive mediation information to attitude

The lack of information regarding PWVIB was previously underlined as the main factor for the negative approach to hiring PWVIB (McDonnall et al., 2014). Even when organizations and individual employees are interested in assisting people with low vision, their lack of knowledge and training undermines their intentions (Richards et al., 2010).

However, information about VID can be easily obtained if the employer desires; therefore, the lack of information may not be enough to affect a negative attitude. Financial risk is also one of the most dominant concerns for discrimination (Brouwers et al., 2020), and without financial incentives, the financial risk remains. That is, lack of VID

information may affect a negative attitude in cases where the lack of information increases financial risk concerns. We, therefore, hypothesize the following:

> o *H5. Financial incentives mediate the impact of the information about VID on the attitude to employ them.*

Financial incentives mediation job match to attitude

Identifying the appropriate person for the job and matching strengths and abilities to the requirements of the position are important for successful hiring and retention (Kuo et al., 2014).

Successful assimilation of people with disabilities in the workplace is common (Blanck, 1998). However, economic subsidies are sometimes required to persuade employers to implement adaptations at work (Ehn et al., 2020). This notion indicates that a job candidate with a visual impairment that may be suited for the job may not suffice to affect employers' positive employment attitude. Moreover, financial incentives are needed to influence employers' motivation to employ the candidate. This finding is corroborated by the risk compensation theory, which assumes that people have a constant level of risk that they are ready to accept (Salminen, 2005). Based on the above statements, we develop the following hypothesis:

> o *H6. Financial incentives mediate the relationship between the job match requirements and employers' attitudes toward employing PWVIB.*

Methodology

Data

A survey was distributed In July 2020 using online panel data (OPD) to employers with hiring authority. That is, owners of companies, human resources managers, or any other manager with hiring authority. OPD has been largely embraced by scholars owing to its many benefits over traditional convenience samples (Porter et al., 2019). Ethics committee approval was given. We asked the following open-ended question: "in your opinion, what would encourage an employer/business to consider a candidate who is blind or visually impaired for employment?"

We also added a closed-ended Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*) with questions requesting the respondent's opinion: "Organizations/Employers would prefer employing a person without a disability over a visually impaired/blind person."

A total of 975 completed questionnaires were collected: 551 (56.5%) were females, and 424 (43.5%) were males. The age range is as follows: 529 (54.3%) were between 25 and 40, 292 (29.9%) were between 41 and 50, and 154 (15.8%) were between 51 and 65. Moreover, employment status is as follows: 38 (3.9%) were part-time employees, 717 (73.5%) were full-time employees, and 220 (23.6%) were independent.

Qualitative survey methodology

We employed a mixed-method design, which supports the extraction of unique insights (Ploum et al., 2019).

First, we manually overviewed all responses and identified major themes from the open question. Each text was tagged appropriately for belonging to one or more of the research themes (Eckhaus et al., 2018a). These variables are presented in Table 1. The responses were binary tagged (Davidovitch et al., 2019); that is, each theme was tagged 1 if the response belonged to the theme and 0 otherwise.

Two coders tagged the themes in parallel. Cohen's kappa was used to assess the inter-consistency between them, showing a high strength of agreement, as follows.

0.96 (p<0.001) for *Financials*, 0.93 (p<0.001) for *Inform*, 0.89 (p<0.001) for *Evidence*, and 0.93 (p<0.001) for *Evidence*.

Quantitative survey methodology

Table 1 presents the research instrument used in this research.

Table 1
Research instrument

Variable code	Variable description	Research item
Financials	Respondents claim the need for financial incentives and support for the firm's ongoing productivity for employing a person with VID. Tax benefits, participation in the cost of accessibility or provision of accessibility equipment, accompaniment and training on behalf of the state, and some kind of acknowledgement will benefit the company's branding and reputation	1-answer belongs to the theme; 0-answer does not belong to the theme
Inform	Candidates are educated and provided with relevant information on the requirements for PWVIB to enable their successful assimilation into the workplace	1-answer belongs to the theme; 0-answer does not belong to the theme
Evidence	Respondents indicate the need to receive some kind of evidence for the capability of a candidate with VID to perform the work requirements. For example, employers may talk to the person's previous employers, personal acquaintance with the candidate, or a trial period backed up legally by the state, allowing them to fire the person with no repercussions.	1-answer belongs to the theme; 0-answer does not belong to the theme
Candidate	The candidate pertains to the person with VID professional background and skills, and the job vacancy possibilities for the candidate	1-answer belongs to the theme; 0-answer does not belong to the theme
Attitude	Employers' attitude toward employing PWVIB	Respondents are asked to express their attitude towards the question: "Organizations/Employers would prefer employing a person without a disability over a visually impaired/blind person", with the responses: 1 (completely disagree) to 5 (completely agree).

Source: Authors' work

We then generated empirical variables from the tagged categories and developed the solutions and developed the (SIEPVD) model. We employed structural equation modelling (SEM) to test the model's goodness-of-fit (Coskun-Setirek et al., 2017; Eckhaus et al., 2018b; Eckhaus, 2019). Specifically, we used path analysis, which is a special case of SEM, where there is no latent variable in the model (Park et al., 2021). In cases where the researcher intends to examine the causal and effect relationship between several independent and dependent variables, SEM is the best

method to be used (Byrne, 2010; Hair et al., 2010; Hair Jr et al., 2014; Fan et al., 2016). This statistical analysis allows the investigation of causal and effect relationships of the variables simultaneously (Byrne, 2010; Hair et al., 2010).

The model fit was estimated using CFI, TLI, NFI, RMSEA, SRMR, and CMIN/DF. Typically, the considered cutoff values for a perfect fit are ≥0.95 for TLI and NFI, ≥0.97 for CFI, ≤0.05 for RMSEA and SRMR, and ≤2 for CMIN/ DF (Erden et al., 2020). Correlations were placed in the model between *Candidate* and *Inform* because they both share an effect on *Financials* and between *Financials* and *Evidence* because they both share an effect on *Attitude*. The model, therefore, presents double arrows between the variables accordingly.

We used AMOS v.26 for SEM and mediation analysis and SPSS v.26 for other statistical operations.

Results

Qualitative survey results
In what follows, we provide qualitative examples for the relationships presented in the model, that is, every effect modelled, to offer an elaborate and more detailed study.

Effect of evidence on attitude
Examples of employers' suggestions for evidence of the candidates' capabilities to perform the job and how this evidence may affect the attitude to employ them are as follows:

Respondent No. 60 (33, M, project manager) suggests, "give examples of organizations where there are employees with a visual impairment so that employers will see that the boogeyman is not as big as they think". Interestingly, the term "boogeyman" is also used by respondent No. 101 (31, F, textile branch manager), who argues that "start with an integration through an association or something like that, so that managers will see that the boogeyman is not so bad and then they will employ more [people VID]."

Respondent No. 145 (41, M, financial manager) then suggests "talk with the candidate's previous employer" to receive evidence of the candidate's capabilities.

Effect of financial incentives on attitude
There are many examples of the financials' effect on attitude. For example, Respondent No. 2 (38, F, laboratory manager) suggests that "It could be that if the state supports him [the employer] or gives him [the employer] a grant for it [for employing a person with VID], it will affect [the employers' attitude]." Many other respondents argue similarly to respondent No. 123 (40, F, events manager), that is, "a monthly grant from the state and financial assistance in making the office accessible."

Financial incentive mediation effect job match and attitude
Respondent No. 149 (36, F, procurement and import) explains that "If the visual impairment restricts the person from doing the work in a good, accurate, fast, and safe manner, do not think there will be an incentive that will encourage the employer to employ the person. If the disability does not limit the candidate, then a financial grant or something of the sort, or perhaps advertising the brand in the media." This respondent clearly expresses the mediation, that is, the negative relationship between *Candidate* and *Financials*, including the positive attitude to employ the person due to *Financials*.

Respondent No. 262 (M, 36, security officer) also explains that "Understanding that the output from this employee [a person with VID] will be the same as a regular employee, otherwise a type of compensation from the state." This respondent explains that financial incentives (*Financials*) are not necessary if the candidate is qualified (*Candidate*); otherwise, *Financials* affect the *Attitude*.

Financial incentive mediation effect between information and attitude
When speaking of the need for information, many respondents do not even mention financial incentives (thus the negative relationship between Inform and Financials). However, they tie the willingness to employ PWVIB with job productivity (thus the effect on the firm performance). For example, Respondent No. 486 (32, M, content director) stated that "Almost every position in the organization requires abilities that an employee with a visual impairment might get tangled with. If it was clear to me as an employer how this would not be a problem or that it had a plausible solution, it would make it easier for me to employ [PWVIB] candidates." This respondent underlines the need for information regarding possible solutions that exist. The respondent also stresses the importance of the firm's productivity owing to the candidate's capabilities. These factors are the final decision criteria that affect employers' attitudes in hiring a candidate.

Respondent No. 614 (48, F, department manager) adds, "if someone with a visual impairment were to come and I would get an explanation about the limitations of the impairment and understand that it is not problematic in terms of performing the job assignment, I would not need additional encouragement." This respondent highlights the importance of information and its negative relationship with *Financials*, that is, the inessentiality of financial incentives if proper information regarding PWVIB at work is available. However, the respondent also strengthens the need for productivity to employ the candidate and that productivity is the final key for hiring the candidate.

Quantitative survey results

Table 2 presents the Spearman correlations, means, and standard deviation values among the variables tagged from the open question, as well as the Likert scale measuring the attitude towards the employment of PWVIB candidates. Figure 2 shows the SIEPVD model's standardized estimates.

Table 2
Correlation Matrix, Means, and SD

	Financials	*Inform*	*Evidence*	*Candidate*	*Attitude*
Financials	-				
Inform	-0.20***	-			
Evidence	-0.16***	0.02	-		
Candidate	-0.23***	-0.8**	-0.04	-	
Attitude	0.07*	-0.05	0.05	-0.01	-
Mean	0.70	0.24	0.10	0.12	4.23
SD	0.46	0.43	0.30	0.32	0.9
N	682	233	101	113	-

*p < 0.05, **p < 0.01, ***p < 0.001
Note: N refers to the number of respondents that expressed the theme, which is therefore different for each of the variables since responses do not include all the variables in each of the texts.

Figure 2
SIEPVD Model Standardized Estimates
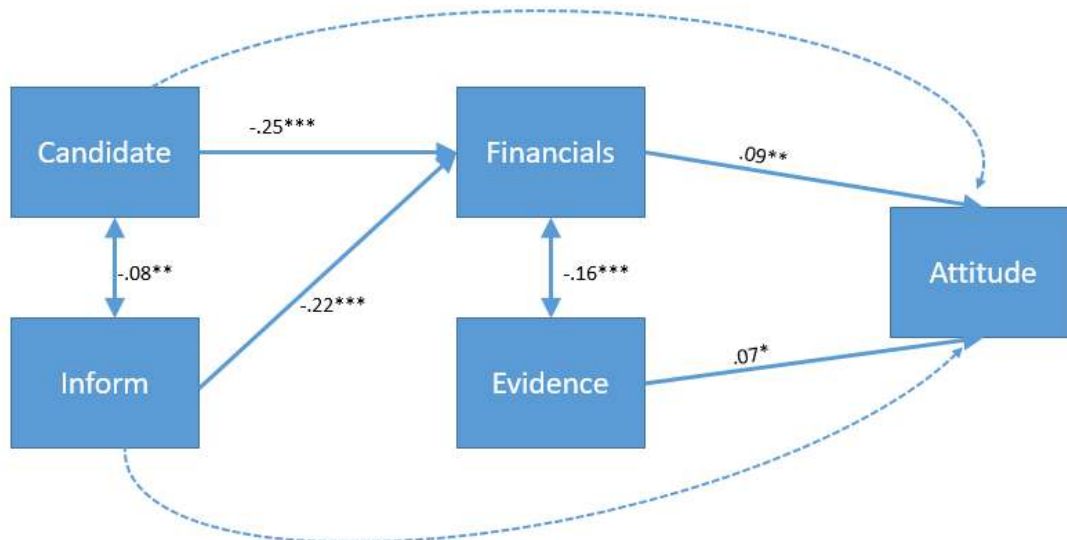
*p < 0.05, **p < 0.01, ***p < 0.001
Note: dotted line implies mediation.

The hypothesized model showed a good fit: CMIN/DF = 1.36, *p* > 0.05, CFI = 0.99, NFI = 0.97, RMSEA = 0.02, TLI = 0.98, and SRMR = 0.02. All hypotheses were supported.

Table 3 presents the SEM model results. *Candidate* and *Inform* negatively affect *Financials* (H3 and H4, respectively), and *Financials* and *Evidence* positively affect *Attitude* (H2 and H1, respectively).

Table 3
SEM model results

Model link	Std coefficients	Significance	Hypothesis
Evidence → Attitude	0.07	*	H1 supported
Financials → Attitude	0.09	**	H2 supported
Inform → Financials	-0.22	***	H3 supported
Candidate → Financials	-0,25	***	H4 supported

Note: *p < 0.05, **p < 0.01, ***p < 0.001

Mediation effects were assessed using the bootstrap approach and are as follows. *Financials* mediation on the indirect effect of *Inform* on *Attitude* (H5) was significant (β = −0.02, *p* < 0.01). Bootstrapped confidence interval (CI) is [−0.035, −0.008]. *Financials* mediation on the indirect effect of *Candidate* on *Attitude* (H6) was significant (β = −0.02, *p* < 0.01). Bootstrapped CI is [−0.04, −0.009]. Notably, there was no direct effect between the *Candidate* and *Inform* to *Attitude*.

Discussion

The research results indicate that all the hypotheses were supported. Among them, the two mediation hypotheses are particularly interesting. There was no direct effect between *Candidate* and *Inform* to *Attitude*, which implies that a full mediation occurred. This result underlines the importance of financial incentives as the "bottom line" from employers' perspectives. That is, the candidate's match to an adequate

job position, or even information, is not enough on their own to affect employment attitude, and some kind of financial or productivity reassurance is essential. These findings are corroborated by the prospect theory (Kahneman et al., 1979), which posits that peoples' decision-making is based on the evaluations of losses and gains, with more emphasis on losses. That is, risk aversion is a dominant part of the cause of the negative attitude of employers to employ PWVIB. In the absence of experience, the assumed axiom of lower productivity and risk aversion takes over (Johnson et al., 1988). Findings show that providing some kind of capability evidence may lower the risk levels' perception and improve the attitude toward employing PWVIB.

This study offers important contributions for supporting PWVIB and improving their employment rate, as well as for staff responsible for employment in organizations. First, to understand the root cause and the proper solution to take, one needs to start by asking the right questions (Shereshewsky, 2001; Serrat, 2017). Many studies have discussed employers' concerns about employing PWVIB. This study, however, to our knowledge, is the first to perform employer integration in the solution. That is, we directly seek the proper solutions from the target population, employers with a negative attitude toward employing PWVIB. This targeted population should be the first to ask about what would change their mind. The response was then investigated empirically and qualitatively. In addition, ample research has been done on the employment of people with disabilities (Dispenza, 2019; Miethlich et al., 2019). Krisi et al. (2021) highlight two main categories of employers' concerns: direct factors- issues directly impacting the employer and the immediate work environment, and indirect factors- which usually have to do with attitudes regarding the impact on the work environment. In addition, known factors that support the employment of PWVIB include financial incentives, as well as utilization of post-employment services (Jang et al., 2013). Still, as McDonnall (2019) argues that "very little empirical research has been conducted to establish best practices and guide service delivery in terms of employment assistance for people with visual impairment" (p. 479). this is the first study that presents and empirically investigates the impact of the provision of evidence, as well as the direct and indirect effect of financial incentives, from the employer's point of view.

Second, employers' lack of knowledge (McDonnall et al., 2020) and financial reasons (Crudden et al., 1999) have been previously discussed in the literature as root causes for PWVIB unemployment. However, results brought to the surface a considerably more important key decision factor for employing PWVIB—employers' need for evidence for job capability. This finding highlights the need for revisiting the candidate approach when applying for jobs or attending job interviews. Employers use job interviews for the assessment of skills (Huffcutt et al., 2001), and candidates' interviewing capabilities may be important (Tay et al., 2006). However, the results of this study show that presenting employers with evidence of job capabilities may have a much higher success for PWVIB to get hired. Although job capability evidence may also profit candidates of the general population, results underline that this evidence is particularly important for PWVIB. The study, therefore, has practical implications for PWVIB.

Limitations and future research

In this study, we have presented several key employers' decision-making factors for employing PWVIB. To extend our current study, future studies may offer further tuning to employers' motivations for hiring PWVIB by focusing on employer demographics. In addition, in this study, we have investigated one culture; future studies may extend

the findings of this study by investigating different cultures, industries, and types of businesses, which could offer different results.

An interesting direction for future study may be the extension of this study by investigating the types of work and their effect on the level of risk avoidance, the need for evidence, and the general attitude of employers. For example, research may investigate employers' attitudes and motivations for hiring PWVIB for "learning by doing" jobs versus other types of jobs. Learning by doing means learning from experiences resulting directly from one's actions versus learning from watching others perform, read, or listen to instructions, descriptions, or lectures (Reese, 2011).

Another interesting future research extension of this study is to explore the effect of academic performance on employers' motivation to hire PWVIB. That is, future studies may investigate if academic achievements offer evidence for job capability or reduce the fear of risk in their employment. Credentials required by an employer to qualify as valid measures, such as a degree, a minimum class rank, grade point average, graduation from a college of at least some minimum quality, or a combination of these (Wise, 1975), should also be investigated.

Future studies may also extend this research to the issues of sustainability and productivity of PWVIB employment, as well as organizations' effect of digital transformation (Bach et al., 2018; Tomičić Furjan et al., 2020) on the employment of PWVIB.

Finally, with about as many as 10% of the respondents indicating the desire for job capability evidence, future studies that will investigate directions for identifying the types of employers' acceptable evidence for PWVIB's capabilities at work may help to lower the employer's risk avoidance of hiring PWVIB. They may also be highly valuable in the research or practice of work rehabilitation for PWVIB.

Work satisfaction may significantly affect a person's happiness (Eckhaus, 2021). This study focuses on the employment of PWVIB, but the results are not limited to this niche. Future studies that will extend this research to other types of disabilities would provide further research support for increasing the employment rate of people with disabilities. In addition, there is still a great need for more comprehensive research comparing the employment of people with and without disabilities and research considering the employment of people with various disabilities.

References

1. Amurani, B. (2019), "Impact of assistive technology on education performance of learners with visual impairment at the University of Rwanda - college of education", Doctoral dissertation, University of Rwanda.
2. Bach, M. P., Spremić, M., Vugec, D. S. (2018) "Integrating digital transformation strategies into firms: Values, routes and best practice examples", Management and Technological Challenges in the Digital Age, CRC Press, pp. 107-128.
3. Blanck, P. D. (1998), "Job placement for employees with disabilities - manpower leads the way", Employment relations today, Vol. 25 No. 3, pp. 57-65.
4. Brouwers, E., Joosen, M., van Zelst, C., Van Weeghel, J. (2020), "To disclose or not to disclose: a multi-stakeholder focus group study on mental health issues in the work environment", Journal of Occupational Rehabilitation, Vol. 30 No. 1, pp. 84-92.
5. Byrne, B. M. (2010), Structural equation modeling with AMOS: Basic concepts, applications, and programming, New York, Taylor and Francis Group Publication.
6. Carvalho-Freitas, M., Souto, J., Simas, A., Costa, N., Santos, L., Marques, A. (2015), "Willingness to work with people with disabilities in future Brazilian professionals", Work, Vol. 50 No. 4, pp. 543-552.

7. Chhabra, G. (2021), "Turning a blind eye to employers' discrimination? Attitudinal barrier perceptions of vision impaired youth from Oslo and Delhi", Disability & Society, Vol. 36 No. 10, pp. 1688-1711.
8. Coskun-Setirek, A., Mardikyan, S. (2017), "Understanding the adoption of voice activated personal assistants", International Journal of E-Services and Mobile Applications (IJESMA), Vol. 9 No. 3, pp. 1-21.
9. Crudden, A., McBroom, L. W. (1999), "Barriers to employment: A survey of employed persons who are visually impaired", Journal of Visual Impairment & Blindness, Vol. 93 No. 6, pp. 341-350.
10. Davidovitch, N., Eckhaus, E. (2019), "Student evaluation of lecturers – what do faculty members think about the damage caused by teaching surveys?", Higher Education Studies, Vol. 9 No. 3, pp. 12-21.
11. Dispenza, F. (2019), "Empowering the career development of persons with disabilities (PWD)", Journal of Career Development, Vol. 48 No. 5, pp. 670-685.
12. Drew, N., Funk, M., Tang, S., Lamichhane, J., Chávez, E., Katontoka, S., Pathare, S., Lewis, O., Gostin, L., Saraceno, B. (2011), "Human rights violations of people with mental and psychosocial disabilities: an unresolved global crisis", The Lancet, Vol. 378 No. 9803, pp. 1664-1675.
13. Eckhaus, E. (2019), "How to be Happy", available at http://www.artistila.com/how-to-by-happy/ (15 August 2022)
14. Eckhaus, E. (2021), "The fourth dimension of happiness and work satisfaction". Management & Marketing", Challenges for the Knowledge Society, Vol. 16 No. 2, pp. 118-133.
15. Eckhaus, E., Ben-Hador, B. (2018a), "To gossip or not to gossip: Reactions to a perceived request to gossip – a qualitative study", Trames: A Journal of the Humanities and Social Sciences, Vol. 22 No. 3, pp. 273-288.
16. Eckhaus, E., Sheaffer, Z. (2018b), "Happiness enrichment and sustainable happiness", Applied Research in Quality of Life, Vol. 14 No. 4, pp. 1079-1097.
17. Ehn, M., Wahlqvist, M., Möller, C., Anderzén-Carlsson, A. (2020), "The lived experiences of work and health of people living with deaf-blindness due to Usher syndrome type 2", International Journal of Qualitative Studies on Health and Well-being, Vol. 15 No. 1, pp. 1-12.
18. Erden, A., Erden, H. (2020), "The relationship between individual innovation and social entrepreneurship characteristics of teacher candidates", International Journal of Curriculum and Instruction, Vol. 12, pp. 185-206.
19. Fan, Y., Chen, J., Shirkey, G., John, R., Wu, S. R., Park, H., Shao, C. (2016), "Applications of structural equation modeling (SEM) in ecological studies: an updated review", Ecological Processes, Vol. 5 No. 1, pp. 1-12.
20. Farrell, S. L., Geraci, A. (2017), "Librarians and compensation negotiation in the library workplace", Library Management, Vol. 38 No. 1, pp. 45-64.
21. Geiger, B. B. (2018), Legitimacy is a balancing act, but we can achieve a much better balance than the WCA. A better WCA is possible, London, Demos.
22. Grilli, L. (2011), "When the going gets tough, do the tough get going? The pre-entry work experience of founders and high-tech start-up survival during an industry crisis", International Small Business Journal, Vol. 29 No. 6, pp. 626-647.
23. Gröschl, S. (2007), "An exploration of HR policies and practices affecting the integration of persons with disabilities in the hotel industry in major Canadian tourism destinations", International Journal of Hospitality Management, Vol. 26 No. 3, pp. 666-686.
24. Grover, P. (2020), "Analysis of profitability: A comparative study of Maruti Suzuki, Tata motors, Hindustan motors and Mahindra and Mahindra", Aayushi International Interdisciplinary Research Journal, Vol. 7 No. 6, pp. 14-26.
25. Hair Jr, J. F., Hult, G. T. M., Ringle, C., Sarstedt, M. (2014), A primer on partial least squares structural equation modeling (PLS-SEM), Thousand Oaks, Sage publications.
26. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E. (2010), Multivariate data analysis, 7th ed., New Jersey, Prentice Hall.

27. Harpur, P. (2012), "Embracing the new disability rights paradigm: the importance of the Convention on the Rights of Persons with Disabilities", Disability & Society, Vol. 27 No. 1, pp. 1-14.
28. Hobfoll, S. E. (1989), "Conservation of resources: A new attempt at conceptualizing stress", American psychologist, Vol. 44 No. 3, pp. 513-524.
29. Huffcutt, A. I., Conway, J. M., Roth, P. L., Stone, N. J. (2001), "Identification and meta-analytic assessment of psychological constructs measured in employment interviews", Journal of Applied Psychology, Vol. 86 No. 5, pp. 897-913.
30. Ijiola, T. O. (2018), "Influence of mortality salience on job commitment of health workers in Lagos state", African Journal for the Psychological Studies of Social Issues, Vol. 21 No. 2, pp. 266-273.
31. Jang, Y., Wang, Y.-T., Lin, M.-H., Shih, K. J. (2013), "Predictors of employment outcomes for people with visual impairment in Taiwan: The contribution of disability employment services", Journal of Visual Impairment & Blindness, Vol. 107 No. 6, pp. 469-480.
32. Johnson, V. A., Greenwood, R., Schriner, K. F. (1988), "Work performance and work personality: Employer concerns about workers with disabilities", Rehabilitation Counseling Bulletin, Vol. 32 No. 1, pp. 50-57.
33. Kahneman, D., Tversky, A. (1979), "Prospect theory: An analysis of decision under risk", Econometrica, Vol. 47 No. 2, pp. 263-291.
34. Kaye, H. S., Jans, L. H., Jones, E. C. (2011), "Why don't employers hire and retain workers with disabilities?", Journal of occupational rehabilitation, Vol. 21 No. 4, pp. 526-536.
35. Klees, S. J. (2017), "The political economy of education and inequality: reflections on Piketty", Globalisation, Societies and Education, Vol. 15 No. 4, pp. 410-424.
36. Krisi, M., Eckhaus, E., Nagar, R. (2021), "Developing a multilevel scale to assess retention of workers with disabilities", Journal of Occupational Rehabilitation, Vol. 32, pp. 138-146.
37. Kuo, P.-J., Kalargyrou, V. (2014), "Consumers' perspectives on service staff with disabilities in the hospitality industry", International Journal of Contemporary Hospitality Management, Vol. 26 No. 2, pp. 164-182.
38. Kuznetsova, Y., Yalcin, B. (2017), "Inclusion of persons with disabilities in mainstream employment: is it really all about the money? A case study of four large companies in Norway and Sweden", Disability & Society, Vol. 32 No. 2, pp. 233-253.
39. Leimeister, J. M., Huber, M., Bretschneider, U., Krcmar, H. (2009), "Leveraging crowdsourcing: activation-supporting components for IT-based ideas competition", Journal of management information systems, Vol. 26 No.1, pp. 197-224.
40. Lleras, C. (2005), "Path analysis", Encyclopedia of social measurement, Vol. 3 No.1, pp. 25-30.
41. Lunt, N., Thornton, P. (1994), "Disability and employment: towards an understanding of discourse and policy", Disability & Society, Vol. 9 No. 2, pp. 223-238.
42. McDonnall, M. C. (2019), "The Importance of Research on Employment Issues for People With Visual Impairments", Journal of Visual Impairment & Blindness, Vol. 113 No. 6, pp. 479-480.
43. McDonnall, M. C., Antonelli, K. (2020), "Are better employment and unemployment rates a good or bad thing for the field of visual impairment?", Journal of Visual Impairment & Blindness, Vol. 114 No. 6, pp. 443-444.
44. McDonnall, M. C., Sui, Z. (2019), "Employment and unemployment rates of people who are blind or visually impaired: Estimates from multiple sources", Journal of Visual Impairment & Blindness Vol. 113 No. 6, pp. 481-492.
45. McDonnall, M. C., O'Mally, J., Crudden, A. (2014), "Employer knowledge of and attitudes toward employees who are blind or visually impaired", Journal of Visual Impairment & Blindness, Vol. 108 No. 3, pp. 213-225.
46. Miethlich, B., Oldenburg, A. G. (2019), "The Employment of Persons with Disabilities as a Strategic Asset: A Resource-Based-View using the Value-Rarity-Imitability-Organization (VRIO) Framework", Journal of Eastern Europe Research in Business and Economics, Vol. 1, pp. 1-13.

47. Park, E. S., Fitzpatrick, K., Das, S., Avelar, R. (2021), "Exploration of the relationship among roadway characteristics, operating speed, and crashes for city streets using path analysis", Accident Analysis & Prevention, Vol. 150.
48. Perufo, J. V., Ozório, L. D. M., Bastian-Pinto, C. D. L., De Barros, S. D. J. M. (2018), "Flexibility in human resources management: a real options analysis", RAUSP Management Journal, Vol. 53 No. 2, pp. 253-267.
49. Ploum, L., Blok, V., Lans, T., Omta, O. (2019), "Educating for self-interest or -transcendence? An empirical approach to investigating the role of moral competencies in opportunity recognition for sustainable development", Business Ethics: A European Review, Vol. 28 No. 2, pp. 243-260.
50. Porter, C. O., Outlaw, R., Gale, J. P., Cho, T. S. (2019), "The use of online panel data in management research: A review and recommendations", Journal of Management, Vol. 45 No. 1, pp. 319-344.
51. Pressman, S. (2014), "A tax Reform that falls flat", Challenge, Vol. 57 No. 4, pp. 82-102.
52. Reese, H. W. (2011), "The learning-by-doing principle", Behavioral Development Bulletin, Vol. 17 No. 1, pp. 1-19.
53. Richards, V., Pritchard, A., Morgan, N. (2010), "(Re)Envisioning tourism and visual impairment", Annals of Tourism Research, Vol. 37 No. 4, pp. 1097-1116.
54. Rivera, L. A. (2011), "Ivies, extracurriculars, and exclusion: Elite employers' use of educational credentials", Research in Social Stratification and Mobility, Vol. 29 No. 1, pp. 71-90.
55. Rosita, R., RS, T. Y. (2019), "The effect of burnout, work experience, and work motivation on employee performance with emotional intelligence as variable moderation", Journal of Business Studies, Vol. 4 No.1, pp. 67-81.
56. Rumrill Jr, P., Schuyler, B. R., Longden, J. C. (1997), "Profiles of on-the-job accommodations needed by professional employees who are blind", Journal of Visual Impairment & Blindness, Vol. 91 No. 1, pp. 66-76.
57. Salminen, S. (2005), "Relationships between injuries at work and during leisure time", Accident Analysis & Prevention, Vol. 37 No. 2, pp. 373-376.
58. Serrat, O. (2017), "The five whys technique", Knowledge solutions, Springer, pp. 307-310.
59. Shereshewsky, J. (2001), "Permission versus permissive marketing", Interactive Marketing, Vol. 3 No. 1, pp. 11-18.
60. Soh, D. W. (2010), "Decision Making Under Risk Across Different Contexts", Master of Arts, Ryerson University.
61. Stirbens, K. A., Guercio, A., Haiber, C., Williams, J. (2010), "Barriers to distance learning in web accessibility for persons with blindness and visual impairment", in Proceedings of the 16th International Conference on Distributed Multimedia Systems, Illinois, USA.
62. Tamako, H. (2007), "Equality of opportunity or employment quotas? - a comparison of Japanese and American employment policies for the disabled", Social Science Japan Journal, Vol. 10 No. 1, pp. 41-57.
63. Tay, C., Ang, S., Van Dyne, L. (2006), "Personality, biographical characteristics, and job interview success: A longitudinal study of the mediating effects of interviewing self-efficacy and the moderating effects of internal locus of causality", Journal of Applied Psychology, Vol. 91 No. 2, pp. 446-454.
64. Taylor, H., Pezzullo, M., Keeffe, J. (2006), "The economic impact and cost of visual impairment in Australia", British Journal of Ophthalmology, Vol. 90 No. 3, pp. 272-275.
65. Taylor, K. A. (2011), "Support and services across the lifespan for individuals with visual impairments in the united states, australia, and Sweden: a comparative analysis", University of Georgia.
66. Tomičić Furjan, M., Tomičić-Pupek, K., Pihir, I. (2020), "Understanding Digital Transformation Initiatives: Case Studies Analysis", Business Systems Research: International journal of the Society for Advancing Innovation and Research in Economy, Vol. 11 No. 1, pp. 125-141.
67. Victor, C., Copolillo, A., Pawluk, D., Gary, K. W., Thacker, L. (2017), "Workplace discrimination and visual impairment: Still a concern after the Americans with Disabilities Act amendments Act", American Journal of Occupational Therapy, Vol. 71 No. 4.

68. Williams, S. K. (1993), "Reaping community trust", in Jones, S. W. (Ed.), Shaping the community college image, Greeley, National Councilfor Marketing and Public Relations, pp. 67-82.
69. Wise, D. A. (1975), "Academic achievement and job performance", The American Economic Review, Vol. 65 No. 3, pp. 350-366.
70. Wuellrich, J.-P. (2010), "The effects of increasing financial incentives for firms to promote employment of disabled workers", Economics Letters, Vol. 107 No. 2, pp. 173-176.
71. Zapata, M. A. (2020), "Disability affirmation predicts employment among adults with visual impairment and blindness", Rehabilitation Counseling Bulletin, Vol. 65 No. 2, pp. 120-128.

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Public Support for Innovation: Changes in Turnover of Granted Companies

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Abstract

Background: Innovation policy supports innovation in companies, as it is crucial for economic, social and environmental development. **Objectives**: The research aims to verify whether companies that have received public support for innovation are experiencing turnover growth. **Methods/Approach:** The research is carried out on the example of the Czech Innovation Programme, and the analysis included 276 projects in the manufacturing industry. The study compares the turnover of enterprises one year before receiving the aid and two years after the granting. The analysis is performed regarding the size of companies, industries and regions. **Results:** When the companies are assessed at the median level, the largest turnover growth was found in the category of small enterprises. Regarding industry, the largest increase was recorded in NACE sections 22, 27, 26, 29 and 30. The lowest increase in turnover was recorded for enterprises in sections 21, 23, 24 and 28. Differences in turnover growth were also observed across regions. **Conclusions:** Providing support for innovation contributes to the growth of turnover. A larger share of public aid should be allocated to the category of small and medium-sized enterprises and knowledge-intensive industries.

Keywords: innovation, public support, turnover, enterprise, industry, region, Czech Republic

Introduction

In the last 20 years, increased attention has been paid to innovation policy and support for innovative enterprises in Europe. In addition to the national level, innovation policy in the regions is also gaining importance (Silva et al., 2021). There is a consensus among experts and policy-makers that building a competitive advantage through innovation is essential for sustainable economic development.

It is assumed that companies that carry out research and innovation activities achieve higher growth, have higher revenues, incomes and market share, create new jobs, export more, create higher added value, have higher labour productivity and so on (Hunady et al., 2020; Zakić et al., 2020). In other words, it is important for the entire economy and society that businesses introduce innovations and thereby significantly contribute to long-term and sustainable competitiveness. However, for companies to be willing and able to bring innovations, they must have good conditions. A favourable business and innovation environment is a prerequisite for developing regions and countries.

Negative factors prevent, limit or slow down the innovative activities of companies, which subsequently harms the development of regions and countries. Obstacles to innovation can be internal (firms' capabilities) or external (issues outside the firm) in origin. (e.g. Segarra-Blasco et al., 2008; Arza et al., 2021). Following the OECD (2005) methodology, which is used for statistical and research purposes, barriers to innovation are divided into economic, knowledge, market and other reasons for not innovating. Economic barriers represent the most important of them, and the lack of financial resources for innovation activities or high costs related to innovations are the main constraints (Klímová et al., 2017; Arza et al., 2021; Mina et al., 2021).

The positive benefits of innovation on the one hand and the barriers to innovation on the other are the main reasons governments implement special programmes to support innovation. These measures aim to help businesses overcome economic barriers, lack of financial resources and high innovation costs. Public aid is considered a crucial factor contributing to economic growth (Rodríguez-Pose et al., 2021). Two groups of arguments usually justify public support for research and innovation (e.g., Grillo et al., 2011; Dodgson et al., 2011, Bleda et al., 2013). The first group of arguments is associated with neoclassical economic theory and its assertion of market failure. Arrow (1962) elaborated on these ideas to justify why the government should support research. The market mechanism does not ensure the optimal allocation of resources, as research and development results (new knowledge) behave as a public good. According to him, this is due to their features, such as indivisibility, appropriability and uncertainty. As a result, companies invest fewer resources in R&D than would be socially optimal. Innovation policy should strive for better efficiency in resource allocation (Novak, 2020). The second group of arguments is associated with institutional theoretical approaches that have identified system failures, which their representatives consider as another reason the government should support research and innovation. Woolthuis et al. (2005) defined institutional failures, interaction failures, capability failures, and infrastructural failures as the main system failures. Moreover, in recent years, environmental approaches have emerged. They argue the importance of innovation for solving social and environmental challenges. (e.g., Schot et al., 2018; Giachi et al., 2022).

The research aims to verify whether companies that have received public support for innovation are experiencing turnover growth. The paper searches for answers to two main research questions: 1) Are companies that have received support for innovation activities increasing their turnover? 2) Does the growth in turnover differ according to the size of the company, industry or region? The study is based on the

analysis of the Czech Innovation programme, which supports the implementation of product and process innovations in practice.

Our research was first presented at the ENTRENOVA conference, and this article is an extension of the presented paper (Klímová et al., 2021). The following text is structured into five chapters. After giving the theoretical context (chapter 2), we explain the research methodology (chapter 3). Chapter 4 presents the research results according to all performed partial analyses. Finally, chapter 5 outlines our conclusions.

Effects of innovation support in companies

Innovation policy interventions aim to introduce innovations into practice and their subsequent dissemination. Government support programmes primarily focus on innovations in emerging technology (i.e. product and process). Non-technology innovations (marketing and organisational) can often be supported alone. The innovation policy also includes support for research and development in companies, as R&D is considered a vital knowledge source for innovations (Halaskova et al., 2020). The positive relationship between R&D activities and innovation performance in both developing and developed countries has been confirmed by Pekovic et al. (2015). Aiding the innovation and research activities is usually implemented as programme support (grant tender). This means that the government announces calls, businesses submit their projects and only those that best meet the required criteria receive support. Financial support is usually in the form of a subsidy (grant). Exceptionally, loans and guarantees are provided.

The selection of projects suitable for financing also has its limits. The more innovative companies are more likely to ask for support, and at the same time, these companies have a higher chance of getting a grant because they better meet the required criteria. In the professional literature, the first effect is often referred to as "self-selection of firms". The latter is connected with administrative selection and is referred to as "cream-skimming" (e.g., Curran et al., 2002, Merito et al., 2010). Similar findings are confirmed by Rodríguez-Pose et al. (2021), who adds that subsidies are often obtained by larger companies with sufficient international and innovative trajectories and that the assignment system is sub-optimal. Novosak et al. (2017) address the spatial dimension of the allocation of subsidies and state that more support is directed to more developed regions.

Most of the research studies focus on evaluating R&D support programmes in companies (e.g., Montmartin et al., 2015; Crespi et al., 2016). However, R&D and innovation are not synonymous. R&D results may or may not lead to innovation. At the same time, R&D is not the only source of innovation. Nevertheless, radical innovations (completely new products) are usually the result of research activities (e.g., Coccia, 2017). As Lewczuk et al. (2020) stated, public aid for innovations is a way of creating institutional incentives for the desired behaviour of firms. Bianchini et al. (2019) examined the relationship between R&D subsidies and business R&D investments concerning the quality of public institutions. The research was carried out on the example of Spain and selected European regions. They rejected the crowding-out effect and confirmed the positive impact of public support, especially on companies located in regions with poorer quality public institutions. Their research showed that public support for R&D is important, especially in disadvantaged areas.

Odei et al. (2021) focused on the Visegrad Countries and confirmed that public subsidies for innovations from local, central and EU sources significantly influenced the level of innovations in companies. Galbraith et al. (2017) put their attention to absorptive capacity (i.e., the ability of the company to identify, value, assimilation, and exploit external information) of SMEs in peripheral regions in Northern Ireland (the

United Kingdom). They concluded that when designing an innovation programme for SMEs, feedback from experts and programme participants is crucial for its success.

An analysis compiled for the UK government (BEIS, 2017) dealt with the impact of innovation support schemes on companies' survival, employment and turnover. The study confirmed a positive effect on the survival rate of businesses, with higher impacts detected for young businesses. Public support also had a positive impact on employment and business turnover. Freel et al. (2019) dealt with the impact of innovation policy interventions on exports in Germany and confirmed their positive effect on the export behaviour of companies. Sidorkin et al. (2021) focused on supporting the research activities of Czech companies and evaluated the effects according to the new patents. They found that subsidies contribute to patenting at the national level but not abroad. This means that the technologies created are not sufficiently novel and do not improve companies' international competitiveness.

Neméthová et al. (2019) investigated the effectiveness of grant support for innovation and the optimal amount of support using the example of less developed regions of Slovakia. They have shown that aid positively and significantly affects labour productivity. They also found that most supported enterprises benefit from a higher subsidy and that its optimal amount is around 2 million euros. Montmartin et al. (2015) also achieved similar results in the example of OECD countries. They argue that the desired leverage effect of public support on private investment can only be achieved if the support is high enough, and if it is not high enough, a crowding-out effect may occur. Jugend et al. (2020) investigated innovation support through a meta-analysis from an open innovation perspective. They drew attention to the fact that innovations do not occur in isolation, that open innovation is increasingly emphasised in managerial practice and public policy, and that the need for public support for open innovation is increasing.

Methodology

The subject of this research is changes in the turnover of manufacturing companies that have received support for innovation activities within the Czech Innovation Programme. The purpose was to determine whether the turnover of the enterprises that received support for innovation activities is growing and whether this growth differs according to the size of the enterprise, industry or region.

The Innovation Programme scheme is part of the Operational Programme Enterprise and Innovation for Competitiveness 2014-2020, co-financed by the European Regional Development Fund (ERDF) and represents Czech companies' most important business support instrument. The analysed measure supports putting product and process innovations into practice (API - Business and Innovation Agency, 2021). In other words, the programme primarily finances the introduction of technological innovations in the manufacturing industry, which is crucial for Czech economic development. The API Business and Innovation Agency (intermediate body) ensures the administration of applications and projects, and the Ministry of Industry and Trade (managing authority) decides on project support.

The granted projects can be implemented in the territory of the Czech Republic except for Prague. This is due to the rules of EU cohesion policy, as Prague belongs to the category of more developed regions. However, it depends on the place of implementation of the project, not the residence of the company. Companies registered in Prague can receive support, but their projects must be located outside Prague.

Six calls for innovative projects have been published under this programme. However, only the first three calls, announced between 2015 and 2017, have been

included in the analysis. In the case of these projects, we can evaluate their first results, and therefore, it is possible to monitor the supported companies with a certain time lag. We generated a database of 623 supported projects based on data from the Ministry of Regional Development CZ (2021). The next task was to add information on companies from the MagnusWeb database (Bisnode, 2021) to this data set. In the next step, it was necessary to make some corrections within the created database.

First, the projects whose implementation was prematurely stopped itself or the government were excluded. Thus, 518 implemented projects remained in the data set. We focused only on the projects of enterprises from the manufacturing industry, which was the main target group of the government programme. After this selection, 457 projects remained in the database. In the third step, only those companies that received support in 2017 and earlier were left in the database to evaluate their results over time. In other words, the projects whose implementation began between 2015 and 2017 have been selected, and as a result, 370 items remained in the data set. Furthermore, it was necessary to exclude projects of companies whose economic data (turnover and number of employees) were not available. After all reductions, 276 supported projects were included in our research.

In the case of each company, the turnover a year before obtaining the subsidy and two years after the granting was investigated. It means that the change in turnover within the three years was assessed. All observed indicators fell from 2014 to 2019, i.e., when there was no economic or pandemic crisis.

Table 1:
Manufacturing industries included in the research

Division code	Division title
10	Manufacture of food products
13	Manufacture of textiles
16	Manufacture of wood and products of wood and cork
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharm. preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment

Note: The division list is incomplete; the table shows only the industries where the granted aid was recorded.
Source: authors' processing based on Eurostat (2008)

The analysis was performed according to the size category of the company, the industry and the region in which the company is resident. Firstly, the analysis concerning the size category was conducted. The size of the company was determined based on the number of employees following the Eurostat definition

(European Commission, 2003): small enterprises (0-49 employees), medium-sized enterprises (50-249 employees) and large enterprises (more than 250 employees). Secondly, the industry analysis was carried out. The industries are defined according to the NACE Rev. 2 classification (Eurostat, 2008). NACE (Nomenclature statistique des activités économiques) is the statistical classification of economic activities in the European Community. In this research, the attention is focused only on the manufacturing industry (section C, divisions 10-33; see Table 1).

Thirdly, attention was paid to regional differences in turnover change. The analysis was processed at the level of NUTS3 Regions according to the European NUTS (Nomenclature of territorial units for statistics) classification (Eurostat, 2021).

Figure 1
Map of NUTS3 regions in the Czech Republic
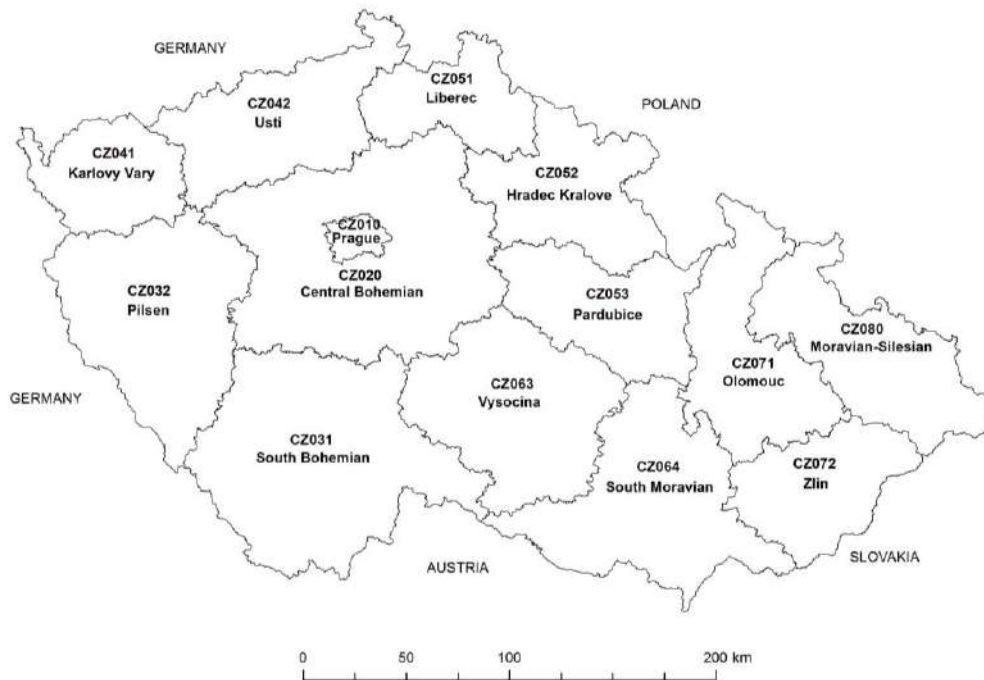
Source: authors' processing

The Czech Republic consists of 14 NUTS3 regions, as shown in Figure 1. The projects within the data set were divided according to the location of the company's registered office, and this criterion was chosen since the enterprises may operate in several regions.

Results and discussion

The research is based on an analysis of 276 companies that implemented a project co-financed by the Innovation Programme. The total amount of subsidy (see, e.g., Table 2) provided to these companies amounted to CZK 3,789.4 million (EUR 147,4 million; EUR 1 = CZK 25.535 at the rate of the European Central Bank at the end of 2017). Individual enterprises got different subsidy amounts, ranging from CZK 1.004 to 100 million (EUR 39,342 – 3,916,193). The average support per company is CZK 13.7 million (EUR 537,683). In more than 90% of projects, the grant is lower than CZK 30 million, i.e., up to EUR 1.17 million. Following Montmartin et al. (2015) or Neméthová et al. (2019), the subsidy provided is quite low, and the results achieved may not be as high.

Size of supported companies and changes in their turnover

Table 2 shows information about the amount of subsidy according to enterprise size. Most of the aid was directed to medium and large enterprises, whereas small enterprises received less than 14% of the allocation. Smaller enterprises also received a lower average subsidy per project, despite state aid rules providing small companies with a higher rate of support (expressed as a percentage of eligible costs).

Table 2
The amount of subsidy by the size of enterprises (in CZK, n=276)

Size category	MIN	MAX	Median	Average	Total	Share *
Small enterprises	1,055,250	41,118,449	6,075,000	7,619,093	518,098,327	13.67%
Medium enterprises	1,004,608	100,000,000	7,037,736	11,624,103	1,592,502,114	42.03%
Large enterprises	2,555,503	100,000,000	13,986,020	23,645,131	1,678,804,302	44.30%
Total	1,004,608	100,000,000	7,778,426	13,729,727	3,789,404,742	100.00%

Note: * The percentage share of the size category in all enterprises
Source: authors' processing based on Ministry of Regional Development CZ (2021)

The basic calculation revealed that not all companies grew in turnover in the examined period, which does not correspond with the basic assumption of evaluation. We identified 62 enterprises with a decrease in turnover within the tested group, i.e., 22.46% of them (see Figure 2).

Figure 2
Number and share of enterprises with increasing or decreasing turnover (n=276)
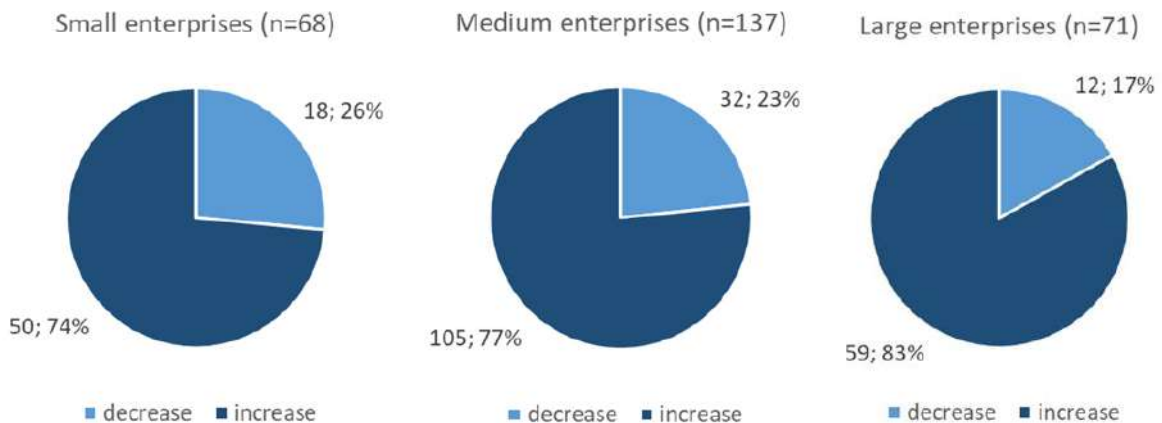
Source: authors' processing based on Ministry of Regional Development CZ (2021)

The highest share of companies with decreasing turnover was observed in small enterprises (26.47%). The lowest share of such companies was found among large entities (16.90%). We consider the number of companies whose turnover has decreased relatively high, both given the favourable economic situation and because of the general positive expectations concerning innovative companies.

The further analysis of turnover growth is focused on 214 companies that have shown a positive change. The crucial decision for calculating and interpreting the results was whether we should work with average values. Because the monitored values for the percentage increase in turnover show significant differences before and

after the granting, the use of averages would lead to distorted conclusions. As a solution, the median values are calculated too, and these values are supplemented by the boundary values of the first and third quartiles. This provides relevant insight into the maximum percentage growth achieved by a quarter, a half and three-quarters of the units in a given category. This systematic approach will also allow us to make a suitable comparison between groups of companies.

Table 3
Percentage of turnover growth according to the size of enterprises (n=214)

Size of enterprises	1st quartile (%)	Median (%)	3rd quartile (%)	Number of enterprises
Small	13.29	28.47	56.31	50
Medium	14.14	26.66	46.13	105
Large	6.87	17.89	38.04	59
All enterprises	12.90	25.53	44.73	214

Source: authors' processing based on Ministry of Regional Development CZ (2021)

Table 3 displays the differences in turnover growth among the size groups of companies. The highest increase at the level of the first quartile was observed within medium-sized enterprises. The value of 14.14% is gently higher than in the group of small enterprises. Nevertheless, this value is significantly higher than in the case of large companies. At the level of the third quartile, growth was inversely proportional to the company's size. The group of medium-sized enterprises does not report such significant internal differences, as the median is already lower than for small businesses, and the third quartile limit is even significantly lower (by more than ten percentage points). Large enterprises did not experience such significant growth, mainly caused by higher initial turnover values before the granting.

Industries and changes in turnover of supported companies

In the next part of the research, attention was paid to the manufacturing industry according to the NACE classification. The manufacturing industry is very important for the Czech economy and employs almost 30% of all employees, which means approximately 1.15 million people (Czech Statistical Office, 2021b). The largest number of people is employed in industries marked with codes 29 (172 thousand), 25 (146 thousand), 28 (119 thousand), 10 (84 thousand) and 22 (82 thousand).

Table 4 demonstrates the amount of subsidy according to the individual NACE divisions. The highest share of support was allocated to sections 25, 28 and 29. If the attention is focused on sections 20 to 32, where the largest number of projects was supported, section 29 stands out due to the highest median and average amount of support. Extremely high values were observed in section 10, where only three projects were supported. We negatively perceive that a very low share of subsidies was granted to sections 21, 26 and 30, which are (according to the OECD and Eurostat methodology) the high-tech industries.

Table 4
The amount of subsidy by the NACE division (in CZK, n = 276)

NACE Section C	MIN	MAX	Median	Average	Total	Share *
10	24,500,000	100,000,000	86,912,795	70,470,932	211,412,795	5.58%
13	5,179,950	95,750,000	8,970,143	37,234,732	186,173,659	4.91%
16	1,575,000	20,274,859	5,989,441	8,520,251	51,121,504	1.35%
17	7,810,532	31,250,000	14,061,881	15,540,923	108,786,460	2.87%
18	1,129,500	38,844,225	1,395,000	13,789,575	41,368,725	1.09%
19	2,317,921	2,317,921	2,317,921	2,317,921	2,317,921	0.06%
20	1,055,250	31,358,000	8,286,308	12,657,012	126,570,123	3.34%
21	6,250,000	7,500,000	6,673,250	6,774,125	27,096,500	0.72%
22	2,082,850	50,000,00	6,342,750	10,340,244	268,846,357	7.09%
23	1,925,000	41,118,449	6,362,479	12,469,188	174,568,630	4.61%
24	2,555,503	99,540,000	11,374,869	20,862,577	229,488,348	6.06%
25	1,123,500	49,000,000	8,789,846	11,943,934	692,748,150	18.28%
26	1,225,000	33,250,000	5,250,000	8,035,404	120,531,056	3.18%
27	1,940,750	62,033,004	6,464,647	13,746,559	274,931,170	7.26%
28	1,004,608	95,000,000	6,750,000	11,118,436	600,395,563	15.84%
29	6,579,919	100,000,000	25,329,181	33,113,261	430,472,394	11.36%
30	2,100,000	19,778,169	6,525,000	8,408,865	75,679,781	2.00%
31	3,482,500	33,034,400	10,247,354	12,611,292	100,890,334	2.66%
32	1,374,625	8,889,636	4,634,412	4,956,597	39,652,774	1.05%
33	26,352,500	26,352,500	26,352,500	26,352,500	26,352,500	0.70%
Section C	1,004,608	100,000,000	7,778,426	13,729,727	3,789,404,742	100.00%

Note: * The percentage share of the industry in the whole manufacturing industry (Section C)
Source: authors' processing based on Ministry of Regional Development CZ (2021)

As a relatively large group of companies achieved negative turnover growth in the period under review, it also seems appropriate to analyse this fact by industry. Table 5 shows the number of companies that achieved positive turnover growth by industry.

Table 5
Enterprises with increasing or decreasing turnover by NACE division (n=276)

NACE Section C	Decrease (number)	Decrease (%)	Increase (number)	Increase (%)
10	0	**0.00**	3	100.00
13	3	**60.00**	2	40.00
16	0	0.00	6	100.00
17	3	42.86	4	57.14
18	2	66.67	1	33.33
19	0	0.00	1	100.00
20	3	30.00	7	70.00
21	0	0.00	4	100.00
22	7	28.92	19	73.08
23	5	35.71	9	64.29
24	1	9.09	10	90.91
25	7	12.07	51	87.93
26	5	33.33	10	66.67
27	8	40.00	12	60.00
28	12	22.22	42	77.78
29	3	23.08	10	76.92
30	2	22.22	7	77.78
31	1	12.50	7	87.50
32	0	0.00	8	100.00
33	0	0.00	1	100.00
Total	**62**	**22.46**	**214**	**77.54**

Source: authors' processing based on Ministry of Regional Development CZ (2021)

Within the sections from 20 to 32, the least successful were companies in sections 27, 23 and 26. In addition, the latter belongs to the high-tech category. Good results were found in section 25, where a lot of projects were supported, and at the same time, a large part of the supported companies achieved an increase in turnover.

Table 6 displays the relationship between public support and the economic performance of enterprises by industry. Some industries include a low number of cases, so the interpretation of the results may not be unambiguous. If there are fewer than three companies in a division group, the values of the first and third quartiles cannot be calculated. At the level of the first quartile, the turnover grew the most in divisions 25 and 27. No other industry achieved a growth of 20%. If we do not consider division 13 (with two enterprises only), at the median level, the highest growth was recorded in industries 22, 27 and 29. At the third quartile level, three industries (17, 22 and 30) reached an increase in turnover by more than 100% (or slightly below 100%). We assess this positively, especially in section 22, where a relatively large number of companies have been analysed, and many people work. If we look at the most frequently supported industries (25 and 28), they grew slightly above 40% at the level of the 3rd quartile.

Table 6
Percentage of turnover growth by NACE division (n=214)

NACE Section C	1st quartile (%)	Median (%)	3rd quartile (%)	Number of enterprises
10	14.99	37.42	48.32	3
13		1195.74		2
16	16.02	36.70	88.48	6
17	1.27	23.99	107.87	4
18		11.94		1
19		22.06		1
20	4.31	20.67	41.90	7
21	6.36	19.66	60.69	4
22	16.03	38.11	105.60	19
23	10.35	17.41	44.38	9
24	1.01	12.56	22.29	10
25	12.91	27.41	41.30	51
26	15.90	30.16	72.01	10
27	20.58	33.01	43.67	12
28	10.68	18.65	43.39	42
29	10.08	31.72	55.54	10
30	25.50	30.39	99.74	7
31	8.24	24.28	32.85	7
32	12.34	27.25	37.37	8
33		**22.54**		1
Section C	12.90	25.53	44.73	**214**

Note: Empty fields are cases where the group includes less than three enterprises.
Source: authors' processing based on Ministry of Regional Development CZ (2021)

Regions and changes in turnover of supported companies

In the last part of the research, the regions were paid attention to. The Czech Republic, where 10.7 million people live, is divided into 14 NUTS3 regions representing the self-governing territorial units. The Central Bohemian Region (1.4 million), Prague (1.3 million), the South Moravian Region (1.2 million) and the Moravian-Silesian Region (1.2 million) have the highest number of inhabitants (Czech Statistical Office, 2021a). In terms of GDP per capita, there is a big difference between Prague and other regions. The position of the Central Bohemian Region in all economic activities is very specific, as this region forms a ring around Prague and is closely connected with the

capital city. Research activities are concentrated mainly in Prague, the Central Bohemian Region and the South Moravian Region (e.g., Žítek, 2016).

Table 7 shows the allocation of the provided support across individual NUTS3 regions. It was observed that the enterprises in the three top regions (Central Bohemian Region, Zlin Region and South Moravian Region) received more than 40% of the funding. The amount of support in the Zlin Region is particularly surprising, as it has half the population of the other two regions.

Table 7
The amount of subsidy by the NUTS3 region (in CZK)

NUTS3 region	MIN	MAX	Median	Average	Total	Share (%)*
CZ010 Prague	1,055,250	50,244,263	5,850,000	9,925,798	248,144,951	6.55%
CZ020 Central Bohemian	2,317,921	100,000,000	8,845,499	20,861,884	584,132,763	15.41%
CZ031 South Bohemian	3,580,500	100,000,000	6,439,959	15,585,033	218,190,460	5.76%
CZ032 Pilsen	1,364,210	50,000,000	7,589,559	11,936,798	238,735,952	6.30%
CZ041 Karlovy Vary	3,638,000	13,192,016	5,929,958	7,586,658	22,759,974	0.60%
CZ042 Usti	2,449,918	99,540,000	11,202,250	22,966,609	206,699,477	5.45%
CZ051 Liberec	1,395,000	57,791,439	5,242,725	13,068,386	91,478,702	2.41%
CZ052 Hradec Kralove	3,456,250	95,750,000	8,889,636	19,580,321	254,544,176	6.72%
CZ053 Pardubice	2,452,707	43,008,261	10,712,934	13,867,054	221,872,871	5.86%
CZ063 Vysocina	2,249,515	51,575,335	7,000,000	11,012,021	187,204,349	4.94%
CZ064 South Moravian	1,004,608	70,726,065	7,500,000	11,395,041	421,616,500	11.13%
CZ071 Olomouc	1,925,000	62,033,004	8,591,771	13,984,686	293,678,406	7.75%
CZ072 Zlin	1,129,500	50,225,000	8,789,846	12,453,502	523,047,094	13.80%
CZ080 Moravian-Silesian	1,123,500	86,912,795	5,355,739	11,554,128	277,299,069	7.32%
Czech Republic	1,004,608	100,000,000	7,778,426	13,729,727	3,789,404,742	100.00%

Note: * The percentage share of the region in all Czech regions
Source: authors' processing based on Ministry of Regional Development CZ (2021)

The low share of Prague is caused mainly due to the rules mentioned above in the programme. On the other hand, many companies have their headquarters in Prague, while their production is primarily in other regions. Less than 8% of the provided support was distributed among the three bottom regions (Karlovy Vary Region, Liberec Region and Vysocina Region). In terms of average and median subsidy levels, no such differences, as in the case of the manufacturing industry, were observed among the Czech regions.

As the Innovation Programme is implemented as part of the EU cohesion policy, it aims not only to enhance innovation activities but also to reduce disparities in the level of development of individual regions. Therefore, we were also interested in whether the financial support is allocated to the poorer or rather to the more prosperous

regions. The average gross domestic product per capita from 2015 to 2017 (Czech Statistical Office, 2021a) was calculated and compared with the subsidy per capita.

Figure 3
Amount of subsidy per capita and GDP per capita in NUTS3 regions
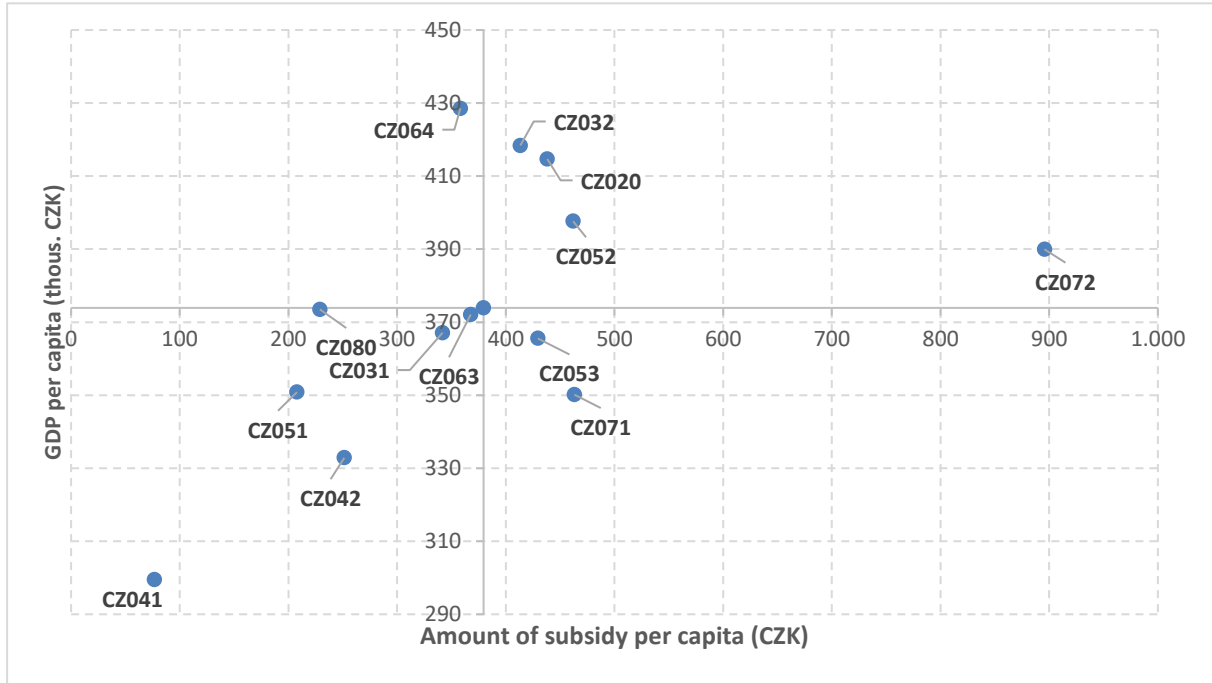
Note: One outlier observation (CZ010) was excluded to visualise the data better.
Source: authors' processing based on Ministry of Regional Development CZ (2021) and Czech Statistical Office (2021b)

Figure 3 presents a scatter plot of the amount of subsidy per capita against GDP per capita in NUTS3 regions. Regions in the upper right quadrant are those with an above-average amount of subsidy received (per capita) and above-average GDP (per capita). Prague was excluded from the chart because it reaches extreme values in both indicators, and the presented results would be significantly distorted. In the case of GDP per capita, Prague achieves extremely high values and is one of the most developed regions in the EU. On the contrary, it has low support values due to public aid rules. The figure indicates that high-performing regions are more likely to be subsidised. The correlation coefficient is 0.51, meaning that the variables are moderately correlated.

Table 8 illustrates the number of enterprises with increasing and decreasing turnover in NUTS3 regions. The largest share of companies with a positive turnover rate can be found in the Pardubice Region (87.5%), the South Bohemian Region and the Zlin Region (both 85.71%). On the opposite, the Karlovy Vary Region has the largest share of companies that experienced a decrease (66.67%), influenced mainly by the low number of supported projects.

Table 8
Enterprises with increasing or decreasing turnover by NUTS3 region (n=276)

NUTS3 region	Decrease (number)	Decrease (%)	Increase (number)	Increase (%)
CZ010 Prague	10	40.00	15	60.00
CZ020 Central Bohemian	8	28.57	20	71.43
CZ031 South Bohemian	2	14.29	12	85.71
CZ032 Pilsen	4	20.00	16	80.00
CZ041 Karlovy Vary	2	66.67	1	33.33
CZ042 Usti	3	33.33	6	66.67
CZ051 Liberec	2	28.57	5	71.43
CZ052 Hradec Kralove	2	15.38	11	84.62
CZ053 Pardubice	2	12.50	14	87.50
CZ063 Vysocina	7	41.18	10	58.82
CZ064 South Moravian	7	18.92	30	81.08
CZ071 Olomouc	3	14.29	18	85.71
CZ072 Zlin	6	14.29	36	85.71
CZ080 Moravian-Silesian	4	16.67	20	83.33
Czech Republic	**62**	**22.46**	**214**	**77.54**

Source: authors' processing based on Ministry of Regional Development CZ (2021)

As shown in Table 9, differences in turnover growth can be observed across regions. The most successful appears to be the South Bohemian Region – one-half of the enterprises experienced up to 47.36% higher turnover than in the year before the aid; one-quarter recorded a rise up to 74.99%. High growth at the median level was also observed in Prague, the Pardubice Region and the Zlin Region.

Table 9
Percentage of turnover growth by NUTS3 region (n=214)

NUTS3 region	1st quartile (%)	Median (%)	3rd quartile (%)	Number of enterprises
Prague	23.47	33.08	43.77	15
Central Bohemian	9.31	15.35	40.78	20
South Bohemian	11.33	47.36	74.99	12
Pilsen	8.40	20.27	59.27	16
Karlovy Vary		17.41		1
Usti	6.22	21.42	131.33	6
Liberec	12.49	22.97	50.97	5
Hradec Kralove	17.48	28.93	39.97	11
Pardubice	18.48	32.98	60.26	14
Vysocina	9.50	25.79	31.15	10
South Moravian	13.35	27.67	37.20	30
Olomouc	6.90	16.90	40.75	18
Zlin	14.95	30.57	64.82	36
Moravian-Silesian	11.90	23.08	34.05	20
Czech Republic	**12.90**	**25.53**	**44.73**	**214**

Note: Empty fields are cases where the group includes less than three enterprises.
Source: authors' processing based on Ministry of Regional Development CZ (2021)

Significant differences in turnover growth were found among companies in the Usti Region, but this is influenced by the low number of units. The lowest rates can be observed in the Central Bohemian, Olomouc and Pilsen Regions. At the level of the

third quartile, the South Moravian Region reached surprisingly low values. This region generally considered very innovative and concerning GDP, has very high expenditures on research and development.

Conclusion

The paper dealt with the changes in the turnover of companies that received support for their innovation activities. The research aimed to verify whether companies that have received public support for innovation are experiencing turnover growth. The paper searched for answers to two main research questions: 1) Are companies that have received support for innovation activities increasing their turnover? 2) Does the growth in turnover differ according to the size of the company, industry, or region?

The research was conducted on the example of the Czech Innovation Programme, and the analysis included 276 projects launched during the period 2015-2017 and implemented in the manufacturing industry. The projects were also divided into NUTS3 regions. The paper investigated the turnover a year before receiving the aid and two years after the granting for each company. Therefore, the change in turnover within the three years was assessed.

The analysis showed that 62 companies (22.46%) reported a decrease in turnover during the observed period, and therefore only 214 companies were included in the more detailed analysis. The decrease was most frequent in small enterprises and least often in large ones. The share of companies with decreasing turnover is higher than expected, both because of the favourable economic situation and the positive expectations relating to innovative companies. Nevertheless, we confirmed that state aid for innovation positively influences companies' economic performance. In the case of many companies, it was a significant increase in turnover over the examined period.

Enterprises that showed an increase in turnover were classified into quartiles according to the increase in turnover. When the success of these companies is assessed at the median level, the largest growth was found in the category of small enterprises. Within the manufacturing industry, we focused mainly on industries with NACE codes from 20 to 32, as most projects were supported in these divisions. At the median level, there was the largest increase in companies in sections 22, 27, 26, 29 and 30 (increase in turnover by more than 30%). On the contrary, the lowest increase in turnover was recorded for enterprises in sections 21, 23, 24 and 28 (increase in turnover by less than 20%). Differences in turnover growth were also observed across regions. At the median level, companies in some regions that are not traditionally innovative recorded high growth.

On the contrary, low growth was recorded in some regions, which are considered to be highly innovative. However, this conclusion cannot be generalised. It was also worth noting that the support usually flows to regions with higher economic performance.

The research has revealed several implications for innovation policy. A high share of public support is allocated to large companies, but the support should help the smaller companies. This should be kept in mind when setting programme rules. Better information and raising public awareness can also contribute to the greater involvement of small companies. More attention should also be paid to companies from the high-tech and medium-high tech industries. The increase in turnover for some companies was low or even negative, which signals that support should not only focus on the technical side of innovation but also on raising awareness of innovations among potential customers (e,g., parallel support for marketing innovation).

The analysis has opened up several questions that offer space for further research. First, the implementation of the whole Innovation Programme, i.e. projects supported up to 2021, should be evaluated with a certain time lag. However, one limitation to this research lies in the fact that the economic performance of companies will be affected by the Covid-19 pandemic in 2020 and beyond. We see another research potential compared to the control group of companies that do not draw any public support for innovation and research activities. At the same time, we are not sure if a sufficient number of such companies will be available. Further research space is offered by qualitative research to determine whether companies would implement their innovation plan even without public support. Such research would allow a better assessment of the crowding-out effect.

The main limit of the research is the short time elapsed since implementing the Innovation Programme, and it is, therefore, not yet possible to assess the longer-term effects. In our research, we were also limited by the unavailability of economic data for many companies, so we had to reduce the research sample. This points to the fact that Czech companies often do not fulfil their obligations and do not publish financial statements. The availability of financial data for more companies and the inclusion of later implemented projects would enable us to obtain more significant research results.

References

1. API – Business and Innovation Agency (2021), „General Information on OP EIC", available at https://www.agentura-api.org/en/op-pik-obecne (20 April 2021)
2. Arrow, K. J. (1962) , "Economic welfare and the allocations of resources of invention", in The Rate and Direction of Inventive Activity: Economic and Social Factors, Princeton, Princeton University Press, pp. 609-626.
3. Arza, V., Lopez, E. (2021), „Obstacles affecting innovation in small and medium enterprises: Quantitative analysis of the Argentinean manufacturing sector", Research Policy, Vol. 50 No. 9, pp. 1039-1052.
4. BEIS (2017), "The impact of public support for innovation on firm outcomes", BEIS Research Paper, No. 3, BEIS, Department for Business, Energy & Industrial Strategy, London.
5. Bianchini, S., Llerena, P., Martino, R. (2019), "The impact of R&D subsidies under different institutional frameworks", Structural Change and Economic Dynamics, Vol. 50 No. September 2019, pp. 65-78.
6. Bisnode (2021), „MagnusWeb", available at https://magnusweb.bisnode.cz (15 January 2021)
7. Bleda, M., del Río, P. (2013), „The market failure and the systemic failure rationales in technological innovation systems", Research Policy, Vol. 42 No. 5, pp. 1039-1052.
8. Coccia, M. (2017), „Sources of technological innovation: Radical and incremental innovation problem-driven to support competitive advantage of firms", Technology Analysis, Vol. 29 No. 9, pp. 1048-1061.
9. Crespi, G., Giuliodori, D., Giuliodori, R., Rodriguez, A. (2016), „The effectiveness of tax incentives for R&D+i in developing countries: The case of Argentina", Research Policy, Vol. 45 No. 10, pp. 2023-2035.
10. Curran, J., Storey, D. J. (2002), „Small business policy in the United Kingdom: the inheritance of the Small Business Service and implications for its future effectiveness", Environment and Planning C: Government and Policy, Vol. 20 No. 2, pp. 163-177.
11. Czech Statistical Office (2021a), „Public database", available at https://vdb.czso.cz/vdbvo2/faces/en/index.jsf (28 December 2021)
12. Czech Statistical Office (2021b), „Statistical Yearbook of the Czech Republic - 2021", available at https://www.czso.cz/csu/czso/statistical-yearbook-of-the-czech-republic-rtnih2q42g (5 January 2022)

13. Dodgson, M., Hughes, A., Foster, J., Metcalfe, S. (2011), „Systems thinking, market failure, and the development of innovation policy: The case of Australia", Research Policy, Vol. 40 No. 9, pp. 1145-1156.
14. European Commission (2003), „Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises", available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32003H0361 (10 May 2022)
15. Eurostat (2008), „NACE Rev. 2 - Statistical classification of economic activities", available at https://ec.europa.eu/eurostat/en/web/products-manuals-and-guidelines/-/KS-RA-07-015 (20 April 2021)
16. Eurostat (2021), „NUTS - Nomenclature of territorial units for statics", available at https://ec.europa.eu/eurostat/web/nuts/background (28 December 2021)
17. Freel, M., Liu, R., Rammer, C. (2019), „The Export Additionality of Innovation Policy", Industrial and Corporate Change, Vol. 28 No. 5, pp. 1257-1277.
18. Galbraith, B., McAdam, R., Woods, J., McGowan, T. (2017), „Putting Policy into Practice: An Exploratory Study of SME Innovation Support in a Peripheral UK Region", Entrepreneurship and Regional Development, Vol. 29 No. 7-8, pp. 668-691.
19. Giachi, S., Alvarez-Tinoco, R. (2022), „Innovation Policy Development for Sustainable Fisheries in the Global South: From R&D to System Transformation", Innovation and Development, Vol. 12 No. 1, pp. 113-134.
20. Grillo, F., Landabaso, M. (2011), „Merits, problems and paradoxes of regional innovation policies", Local economy, Vol. 26 No. 6-7, pp. 544-561.
21. Halaskova, M., Gavurova, B., Kocisova, K. (2020), „Research and Development Efficiency in Public and Private Sectors: An Empirical Analysis of EU Countries by Using DEA Methodology", Sustainability, Vol. 12 No. 17, pp. 1-22.
22. Hunady, J., Pisar P., Durcekova I. (2020), „R&D Investments in the European ICT sector: Implications for Business Performance", Business Systems Research, Vol. 11 No. 3, pp. 30-44.
23. Jugend, D., Fiorini, P. D. C., Armellini, F., Ferrari, A. G. (2020) , „Public support for innovation: A systematic review of the literature and implications for open innovation", Technological Forecasting and Social Chang, Vol. 156 No. July 2020.
24. Klímová, V., Winklerová, L. (2017), "Bariéry pro rozvoj inovací v regionech (Barriers to innovation development in regions)", in Klímová, V., Žítek, V. (Eds.) 20th International Colloquium on Regional Sciences, Masaryk University, Brno, Czech Republic, pp. 246-254.
25. Klímová, V., Žítek, V., Lelková, T. (2021), „The Influence of Public Support for Innovations on the Economic Performance of Enterprises", in ENTRENOVA - ENTerprise REsearch InNOVAtion, IRENET, Society for Advancing Innovation and Research in Economy, Zagreb, Croatia, pp. 323-331.
26. Lewczuk, A., Lewkowicz, J. (2020), „Incentives for Private Innovations - Is Public Support Necessary?", Argumenta Oeconomica, Vol. 45 No. 1, pp. 105-139.
27. Merito, M., Giannangeli, S., Bonaccorsi, A. (2010), „Do incentives to industrial R&D enhance research productivity and firm growth? Evidence from the Italian case", International Journal of Technology Management, Vol. 49 No.1/2/3, pp. 25-48.
28. Mina, A., Di Minin, A., Martelli, I., Testa, G., Santoleri, P. (2021), „Public funding of innovation: Exploring applications and allocations of the European SME Instrument", Research Policy, Vol. 50 No. 1.
29. Ministry of Regional Development CZ (2021), „DotaceEU.cz. European Funds Portal in the Czech Republic", available at https://www.dotaceeu.cz/en/home-en (15 January 2021)
30. Montmartin, B. A., Herrera, M. (2015), „Internal and external effects of R&D subsidies and fiscal incentives: Empirical evidence using spatial dynamic panel models", Research Policy, Vol. 44 No. 5, pp. 1065-1079.
31. Neméthová, V., Širanová, M., Šipikal, M. (2019), „Public support for firms in lagging regions - evaluation of innovation subsidy in Slovakia", Science & Public Policy, Vol. 46 No. 2, pp. 173-183.
32. Novak, I. (2020), „Comparative analysis of innovation performance of European Union countries", Notitia - journal for economic, business and social issues, Vol. 6 No. 1, pp. 1-11.

33. Novosák, J., Hájek, O., Novosáková, J., Lindner, M. (2017), „Enterprise support policy and territorial cohesion: The Czech Republic (2007-2013)", Journal of Urban and Regional Analysis, Vol. 9 No. 2, pp. 141-157.
34. Odei, S. A., Stejskal, J., Prokop, V. (2021), „Revisiting the Factors Driving Firms' Innovation Performances: the Case of Visegrad Countries", Journal of the Knowledge Economy, Vol. 12 No. 3, pp. 1331-1344.
35. OECD (2005), Oslo manual. The Measurement of Scientific and Technological Activities, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, 3rd ed., Paris, OECD.
36. Pekovic, S., Lojpur, A., Pejic-Bach, M. (2015), „Determinants of innovation intensity in developed and in developing economies: The case of France and Croatia", International Journal of Innovation Management, Vol. 19 No. 5.
37. Rodríguez-Pose, A., Belso-Martinez, J.A., Díez-Vial, I. (2021), „Playing the innovation subsidy game: Experience, clusters, consultancy, and networking in regional innovation support", Cities, Vol. 119.
38. Schot, J., Steinmueller, W.E. (2018), „Three frames for innovation policy: R&D, systems of innovation and transformative change", Research Policy, Vol. 47 No. 9, pp. 1554-1567.
39. Segarra-Blasco, A., Garcia-Quevedo, J., Teruel-Carrizosa, M. (2008), „Barriers to innovation and public policy in Catalonia", International Entrepreneurship and Management Journal, Vol. 2008 No. 4, pp. 431-451.
40. Sidorkin, O., Srholec, M. (2021), „Do Direct Subsidies Stimulate New R&D Outputs in Firms? Evidence from the Czech Republic", Journal of the Knowledge Economy, early access.
41. Silva, P., Pires, S. M., Teles, F. (2021), „Explanatory models of regional innovation performance in Europe: policy implications for regions", Innovation: The European Journal of Social Sciences, Vol. 34 No. 4, pp. 609-631.
42. Woolthuis, R. K., Lankhuizen, M., Gilsing, V. (2005), „A system failure framework for innovation policy design", Technovation, Vol. 25 No. 6, pp. 609-619.
43. Zakić, N., Popović, J., Miškić, M. (2020), „The Linkages Between Investments in Innovation and Business Performance in Serbia", Management: Journal of Sustainable Business and Management Solutions in Emerging Economies, Vol. 25 No. 3, pp. 1-11.
44. Žítek, V. (2016), "Změny zaměstnanosti ve výzkumu a vývoji v českých krajích (Changes of employment in research and development in the Czech regions)", in Klímová, V., Žítek, V. (Eds.), 19th International Colloquium on Regional Sciences, Masaryk University, Brno, Czech Republic, pp. 289-295.

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Impact of Organizational Culture on Organisational Performance: A Study on the Employees in Educational Institutions

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Abstract

Background: The purpose of the paper is to assess organisational culture's role on the performance of employees in the educational sector. **Objectives:** The paper seeks to address: what type of organisational culture is contributing to organisational performance, how organisational learning can be enhanced, how team orientation can be encouraged, and technical assistance and innovation can be promoted in developing economies. **Methods/approaches:** The data was collected from 350 respondents from different educational institutes' employees of the Garage zone of SNNPR, Ethiopia. Structural equation modelling was used to test the proposed hypothesis. **Results:** The results showed that organisational dimensions such as organisational learning, team orientation and strategic direction and intent are supported, and it is proved that these dimensions can significantly influence the overall performance of the organisation in the study area, whereas the remaining two dimensions: creating change, and goals and objectives are not supported by their organisations. **Conclusions:** The study concludes that the culture of creating change can enable organisations to achieve their goals and objectives. Organisations must focus on improving the capability of human resources. Especially, it is compulsory for the employees of the educational institutions as they must adopt technological assistance and other types of knowledge of value to encourage innovative practices in the teaching-learning process.

Introduction

Owing to the increased demands and expectations of the consumers on better public service delivery, competition in the marketplace, technological advancement (Kennerley et al., 2002), and today's changing and competitive business environment in both the public and private sectors in many developing countries, measuring organisational performance has become pertinent to evaluate the success of an organisation (Tariq et al., 2020). Especially if the public sectors remain keenly competitive with the private sector, organisations must adopt innovative strategies for better performance (Hughes et al., 2018). It is believed that if any organisation fails to adopt innovative strategies, it may hamper the institution's competitiveness and sustainability. Thus, an organisation's working culture in terms of organisational learning, mission, team orientation, creating change, and strategic direction and intent are a crux to determining the effective performance of an organisation (Denison, 2010). Many studies on organisational culture made significant efforts to examine how organisational culture can influence the organisational performance of different organisations (Lu et al., 2013) due to increased attention raised on the subject and its implication for organisational effectiveness and competitiveness (Tariq et al., 2020). Organisational performance is considered the most important subject in organisational studies (Kennerley et al., 2002). Organisational performance can be understood as the ability of the employee to undertake his job assignments efficiently to fulfil the organisation's goals and objectives (Hakim, 2015). Organisational performance is also understood as the degree of achievement that, in turn, improves the employee's efficiency. At the same time, Mahal (2009) claims that organisational performance is also understood as the capacity and capability of an organisation to meet its goals most efficiently and effectively. Thus, it is also understood that organisational performance is a concerted effort of all units of an organisation to work together as a team by adopting innovative strategies to achieve the goals and objectives of an organisation.

Due to an increasingly diverse and global workforce, the organisation 's culture has been changing, and it has an undeniable impact on the performance of any organisation. Several studies have identified organisational culture's positive and negative influences on organisational performance (Lim, 1995). However, they have not successfully brought the potential relationships between these two factors in a detailed manner. Further, it is argued that despite having extensive literature on the influence of organisational culture on the performance of the employees, no in-depth studies are being conducted on how different countries can measure organisational performance and what are the specific challenges these countries have been facing (Richard et al., 2009). Especially concerning organisational culture with organisational performance, a clear-cut knowledge gap exists in African countries (Nwibere, 2013). Similarly, Piercy et al. (2004) conducted their research in developed countries, and even questioned the applicability of Western management techniques and practices in developing countries. However, the applicability of these practices has been universally recognised.

In particular, this is especially important to carry out the study in developing countries like Ethiopia as the public sectors' reforms are still taking shape to ensure better organisational performance and better public service delivery. There is inadequate evidence regarding the combination of organisational culture, especially in terms of organisational learning, strategic direction and intent, goals and objectives; involvement in terms of team orientation and capability development; adaptability in terms of creating change, promoting innovation, and technological assistance etc. are being the fundamental aspects of the overall performance of educational sector

of Garage zone of Southern Ethiopia. The study primarily attempts to assess the role of organisational culture on organisational performance in the public service sector. While doing so, this paper addresses questions like what type of organisational culture contributes to the performance of the selected public institutions, how organisational learning can be enhanced, and how team orientation can be encouraged. Technical assistance and innovation can be promoted in developing economies.

This paper consists of four parts. The first part constitutes the introduction, where the basic organisational culture and performance concept is presented. It also highlighted the research gap with particular reference to the African context in general and the Ethiopian context. The second part represents a literature review; accordingly, hypotheses have been framed. The third part deals with the research methodology. The final part brings out the analysis and discussion of the data, the conclusion and future directions for study.

Literature Review

Organizational Culture

There have been many definitions of the organisational culture construct. However, there is no universal definition of the same (Kareem et al., 2020). For instance, organisational culture is defined as "values, beliefs and principles that serve as a foundation for an organisation's management system" (Lu et al., 2013, p. 35). These values, beliefs and principles are established within an organisation and play an important role in coordinating, promoting teamwork and holding the organisation together (Hakim, 2015). It influences the workplace, which impacts the thinking of the employees, who act significantly within and between organisations. Therefore, organisational culture has a positive relationship with the performance of the organisation (Warrick, 2017). Organisational culture promotes solidarity among the employees and instils high commitment for greater productivity. It is, therefore, seen as an essential component of organisational performance (Kenny, 2012). It includes that the employees of an organisation discuss and share their tasks with each other and other stakeholders to achieve an organisation's goals (Pathiranage, 2019). For any organisation to improve and increase its profitability and performance, strong organisational culture is an important factor that also aligns with the organisation's current and future direction. Schein (2011) indicates that organisational culture can be visible in private, public, non-profit organisations, and governmental organisations, which helps to unite employees of different identities and backgrounds. While highlighting better communication and less conflict, it is said that having a shared culture at the workplace plays an important role, which is essential to promote organisational performance (Pathiranage, 2019). These values and beliefs are expected to activate "individuals' cognitive awareness, attitudes, sense of controllability", that in turn impacts the performance and drives to meet the goals and objectives of the organisation. Organisational culture motivates the employees to display engagement qualities by being "energetic, enthusiastic, passionate, focused and dedicated" and to perform their tasks for the organisation's overall development (Ababneh, 2021, p.12). Succinctly, organisational culture is understood and considered an important variable to meet the same's goals and objectives. It creates an environment that influences business and operational accomplishments (Warrick, 2017).

Numerous studies have highlighted the potential link between organisational culture and performance (Shahzad et al., 2012; Piercy et al., 2004). According to Denison et al. (1991), a participative culture is vital for any organisation with better

results than those without such a culture. As far as the delivery of quality products and services to the customers is concerned, organisational culture plays a crucial role in motivating the employees and determining their performance, which has the organisation's overall effectiveness (Kennerley et al., 2002). While highlighting the difference between positive and strong culture and negative and weak organisational culture, it is highlighted that the former can make an employee perform better and achieve the targets. In contrast, the latter makes the employee underperform, achieving no results. In other words, organisational culture has an active and direct role in an organisation's performance management (Ababneh, 2021). However, it is highlighted that due to the difference in organisational culture, all organisations do not yield the same results as it varies from industry to industry and the location. Thus, it is evident that poor organisational culture leads to poor performance and productivity (Pedler et al., 2017). Thus, the top management of any organisation considers the significance of strong organisational culture for better performance and productivity. Table 1 presents the literature review of the most relevant previous research.

Table 1
Literature review of previous research

Authors	Research aim	Methods
Nikpour (2017)	This study highlights the importance of organisational culture and examines the role of employee's commitment in the organisation for a better organisational performance	Quantitative case study; Data was collected from the education office of Kerman province
Givens (2012)	This study focused on the organisational performance in non-profit religious organisations (churches). The study attempted to identify the potential relationship between organisational culture and performance.	Quantitative methods; Data was collected from staff and pastors of 43 Christian churches
Nazarian et al. (2017)	This study investigates the role of national culture and the balanced of hotel organisational culture in organisational performance.	Quantitative methods; Data were gathered from 96 hotels in London, UK
Singh et al. (2019)	This study investigates the role of organisational performance of small and medium-sized enterprises (SMEs)	Quantitative methods; Multisource data collected from 404 SMEs
Kareem et al. (2020)	This study investigates the impact of supply chain dynamic capabilities on operational performance in Hungarian manufacturing companies.	Quantitative methods; Data were collected from 208 supply chain management professionals from the Hungarian manufacturing industry

Source: Compiled by the researcher

Nikpour (2017) have found that an employee's organisational commitment towards the organisation's goals can significantly impact the performance, which is proved in the educational offices. Givens (2012, p. 23) concluded that a "strong relationship between the organisational mission and learning and innovation may help the church continue to improve in areas necessary for optimal performance". Singh et al. (2019) conclude that the top management significantly improves the employee's performance, that in turn, succeeds in achieving the goals of an organisation. Kareem et al. (2020) found that building dynamic supply chain

capabilities can assist manufacturing companies with achieving effective supply chains in a dynamic environment.

Hypotheses development
Organisational learning and organisational performance
The organisational learning concept has received immense attention since 1980. Past research in this field has proved that organisational learning enhances an organisation's performance by creating highly developed knowledge for employees (Al Dari et al., 2021; Kummitha et al., 2021a). Ihsaan et al. (2013) stated that to preserve a great position in a quickly developing society and competitive market, organisations got to focus on organisational learning and shifting into learning organisations. Research by Tariq et al. (2020) suggests that organisational learning is an effective strategy for improving sustainable organisational performance and competitive edge. Pedler et al. (2017) investigate the significance of learning for organisations, looking at the organisational culture perspective. The study suggests that learning is particularly vital to organisations in this globalised society because it shows how to do things differently to ensure organisational performance. Thus, organisational learning is important for organisational success and cannot be underestimated. However, Alsabbagh et al. (2017) study found that organisational culture did not significantly impact educational sectors in Damascus city, and this opposite effect of organisational culture contributed to organisational learning. Further incentive to investigate the impact of organisational learning on organisational performance in developing countries, we proposed the following hypothesis:

- o *H1: Organizational Learning has a significant impact on organisational performance*

Creating change and organisational performance
In the past few decades, several studies focused on employee behaviour for managing organisational change (Islam et al.,2020). Creating change in the organisation is one of the most complex situations because, during the change process, an employee feels fear and uncertainty, which causes employee cynicism, resistance, and unsupportive behaviour in organisational change. Therefore, past research suggests that employee of organisations plays an important role in managing organisational change successfully (Al-Ali et al., 2017; Kummitha et al., 2021b). Change management theories mainly developed in western society are examined the change supportive behaviour of the employee in the western context (Islam et al., 2020). Barkema et al. (2015) raised the concern that there are differences in social, economic, cultural, and contextual context. Due to these differences, the nature of an organisation in western countries' context may not be the same for developing countries. In the process of organisational change, the researcher witnessed employee behaviour. Especially, such studies in the setting of a developing country such as Ethiopia are rare (Bakari et al., 2017). Accordingly, we proposed the following hypothesis:

- o *H2: Creating change significantly impacts Organisational Performance*

Team orientation and organisational performance
Team orientation is one of the important components of organisational culture. Under team orientation, all the work activities of an institution are organised and performed by teams rather than individuals" (Rahman, 2017). Managers and subordinates, as a team, make efforts to solve problems and achieve the organisation's goals. While

highlighting the team orientation with the performance of an organisation, Su et al. (2009) make it clear that high performance is ensured when all parts of an organisation work as a team to meet its targets. Under team orientation, quality products and services are delivered to customers promptly. Thus, it is understood that teamwork is essential in bringing the best organisational performance. In a similar vein, Cohen et al. (1997, pp. 239-240) believe that if the employees of an organisation can work as a team, they would also make them formulate and implement strategies. Thus, it is necessary to examine whether team orientation is being practised in the selected institutions or not. And if team orientation is being practised, how does it impact the organisational performance of the selected public service institutions? The third hypothesis is as follows:

- o *H3: Team orientation has a significant impact on organisational performance*

Strategic direction and intent contribute to organisational performance

Strategic direction and intent are important components in the organisational culture, and it is understood as the philosophical base of the management process (Pathiranage, 2019). It represents the purpose of an organisation and its endeavour to achieve the targets and especially focuses on the characteristics and dynamics of competitive interaction. It provides opportunities for exploring new possibilities. Given the competitive environment in the developing countries, strategic direction motivates the employees and the organisation by "entering new markets, expanding market capabilities by learning and acquiring new knowledge, building bases of resources and experiences, realising a firm's strategic transformation" (Tariq et al., 2020, p. 32). However, Rui et al. (2008) argue that organisations have an ambitious strategic objective, make rational choices, have a strategic objective as the priority and do they have a strong decision-making role for their top managers or management team. Su et al. (2009) state that any organisation with a strong strategic intent can seek market share and give tough market competition with its performance. Through effort and commitment, strategically aggressive organisations can better set goals and motivate all individual actors of an organisation to win the marketplace and ensure better performance (Ferrier, 2001). In this research, we intend to empirically test the relationship between strategic direction and intent and organisational performance in developing countries. Therefore, the fourth hypothesis is as follows:

- o *H4: Strategic direction and Intent has a significant impact on Organisational Performance*

Goals and objectives and organisational performance

Organisational goals and objectives are fundamental to achieving the mission of an organisation. These goals and objectives are very much associated with job attitude and performance (Parker et al., 2003; Kummitha et al., 2021a). Organisations typically implement important steps, including recruiting, section, training and development, compensation, and performance management. Ideally, each step is formulated and implemented to fulfil organisational goals and objectives (Odkhuu et al., 2019). Schweitzer et al. (2004) found that organisational goal setting motivated employees' unethical behaviour. Lastly, Hakim (2015, p. 26) is of the view that organisational performance practices, such as "rewards and incentive system, were expected to increase the motivation of the employees but instead were positively related to an egoistic climate that engenders self-interest". Therefore, in line with this, we proposed the following hypothesis

    o *H5: Organisational goals and objectives have a significant impact on organisational performance*

Research Methods

Participants and procedure

The study is conducted in the Garage zone of SNNPR, Ethiopia. The garage zone contains fifteen woredas and four city administrations (Wolikita, Butajira, Buee and Emdebir city administrations). The current study is conducted in four city administrations in the Garage zone of Ethiopia. The mentioned four city administrations have contributed to its increase in population, economic development, and special expansion. This rapid growth of the cities has brought about a tremendous increase in the demand for Civil Service Reform, particularly institutional reform (Butajira Civil Service Office, 2020). The reason for choosing public service institutions in Ethiopia as a case study is the dynamic competitive environment of developing countries.

    The target population comprised individuals employed by public service institutions, including primary and secondary schools and colleges in four cities. We used a simple random sampling technique as it offers advantages such as data accuracy, lack of bias, competency to acquire generalisable outcomes and simplicity. The written format questionnaire was distributed randomly to 732 employees of educational institutions. The data were collected during February and April 2020. We received 350 employees who filled out the questionnaire in the correct format. This yielded a 47.81% response rate, considered acceptable compared to a typical response rate of 15-20% (Bhattacherjee, 2012). During data collection, we make sure that there is no missing information from the questionnaire.

Research instruments

Five variables operationalised the organisational culture: Organisational learning, Creating change, Team orientation, Strategic direction and Intent, and Goals and Objectives. A total of 24 items used to measure organisational culture were adopted from Kareem et al. (2020); and Ababneh (2021). Internal Process and Learning and Growth perspectives variables used to understand the organisational performance. A total of 8 items used to measure organisational performance were adopted from Shahzad et al. (2012) and Richard et al. (2009). The questions were designed on a five-point Likert scale ranging from 1= strongly disagree to 5= strongly agree. The list of measurement items is presented in Appendix 1.

Demographics information

Table 2 presents the demographic information of the respondents. Of 350 respondents, 65.71% were male, and 34.29% were female. 7.14% were age group 18-25, 35.14% were age group 26-34, 44.57% were age group 35-54, and 13.15% were age group 55-60. 26.28% had a Diploma, 44.57% had a bachelor's degree, and 29.15% had a master's degree; 18.28% had below 3 years of work experience, 23.15% had 3-5 years, 32.85% had 6-10 years and 25.72% having above 10 years work experience. The educated and experience population of our survey is a better representative for our study to fulfil our research objectives, as we believe better work experience of the respondents can better understand the institute's culture and performance.

Table 2
Demographic information of the respondents

Characteristics	Categories	Frequency	Percentage（%）
Sex	Male	230	65.71
	Female	120	34.29
Age	18-25 years	25	7.14
	26-34 years	123	35.14
	35-54 years	156	44.57
	55-60 years	46	13.15
Educational Qualification	Diploma	92	26.28
	BA/BSC	156	44.57
	MA/MSC	102	29.15
Years of service	Below 3 years	64	18.28
	3 – 5 years	81	23.15
	6- 10 years	115	32.85
	Above 10 years	90	25.72

Analyses and Results

Common method variance (CMV)

Studies suggest that common method variance (CMV) occurs when the data related to dependent and independent variables are collected at the same source (Hair et al., 2011), which can negatively affect the research results. Some scholars address different techniques to assess the issues of CMV in data sets. For example, Pitafi et al. (2018) stated that Harman single factor test is widely used to assess CMV. According to this approach, a principal component analysis (PCA) was utilised for all the items included in the study. The results indicate that the total variance for a single factor is less than 50%. We conclude that common method bias does not bewilder the interpretations of the results.

Descriptive statistics

Table 3 represents the descriptive statistic (mean, stranded deviation, and correlation). The results report that the mean score for all constructs was between 3.12-3.73, which indicates that all the variables indicate that the organisation has a good implementation of organisational culture. Also, correlation results show that each of the constructs is positively significant.

Table 3
 Descriptive statistics

	Mean	S.D.	TO	SDI	GO	IP	LGP
OL	3.12	1.10	1				
CC	3.20	1.10	.297**	1			
TO	3.73	1.02	.286**	.339**	1		
SDI	3.66	1.03	.195**	.310**	.285**	1	
GO	3.60	1.07	.219**	.266**	0.083**	.111**	1
IP	3.35	1.02	.321**	.302**	.123**	.330**	.105**
LGP	3.32	0.912	.521**	.391**	.203**	.202**	.212**

**. Correlation is significant at the 0.01 level (2-tailed).
OL= Organizational Learning, CC= Creating change, TO= Team orientation, SDI= Strategic direction and Intent, GO= Goals and Objectives, IP= Internal Process, LGP= Learning and Growth perspectives.

Validity and Reliability

The proposed study was analysed in two steps. We analysed the measurement and structural models (Table 4).

Table 4
Convergent factor analysis

Constructs	Measurement Items	Loadings	CA	CR	AVE	P- Value
Organizational Learning	OL1	0.505	0.74	0.71	0.53	0.000
	OL2	0.684				0.000
	OL3	0.48				0.000
	OL4	0.769				0.000
	OL5	0.561				0.000
Creating change	CC1	0.645	0.70	0.72	0.51	0.000
	CC2	0.573				0.000
	CC3	0.673				0.000
	CC4	0.434				0.000
	CC5	0.482				0.000
Team orientation	TO1	0.79	0.878	0.88	0.596	0.000
	TO2	0.867				0.000
	TO3	0.692				0.000
	TO4	0.793				0.000
	TO5	0.702				0.000
Strategic direction and Intent	SDI1	0.829	0.793	0.809	0.521	0.000
	SDI2	0.534				0.000
	SDI3	0.78				0.000
	SDI4	0.709				0.000
Goals and Objectives	GO1	0.766	0.872	0.872	0.578	0.000
	GO2	0.803				0.000
	GO3	0.715				0.000
	GO4	0.761				0.000
	GO5	0.754				0.000
Internal Process	IP1	0.765	0.871	0.873	0.698	0.000
	IP2	0.888				0.000
	IP3	0.848				0.000
Learning and Growth perspectives	LGP1	0.922	0.945	0.946	0.778	0.000
	LGP2	0.874				0.000
	LGP3	0.905				0.000
	LGP4	0.911				0.000
	LGP5	0.793				0.000

a= Cronbach's alpha, CR =Composite Reliability and Average, AVE=Variance Extracted

Results in table 4 indicated that factor loading of all items is higher than 0.60, composite reliability (CR) >0.70, Cronbach's alpha (CA)>0.70, and average variance extracted (AVE) >5.0, which are higher than the suggested thresholds (Bagozzi et al., 1991). These results affirm that our hypothesised research model has acceptable internal consistency, good composite reliability, and convergent validity.

For Discriminant validity, we observed the AVE square root value, as shown in Table 5. All values of the AVE square root value are higher than the intercorrelation of each construct. These results indicate that each viable is different from the others (Hair et al., 2011). Therefore, the hypothesised model has good discriminant validity and reliability. It is worth examining the structural relationship among the variables.

Table 5
Discriminant validity

	AVE	OL	CC	TO	IP	SDI	GO	LGP
OL	0.53	**7.28**						
CC	0.51	0.312**	**0.714**					
TO	0.596	0.112**	0.442**	**0.772**				
IP	0.698	0.512	0.394	0.214*	**0.835**			
SDI	0.521	0.012*	0.310**	0.358***	0.361***	**0.722**		
GO	0.578	0.412*	0.202**	0.308***	0.327***	0.404***	**0.76**	
LGP	0.778	0.102**	0.223**	0.233	0.132	0.297	0.098	**0.882**

Notes: Bold values in diagonal represent the squared root estimate of AVE

Measurement model

To analyse the model fit, three different types of model fit criteria were chosen, including incremental fit, absolute fit, and parsimonious fit, as proposed by (Hair et al., 2011). The results confirm an adequate model fit (CMIN/df= 1.64, CFI=0.903, TLI= 0.901, IFI=0.928, RMSEA=0.057).

Structural model

This study aims to investigate organisational culture's impact on organisational performance in public institutions in Ethiopia, based on organisational learning, creating change, team orientation, strategic direction and intent, goals and objectives, internal process, and learning and growth perspectives variables. SEM with maximum likelihood was performed. It is commonly used in behavioural research to examine the causal relationships between multiple constructs (Hair et al., 2011).

Hypothesis testing

To test the proposed hypothesis of the study, the Beta Coefficient values and P-values were analysed. Table 6 indicates the results of the proposed hypothesis.

Table 6
Result of hypothesis Test

NO.	Hypotheses	Beta Coefficient	*P*-Value	Result
H1	Organizational Learning→ Organizational Performance	0.359	0.041	Supported
H2	Creating change→ Organisational Performance	0.053	0.797	Not Supported
H3	Team orientation → Organisational Performance	0.820	0.000	Supported
H4	Strategic direction and Intent → Organisational Performance	0.350	0.006	Supported
H5	Goals and Objectives → Organizational Performance	0.153	0.203	Not Supported

Hypothesis one (H1) was supported at 5% significance level (β= 0.359, *P*=0.041). Hypothesis (H2) was not supported by the SEM model (β= 0.53, *P*=0.797). Hypothesis (H3) was supported at 1% significance level (β= 0.820, *P*=0.000), as well as hypothesis (H4), was supported by the SEM model (β= 0.350, *P*=0.006). Hypothesis (H5) was not supported by the SEM model (β= 0.153, *P*=0.203).

Figure.1
The SEM model analysis
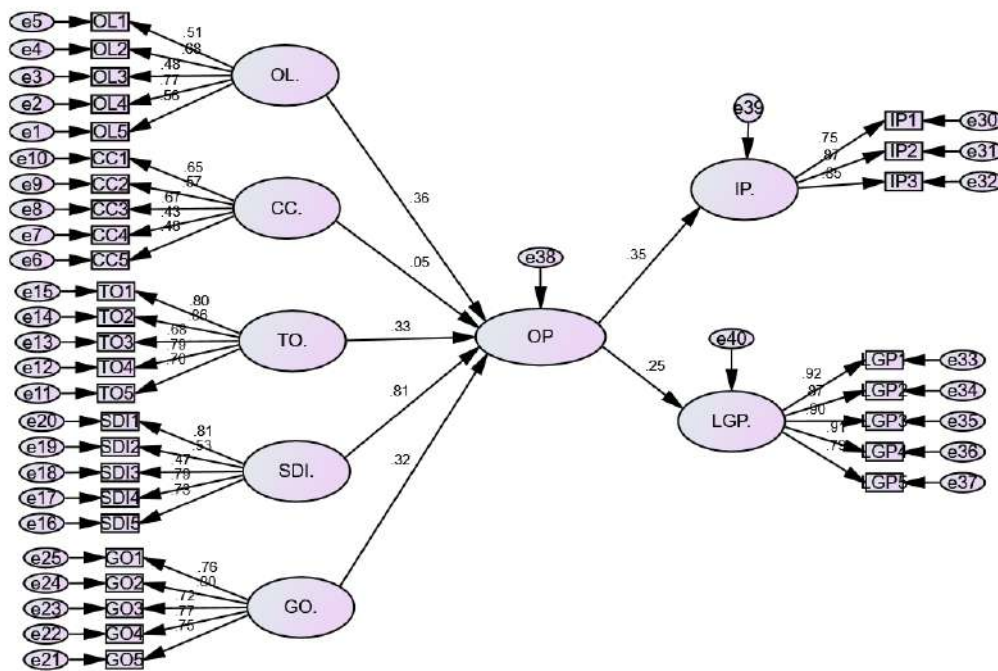
Source: Authors' work

Discussion

The study has come up with five hypotheses, and findings reveal that the five components of organisational culture affect the performance of the selected educational institutions. The first hypothesis, "organisational learning contributes to organisational performance, " is supported by the SEM model. The findings show that organisational learning significantly contributes to educational institutions' improved performance. In particular, the respondents replied that their respective institutions reward those who take risks. The respondents see failure as an opportunity to learn and improve themselves to meet the organisation's goals. The respondents also said that they believe in day-to-day learning and knowledge sharing, which significantly improves individual performance and the overall performance of the institutions. The result has supported the idea of Odkhuu et al. (2019) that an organisational learning culture is an important component for employees. It encourages them to involve in knowledge sharing and collaboration.

The second hypothesis, that is, "creating change contributes to organisational performance", was not supported by the SEM model. The respondents believe that educational institutions are facing challenges in providing technical assistance and other types of knowledge value to encourage innovative practices in different schools that, in turn, increase the gap between the teaching and learning process. It is observed in the field survey that the institutions fall short in gathering up-to-date information and knowledge that, in turn, negatively affects the performance of the institution. In particular, the financial constraints of the institutions resulted in an improper allocation of resources that diminished the innovative capability of the institution. The selected institutions also fail to provide skill up-gradation to the teachers and other non-teaching staff to bring innovative practices. The findings support the ideas of Kareem et al. (2020) that bringing change in an organisation through innovative orientation can positively influence the performance of an organisation. Through innovative ideas and strategies, an organisation can have the capability to

introduce new products and processes. Thus, it is proved that creating change contributes to organisational performance and is found insignificant in improving selected educational institutions' performance.

The third hypothesis, that is, team orientation contributes to organisational performance, was supported by the SEM model. The respondents believe that the institutions promote team cohesiveness, which in turn motivates organisational performance. Importantly, the management reduces unnecessary conflicts among the teachers and non-teaching staff. This aspect brings positive results in the countries like Ethiopia, which believes in and practices ethnic federalism to establish the equality of all ethnic groups. The respondents also observed that the work activities/assignments are organised among the staff members rather than induvial. Also, the staff members are mutually accountable for the organisational performance, and it promotes the collective responsibility of the employees that positively impacts the institution's performance. This finding is in line with some major studies on organisational culture. For instance, it is said that employees who believe in and practice team orientation in any organisation behave consistently with organisational values (Denison et al., 1991).

The fourth hypothesis, that is, strategic direction and intent contribute to organisational performance, is supported by the SEM model. The employees expressed that the management of their institutions conveys clear strategic intent on the institution's purpose and what and how an institution can contribute. They said their institution is applying clear strategies to promote a conducive atmosphere to their work culture. Educational institutions have a clear direction in their work and a well-planned strategy to design the curriculum and deliver it to the students. As far as educational institutions are concerned, it is observed that despite clear strategic direction, the said institutions fall short in their implementation to achieve common organisational goals and objectives. In organisations with strong organisational cultures, top management and employees always work together to ensure better performance, and if coordination is lacking, it may have a negative effect. It is highlighted in the following hypothesis.

The fifth hypothesis is that "goals and objectives can contribute to organisational performance", which is not supported by the SEM model. As mentioned, the institutions fail to achieve goals and objectives successfully despite clear direction. The respondents believe that implementing innovative practices is key to achieving the goals and objectives of any institution. However, the selected educational institutions in Garage zone administration are not promoting innovative practices, which affects the institutions' goals and objectives. Even the institutions are not supporting value creation in their work to achieve the goals and objectives of the institutions. In the field study, it is observed from the respondents that the higher officials are not holding regular meetings with the staff members to meet the day-to-day activities and achieve the overall goal and objectives. There is no proper performance measurement system to achieve the goals and objectives. It also highlights that the lack of communication between the top management and employees belong to the lower and the middle level. All of these highlight the under-utilisation of available resources for achieving the goals and objectives of an institution. This finding supports the idea of Jarad et al. (2010) that the performance of an organisation can only be enhanced when it achieves its goals by using resources efficiently and effectively. This argument makes it clear that institutions must adopt and nurture certain values, beliefs, and norms to achieve their goals and objectives. It is the need of the hour in developing countries like Ethiopia.

Conclusion

It can be concluded that organisational dimensions such as organisational learning, team orientation, and strategic direction and intent are supported, and it is proved that these dimensions can significantly influence the overall performance of the organisations in the study area. At the same time, the remaining two dimensions are not supported by their organisations creating change; and goals and objectives. Though the extant literature (Schein, 2001; Jarad et al., 2010) highlights a positive correlation between the components of organisational culture and organisational performance, the study results found that only three hypotheses positively influence organisational performance. The culture of creating change can enable the organisation to achieve its goals and objectives. Especially, it is very much necessary in educational institutions as these institutions must adopt technological assistance and other types of knowledge of value to encourage innovative practices. The respondents are of the view that the student-teacher relationship has a positive influence on the innovation capability of an institution. Thus, the study clarified that creating change can positively influence organisational performance.

The study results recommend for outcome-oriented organisations bring a better performance that meets the needs of the service receivers. The study findings also revealed that the culture of involvement in the organisation is found to be insecure. Therefore, the study recommends that organisations focus on improving human resources capability by conducting training programs within the organisation. There is also a need to focus on creating change by introducing innovative strategic practices for better organisational performance that, in turn, ensure better service delivery. Due to the competitive nature of today's environment, the selected institutions must show flexibility and adopt innovative strategies and practices for a strong organisational culture. Especially, it is the need of the hour for the developing countries of Africa, which are far behind in promoting and teaching innovative practices as a part of organisational culture. The study finds the urgency to carry out regular appraisals to determine the performance of its employees for an effective performance that, in turn, certainly boosts the employee's performance.

The study results will be helpful to other public sectors in Ethiopia and other African countries. There are few studies on assessing organisational culture vis-à-vis organisational performance in educational institutions in Ethiopia. The previous studies which investigated organisational performance have focused on the private sector, and the difference in performance in public and private sectors is evident in developing countries. In this concern, the present study attempted to assess organisational culture on the performance of the public service institutions, which has added value to the existing literature in the African countries. The five hypotheses' results can significantly help bridge the research gap on the organisations' culture, knowledge, and technological capabilities. Especially it can motivate the organisational culture practices and researchers to focus on addressing the technological handicaps within the organisations and organisational learning in other public service institutions in Ethiopia in particular and African countries in general. The negative result on the relationship between creating change and; goals and objectives may highlight the challenges many organisations have faced in developing countries like Ethiopia. Thus, the study highlights the importance of imparting innovative strategies and techniques to bring better results in educational intuitions. For example, the study established the significance of the technological capabilities of the employees and the adoption of innovative strategies and techniques in the organisations, which significantly contribute to the overall development of public service institutions.

The study is subject to a few limitations. First, even though the Garage zone administration of Ethiopia has many public service organisations, the researchers delimited the study to the educational sector. Second, as far as the geographical area of the study is concerned, the study collected the data from one of the developing countries of Africa – Ethiopia. Hence, the generalisation of the findings is restricted. Third, though gender is a factor considered in the study, however, there is no detailed analysis of how different components of organisational culture and job functions affect male and female employees, respectively. Thus, the gender dimension could also be added to understand organisational culture vis-à-vis organisational performance.

The present study focused on the organisational cultural pattern and its assessment in Ethiopia. It would give a more detailed assessment if future research could compare with other African countries by taking different components of organisational culture vis-à-vis organisational performance. The study took only five components of organisational culture to conduct the research and did not include other components. Future research should focus on other components of the organisational culture and how it affects the performance of the organisations in African society. The study also did not include the managers' perception of improving organisational culture concerning the better performance of the organisation. Since the administrative behaviours are rigid, hierarchical and top-down oriented in many developing countries, further studies must focus on how the management-employee relationships can influence organisational performance in developing countries. As was mentioned, further research could also focus on how the gender dimension plays a role in influencing the organisation's performance and the challenges and possibilities involved in it.

References

1. Ababneh, O. M. A. (2021), "The impact of organisational culture archetypes on quality performance and total quality management: the role of employee engagement and individual values", International Journal of Quality & Reliability Management, Vol. 38 No. 6, pp. 1387-1408.
2. Al Dari, T., Jabeen, F., Hussain, M., Al Khawaja, D. (2021), "How types of organisational culture and technological capabilities contribute to organisational learning", Management Research Review, Vol. 44 No. 3, pp. 437-459.
3. Al-Ali, A.A., Singh, S.K., Al-Nahyan, M., Sohal, A.S. (2017), "Change management through leadership: the mediating role of organisational culture", International Journal of Organizational Analysis, Vol. 25 No. 4, pp. 723-739.
4. Alsabbagh, M., Khalil, A. H. A. (2017), "The Impact of Organizational Culture on Organizational Learning (An Empirical Study on the Education Sector in Damascus City)", International Journal of Academic Research in Business and Social Sciences, Vol. 7 No. 4, pp. 579-600.
5. Bagozzi, R. P., Yi, Y., Phillips, L. W. (1991), "Assessing construct validity in organisational research", Administrative Science Quarterly, Vol. 36 No. 3, pp. 421-458.
6. Bakari, H., Hunjra, A. I., Niazi, G. S. K. (2017), "How does authentic leadership influence planned organisational change? The role of employees' perceptions: Integration of theory of planned behavior and Lewin's three step model", Journal of Change Management, Vol.17 No. 2, pp.155-187.
7. Barkema, H. G., Chen, X. P., George, G., Luo, Y., Tsui, A. S. (2015), "West meets East: New concepts and theories", Academy of Management Journal, Vol. 58 No. 2, pp. 460-479.
8. Bhattacherjee, A. (2012), Social Science Research: Principles, Methods, and Practices, 2nd ed., Tampa, Florida, University of South Florida Scholar Commons.

9. Butajira Civil Service office (2020), "Quarterly performance report for F.Y. 2020", Butajira (Unpublished).
10. Cohen, S. G., Bailey, D. E. (1997), „What Makes Teams Work: Group Effectiveness Research from the Shop Floor to the Executive Suite", Journal of Management, Vol. 23 No. 3, pp. 239-290.
11. Denison, D. R. (2000), "Organisational culture: Can it be a key lever for driving organisational change", The international handbook of organisational culture and climate, Vol. 18 No. 4, pp. 347-372.
12. Denison, D. R., Spreitzer, G. M. (1991), „Organisational culture and organisational development: A competing values approach", Research in organisational change and development, Vol. 5 No. 1, pp. 1-21.
13. Ferrier, W. J. (2001), „Navigating the competitive landscape: The drivers and consequences of competitive aggressiveness", Academy of management journal, Vol. 44 No. 4, pp. 858-877.
14. Givens, R. J. (2012), „The study of the relationship between organisational culture and organisational performance in non-profit religious organisations", International Journal of Organization Theory & Behavior, Vol. 15 No. 2, pp. 239-263.
15. Hair, J. F., Ringle, C. M., Sarstedt, M. (2011), „PLS-SEM: Indeed a silver bullet", Journal of Marketing Theory and Practice, Vol. 19 No. 2, pp. 139-152.
16. Hakim, M. A. (2015), „Organizational Culture and Job Satisfaction in Bank: Perceptions and Reactions of Employees", Global Disclosure of Economics and Business, Vol. 4 No. 2, pp. 167-180.
17. Hughes, A. M., Zajac, S., Spencer, J. M., Salas, E. (2018). „A checklist for facilitating training transfer in organisations", International Journal of Training and Development, Vol. 22 No. 4, pp. 334-345.
18. Ihsaan, M., Yousaf, J., Sohaib, M., Majeed, A. (2013), „Measuring the levels of learning in organisations: A comparative study of food sector of Pakistan", International Journal of Organizational Learning and Change, Vol. 1 No. 1, pp. 67-70.
19. Islam, M. N., Furuoka, F., Idris, A. (2020), "Employee championing behavior in the context of organisational change: a proposed framework for the business organisations in Bangladesh", Journal of Asia Business Studies, Vol. 14 No. 5, pp. 735-757.
20. Jarad, I. A., Yusof, N., Shafiei, M. W. M. (2010), "The Orgnaizational performance of housing developers in Peninsular Malaysia", International Journal of Housing Markets and Analysis, Vol. 3 No. 2, pp. 146-162.
21. Kareem, M. A., Kummitha, H. V. R. (2020), „The Impact of Supply Chain Dynamic Capabilities on Operational Performance", Organizacija, Vol. 53 No. 4, pp. 319-331.
22. Kennerley, M., Neely, A. (2002). „A framework of the factors affecting the evolution of performance measurement systems", International journal of operations & production management, Vol. 22 No. 11, pp. 1222-1245.
23. Kenny, G. (2012), „Diversification: Best practices of the leading companies", Journal of Business Strategy, Vol. 33 No. 1, pp.12-20.
24. Kummitha, H. R., Kolloju, N., Jancsik, A., Szalók, Z. C. (2021a), „Can Tourism Social Entrepreneurship Organizations Contribute to the Development of Ecotourism and Local Communities: Understanding the Perception of Local Communities". Sustainability, Vol. 13 No. 19, pp. 1-15.
25. Kummitha, H. R., Kummitha, R. K. R. (2021b), „Sustainable entrepreneurship training: A study of motivational factors", The International Journal of Management Education, Vol.19 No. 1, pp. 1-9.
26. Lim, B. (1995), "Examining the organisational culture and organisational performance link", Leadership & Organization Development Journal, Vol. 16 No. 5, pp. 16-21.
27. Lu, M., Nicholson, G., Schmid, F., Dai, L., Chen, L., Roberts, C. (2013). „A framework for the evaluation of the performance of railway networks", International Journal of Railway Technology, Vol. 2, pp. 79-96.
28. Mahal, P. K. (2009). „Organisational culture and organisational climate as a determinant of motivation", IUP Journal of Management Research, Vol. 8 No. 10, pp.38-51.

29. Nazarian, A., Atkinson, P., Foroudi, P. (2017), „Influence of national culture and balanced organisational culture on the hotel industry's performance", International Journal of Hospitality Management, Vol. 63, pp. 22-32.
30. Nikpour, A. (2017), „The Impact of Organizational Culture on Organizational Performance: The Mediating Role of Employee's Organisational Commitment", International Journal of Organizational Leadership, Vol. 6, pp. 65-72.
31. Nwibere, B. (2013), „The influence of corporate culture on managerial leadership style: The Nigerian experience", International Journal of Business and Public Administration, Vol. 10, pp. 166-187.
32. Odkhuu, K., Moon, M. J. (2019), „Effects of Ethics and Performance Management on Organizational Performance in the Public Sector", Public Integrity, Vol. 22 No. 4, pp. 372-394.
33. Parker, C. P., Baltes, B. B., Young, S. A., Huff, J. W., Altmann, R. A., Lacost, H. A., Roberts, J. E. (2003), „Relationships between psychological climate perceptions and work outcomes: a meta-analytic review", Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organisational Psychology and Behavior, Vol. 24 No. 4, pp. 389-416.
34. Pathiranage, J. (2019), „Organisational culture and business performance: an empirical study", International Journal of Economics and Management, Vol. 24 No. 2, pp. 264-278.
35. Pedler, M., Burgoyne, J. G. (2017), "Is the learning organisation still alive?", The Learning Organization, Vol. 24 No. 2, pp. 119-126.
36. Piercy, N. F., Low, G. S., Cravens, D. W. (2004), „Examining the effectiveness of sales management control practices in developing countries", Journal of World Business, Vol. 39 No. 3, pp. 255-267.
37. Pitafi, A. H., Liu, H., Cai, Z. (2018), „Investigating the relationship between workplace conflict and employee agility: The role of enterprise social media", Telematics and Informatics, Vol. 35 No. 8, pp. 2157-2172.
38. Rahman, U. U., Rehman, C. A., Imran, M. K., Aslam, U. (2017), "Does team orientation matter? Linking work engagement and relational psychological contract with performance", Journal of Management Development, Vol. 36 No. 9, pp. 1102-1113.
39. Richard, P. J., Devinney, T. M., Yip, G. S., Johnson, G. (2009), „Measuring Organisational Performance: Towards Methodological Best Practice", Journal of Management, Vol. 35 No. 3, pp. 718-804.
40. Rui, H., Yip, G. S. (2008), „Foreign acquisitions by Chinese firms: A strategic intent perspective", Journal of World Business, Vol. 43 No. 2, pp. 213-226.
41. Schein, E. H. (2011), "The concept of organisational culture: Why bother", Classics of organisational theory, Vol. 7, pp. 349-360.
42. Schweitzer, M. E., Ordóñez, L., Douma, B. (2004), "Goal setting as a motivator of unethical behaviour", Academy of Management Journal, Vol. 47 No. 3, pp. 422-432.
43. Shahzad, F., Luqman, R. A., Khan, A. R., Shabbir, L. (2012), „Impact of organisational culture on organisational performance: An overview", Interdisciplinary Journal of Contemporary Research in Business, Vol. 3 No. 9, pp. 975-985.
44. Singh, S. K., Gupta, S., Busso, D., Kamboj, S. (2019), „Top management knowledge value, knowledge sharing practices, open innovation and organisational performance", Journal of Business Research, Vol. 128, pp. 788-798.
45. Su, S., Baird, K., Blair, B. (2009), „Employee organisational commitment: the influence of cultural and organisational factors in the Australian manufacturing industry", The International Journal of Human Resource Management, Vol. 20 No. 12, pp. 2494-2516.
46. Tariq, A. Z., Rosmaini, T., Mohammed, A., Rumman, A. (2020), „The Relationship Between Knowledge Management, Organizational Culture, and Organizaional Performance", TEST Engineering & Management, Vol. 83, pp.2957-2972.
47. Warrick, D. D. (2017), „What leaders need to know about organisational culture", Business Horizons, Vol. 60 No. 3, pp. 395-404.

Appendix 1. List of Measurement Items

Team orientation

TO1: Cooperation and collaboration across functional roles are actively encouraged in this organisation.

TO2: Working in this organisation is like being part of a team.

TO3: Work is sensibly organised in this organisation so that each person can see the relationship between his/her work and the organisation's goals.

TO4: Teams are the primary building block of this organisation.

TO5: This organisation relies on horizontal control and coordination to get work done rather than hierarchy.

Creating change

CC1: The way things are done is very flexible and easy to change.

CC2: This organisation responds well to competitors and other changes in the external business environment.

CC3: This organisation continually adopts new and improved ways to do work.

CC4: Attempts to change this organisation usually meet with resistance.

CC5: Different units in this organisation often cooperate to create change.

Organizational Learning

OL1: This organisation encourages innovation and rewards those who take risks.

OL2: We view failure as an opportunity for learning and improvement.

OL3: Many things "fall between the cracks" in this organisation.

OL4: Learning is an important objective in our day-to-day work.

OL5: We ensure that the "right-hand knows what the left is doing".

Strategic direction and Intent

SDI1: This organisation has a clear mission that gives meaning and direction to our work.

SDI2: This organisation has a long-term purpose and direction.

SDI3: The strategic direction of this organisation is unclear to me.

SDI4: This organisation has a clear strategy for the future.

SDI5: Our organisation's strategy is leading other firms to change how they compete.

Goal and Objectives

GO1: There is widespread agreement about the goals of this organisation.

GO2: The leadership of this organisation has "gone on record" about the objectives we are trying to meet.

GO3: We continuously track our progress against our stated goals.

GO4: The people in this organisation understand what needs to be done for us to succeed in the long run.

GO5: We have a shared vision of what this organisation will be like.

Customer satisfaction perspectives

CSP1: Increases the citizen's or entrepreneur's interest in government programmes Performance.

CSP2: Emphasises the behaviour of employees that instilled confidence in customers.

CSP3: Understands the customer's specific needs, thus increasing customer satisfaction.

CSP4: Improving responsiveness to the customer.

CSP5: Communicating with the public about performance.

Internal Process

IP1: Improving the communication between the legislature and legislative staff.

IP2: Communicate the purpose for using performance measurement to employees

IP3: Improves cross-agency cooperation/coordination (within an agency/internal Help to reduce duplicating services.

Learning and Growth perspectives

LGP1: Is increasing awareness of factors that affect performance results.

LGP2: Improving the effectiveness of the agency programmes.

LGP3: Help staff monitor progress toward intended programmes/service results.

LGP4: Increases staff participation in the process of developing performance measures.

LGP5: Provides training for management and staff about performance measurement development and selection.

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Applying Model of Brand Equity in Higher Education Marketing Context

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Abstract

Background: The idea of brands is currently swiftly transferring from the market for goods to the market for services, giving rise to the service brand. Globalisation, the accelerated and increased development of service activities, and more rivalry in the provider's market have all contributed to this. **Objectives:** The primary goal of this study is to empirically test the conceptual model in higher education to create a comparative study based on different contextual dimensions and better understand brand equity in higher education. **Methods/Approach:** A quantitative research method was applied. Using a questionnaire, which was sent to students by e-mail, the data were collected. The sample chosen targeted 250 actual (university students) in Slovenia. **Results:** Consumer traits and concepts related to the brand equity's awareness dimension have no discernible influence on consumers' perceptions of brand equity. Promotional actions intended to increase brand equity by increasing awareness were ineffective and had a favourable effect on the brand equity of the symbolic qualities. All service characteristics were discovered to be important. Price, excellent quality, and benefits all had a large and positive impact on brand equity. In conclusion, all financial factors had a substantial and favourable effect on brand equity. **Conclusions:** The research's findings showed that the customer-based brand equity model might be used to create a competitive advantage in the higher education sector and to direct marketing efforts.

Introduction

The idea of brand equity began to get noticeable attention in the 1980s. An essential idea in marketing is brand equity. Due to the distinctive aspects of the service and the predominance of experience and credence traits, it is frequently claimed that marketing in the service industry is relatively difficult (Mourad et al., 2011). As the concept of brands quickly spreads from the market for products to the market for services, the service brand is created. This has been made possible by factors such as globalisation, the quickening and expanding development of service industries, and more competition in the market for the provider. The rate of globalisation is accelerating, and it is noticeably affecting schooling (Alhalwaki et al., 2019). Due to these circumstances, businesses have been compelled to recognise the value of service brands as a source of competitive advantage or liability. Although consumers must deal with immaterial components of the offer, service providers work to make their offerings more tangible. By assuring consistent service quality and tailoring them to customers' needs, they provide value to the physical components of the offer (Vukasović, 2020). The idea of brand equity is very important for consumer decision-making. Brand equity evaluates the brand's value to the company and the consumer. This increased value for the consumer results from the brand's function as a sign of desirable qualities and as the foundation for creating an emotional connection. (Mourad et al., 2011; Mourad et al. 2020). The current study uses tried-and-true brand equity methods that have been modified for use in the service industry and the particular context of higher education. The resulting brand equity model is then tested among current higher education students in a market for higher education.

In numerous academic pieces of research, brand equity was empirically tested and measured using various models and situations. Erdem et al. (1998) divided brand equity measurement techniques into component-based models that track brand equity's determinants and holistic models that aim to evaluate the brand as a whole. Eleven consumer-based brand equity indicators were compared by Agarwal et al. (1996), who also looked at how they related to one another and where they diverged. The complete multidimensional component-based model was created by Aaker (1991). The primary characteristics of brand equity are awareness, brand associations, perceived quality, loyalty, and other proprietary assets.

Additionally, Keller (1993) created a customer-based brand equity model that emphasized familiarity, awareness, and positive, powerful, and distinctive brand associations. According to him, brand knowledge—which includes awareness, attributes, benefits, images, ideas, feelings, attitudes, and experience—determines brand equity. Based on these two models, cobb-Walgren et al. (1995) empirically demonstrated that brand equity influences the general perception of the brand image and the brand attitude. Perceived quality (PQ), perceived value for the cost (PVC), uniqueness, and willingness to pay a price premium for a brand are the four main aspects of customer-based brand equity that Netemeyer et al. (2004) investigated. Based on these two models, Yoo et al. (2000) created a 22-item multidimensional scale for gauging brand equity (Mourad et al., 2011; Mourad et al., 2020). Using samples from two distinct nations, the USA (a developed market) and Egypt, Mourad et al. (2020) empirically investigated the multidimensionality part of the brand equity model, which includes brand awareness and brand image. Retamosa et al. (2020)'s study looked at the disparities between business, nursing, and engineering majors in service quality, loyalty, community, brand personality, shared values, and brand trust. According to a study by Kaushal et al. (2019), student loyalty behaviour was affected by institution reputation in both direct and indirect ways by satisfaction. In their 2019 study, Sultan et al. (2019) demonstrated a link between

experience-centric brand performance and brand image and its causes and effects. According to Sultan et al. (2019), their model strongly emphasised the significance of experience-centric service quality traits and how they affected university branding strategies for long-lasting favourable intentions (Girard et al., 2020). To design, build, and empirically test a model of university social augmenters' brand equity, Eldegwy et al. (2018) integrated branding and higher education literature in their research. Palmer et al. (2016, p. 2) pointed out that "Higher Education brands typically comprise complex bundles of benefits, most notably academic and social benefits, such that the distinction between these two brand dimensions may be complex, with some students seeing the primary benefit of Higher Education as a process of socialisation." The factors that affect customer-based brand equity in various higher education marketplaces are investigated empirically. Numerous scenarios have been used to evaluate this and other models.

This study defines brand equity as a multidimensional construct in the higher education service business using a component-based methodology (Aaker, 1991; Keller, 1993). In a growing market for higher education, this paper's selected conceptual model will be practically tested. A quantitative research method was applied to test the appropriateness of the adopted conceptual model. Using a questionnaire, which was sent to students by e-mail, the data were collected.

The investigation of the factors influencing service brand equity in the context of higher education is presented in this paper. All post-secondary instruction, training, and research guidance at educational institutions like universities recognised as institutes of higher education by state authorities are referred to as higher education. It encompasses all activities that a particular nation considers to be part of higher education, including correspondence courses that use technology and are aimed at a wide range of students, as well as shorter-term education and training programs that last between two and three years (polytechnics, junior colleges, and different types of technical speciality schools). Higher education institutions must recognise, capitalise on, and manage their significant brand equity due to increased competition (Lomer et al., 2018). Several studies have recently been carried out to address various issues regarding university branding and brand equity (Kaushal et al., 2019; Mourad et al., 2020; Retamosa et al., 2020; Girard et al., 2020; Harshani et al., 2020). This study's unique value is its empirical contribution, which was achieved by using higher education as an example of service and examining the factors that influence brand equity from the consumer's perspective. This is specifically regarding Slovenian higher education services as an example of a developing higher education market.

The paper is organised as follows. After the introduction, the research propositions development is presented. The methodology part is then offered, beginning with an overview of the research tool and data collecting, then going into great detail about the characteristics of the sample and data analysis. The evaluation of model fit with a validity and reliability analysis comes first in the results section. Because of the paper's theoretical and practical contributions, research limits, and opportunities for future research, the paper's conclusion is presented in the last part.

Research propositions

The empirical model used in this study was created by Mourad et al. (2011; 2020) and evaluated in the HE markets. The accepted framework combines the characteristics of HE services that determine BE with the theorised two dimensions of BE: brand awareness and brand image. It was developed by incorporating the frameworks of Aaker (1991) and Keller (1993). Figure 1 depicts the created service brand, equity model.

Figure 1
Proposed conceptual model of brand equity in higher education service
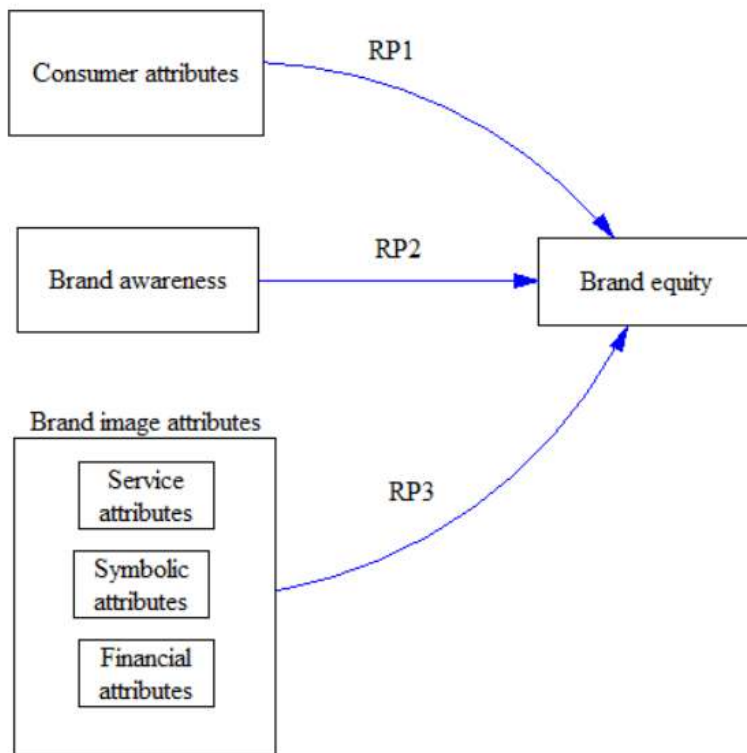
Source: Author's work

Consumer attributes and brand equity

Customer attributes are the socioeconomic traits that the individual consumer has. Consumer attributes included gender, age, education programme enrolled and employment status. The image and awareness dimension was split from the consumer attribute dimension. We assume that gender, age, and education positively relate to brand equity. Higher education is usually associated with a standard of living and a better flow of information, and more information can mean greater brand awareness and valuation. Hence, we propose a positive relationship between *consumer attributes* and brand equity. We formulate the following research proposition:

   RP1: Consumer attributes are related to brand Equity.

Brand awareness and brand equity

The first step in building brand equity is raising brand awareness. The capacity of a consumer to identify or remember that a brand belongs to a specific product or service category (Aaker, 1991). This dimension refers to whether consumers can recall or recognise a brand and is related to the strength of a brand's presence in consumers' minds (Aaker, 1991). The awareness dimension of brand equity in higher education is determined by the information available about the brand from promotional activities (Aaker, 1991; Keller, 1993; Pinar et al., 2014). Universities' brands are more known through advertising, which lowers the perceived risk of the education service (Keller, 1993). According to Keller (1993), marketing information about the service develops brand recognition and awareness, which leads to brand knowledge and, ultimately, brand equity. The right communication instrument must be developed to strengthen the university's brand position and manage its brand equity (Sharma et

al., 2013; Pinar et al., 2014; Mourad, 2020). Hence, we propose a positive relationship between brand awareness measured by promotion activities and brand equity.

RP2 Brand awareness is related to brand equity.

Brand image attributes and brand equity

Given that quality is assessed after consumption, higher education is an environment where the brand image may have a major risk-reducing impact (Byron, 1995; Binsardi et al., 2003; Chen, 2008). Because brand serves as a differentiating tool that provides cues to consumers during the decision-making process, having a strong brand is crucial as a risk reducer that simplifies the decision-making process (Erdem et al., 1998; Temple, 2006; Lockwood et al., 2007; Chen, 2008). A number of additional elements directly impact the assessment of educational quality and, consequently, the perception of the university brand (Kurz et al., 2008). The level of staff, location, size, history, and international agreements are some of these considerations (Mazzarol et al., 2008; Binsardi et al., 2003; Chen, 2008; Mourad et al., 2011). According to research on brand equity, factors influencing brand image include service, symbolic and financial features, brand personality, social image, and market position (Aaker, 1991). Rankings of universities (Keller, 1993; Kent et al., 1993), as well as their overall reputation and image (Byron, 1995; Cheng et al., 1997), are important factors in lowering perceived risk and improving BE. Accordingly, we formulate the following research proposition:

RP3: Brand image attributes are related to brand equity.

Methodology

Research instrument

This study aims to ascertain whether the principle of customer-based brand equity can be applied to higher education. Due to the nature of the research, the student context of customer-based brand equity will be the main focus. To establish a comparative study based on many contextual variables, the primary goal of this research is to experimentally examine the accepted conceptual model in rising higher education markets. A quantitative research method was applied to test the appropriateness of the adopted conceptual model. Using a questionnaire, which was sent to students by e-mail, the data were collected. The final response rate of students was 67.5%.

The data were collected from October 2020 to January 2021. Descriptive statistics are used to express the essential data features. A correlation coefficient was used to determine the linear relationships between the chosen variables. A linear structural equation modelling was used to examine the conceptual model and its correlations. Thus, the theoretical conceptual model's compatibility with the empirical data was examined. Table 1 presents the used research instrument.

Table 1
Research instrument

Dimension	Research items
Brand equity (BE)	BE1: This faculty provides high-quality education BE2: The education service in this faculty is one of the best when compared to all other universities in Slovenia BE3: This faculty provides good value for money BE4: There are good reasons to go to this faculty rather than other BE5: I trust the educational service of this faculty BE6: When it comes to universities, this is the faculty I am most familiar with
Consumer attributes (CA)	CA1: Gender (Male, Female) CA2: Age CA3: Educational programme (The first level of Bologna studies, The second level of Bologna studies, The third level of Bologna studies) CA4: Current employment status (Student, Employed or self-employed)
Brand awareness (BA)	PA1: Ads in newspapers and magazines PA2: School visits by faculty staff PA3: Mails from the faculty to students and parents PA4: Sponsorship of sports events or other events PA5: Special articles about the faculty in newspapers & magazines PA6: Faculty booklet, posters, flyers, etc.
Service attributes (SA)	SERVICE1: This faculty fee is suitable for the service provided SERVICE2: Considering what I would pay for this faculty brand, I will get much more than my money's worth SERVICE3: I consider joining this faculty a good deal since the benefits I receive are more than the fees SERVICE4: In comparison to other faculties, the education service in this faculty is of high quality SERVICE5: The education service in this faculty is the best in Slovenia SERVICE6: This faculty provides the same education quality over time STAFF1: I trust the staff of this faculty STAFF2: Concerning students' interests, this faculty seems to be very caring STAFF3: I can expect superior performance from the staff of this faculty STAFF4: The performance of the staff is good all over the year
Symbolic attributes (SYM)	SOCIAL1: This faculty is honest SOCIAL2: This is an up-to-date faculty SOCIAL3: This is a successful faculty SOCIAL4: This is an upper-class faculty in the society SOCIAL5: This is a tough faculty REPUT1: This is an old-faculty REPUT2: This faculty has more experience in the educational field REPUT3: The history of this faculty is known to the labour market REPUT4: This faculty has international links that I am interested in REPUT5: I trust the foreign countries that this faculty is dealing with REPUT6: The foreign countries that this faculty is dealing with have credibility
Financial attributes (FA)	PRICE1: University offers a favourable relationship between quality and price of service PRICE2: Is a financially stable institution (faculty) QUALITY1: The services are of high quality QUALITY: University has a capable management BENEFIT1: This faculty has a special office to keep a good relationship with its graduates BENEFIT2: The faculty provides career support to its graduates BENEFIT3: The degree from this faculty is superior in the labour market BENEFIT4: I am sure that the graduate of this faculty will get good jobs

Source: Author's work based on previous research

A variety of recognised scales from earlier studies (Vorhies, 1997; Mourad et al., 2011; Vukasović, 2015) were used in the questionnaire's construction. According to Aaker (1991) and Keller (1993), brand equity is a multidimensional phenomenon. Customer attributes are the socioeconomic traits that the individual consumer has. Gender, age, the type of schooling a person is engaged in, and employment position were all included as customer features in the suggested model (Keller, 1993; Lockwood et al., 2007; Mourad et al., 2011). Brand awareness is measured by promotional activities, which cover all the promotional activities conducted by higher education institutions (Kent et al., 1993; Chen, 2008; Mourad et al., 2011). The quality of the education provider's course selection, study methodology, and quality control are service qualities (Kent et al., 1993; Cheng et al., 1997; Kurz et al., 2008; Chen, 2008; Mourad et al., 2011). In our suggested model, symbolic attributes indicate the overall perception, social responsibility, innovation, and focus on the international market of the faculty. Symbolic attributes include connotations linked to brand personality and identity (Byron, 1995; Cheng et al., 1997; Mourad et al., 2011). The relationship between service quality and cost, as well as the faculty's financial stability, is covered by financial qualities (Vukasović, 2016).

Data

250 Slovenian university students were the intended sample for the current investigation. The popular faculties (Doba Faculty and International School for Social and Business Studies) in Slovenia's two largest cities, Maribor and Celje, were used to choose university students. Table 2 presents details on sample characteristics.

Statistical methods

A linear structural equation modelling was used to examine the conceptual model and its correlations. This made it possible to test if the theoretical, conceptual model and empirical facts were compatible. A statistical application called LISREL was employed for the latter. The reliability of the latent variables was investigated using structural modelling, and the Fornell-Larcker rule, as well as the composite or the converging reliability of latent variables, respectively, examines a discriminatory validity of latent variables by applying average variance extracted (AVE). The fit was evaluated using the fit indices Critical N, Root Mean Square Residual, Goodness of Fit Index, and Root Mean Square Error (RMSEA).

Table 2
Sample characteristics (Consumer attributes)

	Sample size	**250**
Gender	Male	61%
	Female	39%
Age	Mean age	24
	Standard deviation	1.2
Educational programme enrolled	The first level of Bologna studies	35%
	The second level of Bologna studies	61%
	The third level of Bologna studies	5%
Current employment status	Student	35%
	Employed or self-employed	65%

Source: Author's work

Results

Assessment of Model Fit

Other statistical criteria, such as RMSEA (Root Mean Square Error of Approximation), NFI (Normed Fix Index), CN (Critical N), RMSR (Root Mean Square Residual), and GFI, can be used to assess the structural models (Goodness of fit index). There are various evaluation criteria, but it is challenging to determine which is best or most appropriate. As a result, the chosen criteria are shown in the next section. It is reasonable to conclude that the model fits the data reasonably well based on the presented criteria. That is to say, RMSEA is 0,079 (if 0,080, the model is reasonably excellent), NFI is 0,98 (if close to 1, the model fits the data), CN is 188 (should be over 200 to fit well, but it is relatively near to 200), SRMR is 0,041 (should be below 0,050 to fit well), and GFI is 0,95. (it should be above 0,90 to fit well). Since the proposed structural model accurately predicted the data, its contents or relationships with the latent variables can also be examined.

The brand equity SEM model developed in the current study is shown in Table 3.

Table 3
The brand equity SEM

	β	Sig	VIF	Research proposition
Consumer attributes (CA)				
Gender	-0.002	0.931	1.076	RP1 → Not confirmed
Age	-0.012	0.415	2.241	
Educational programme	-0.030	0.142	3.754	
Current employment status	-0.078	0.104	4.742	
Brand awareness (BA)				
Promotional activitteis (PA)	-0.002	0.943	1.279	RP2 → Not confirmed
Brand image attributes				
Service attributes				RP3 → Confirmed
Service quality (SERVICE)	0.176	0.004***	8.952	
Staff (STAFF)	0.067	0.000***	7.643	
Symbolic attributes				
Social image (SOCIAL)	0.169	0.001***	8.241	
Personality (PERSON)	0.079	0.000***	6.751	
Financial attributes				
Benefits (BENEFIT)	0.064	0.002***	5.895	
Price (PRICE)	0.043	0.000***	3.753	
High quality (QUALITY)	0.051	0.000***	2.643	

Source: Author's work

Consumer characteristics and concepts related to the brand equity's awareness dimension do not influence consumers' perceptions of brand equity. Promotional efforts that were largely anticipated to boost brand equity by raising awareness resulted in little consequence. Despite the literature being in existence (Aaker, 1991; Mourad et al., 2011), there is no proof that marketing efforts influence how much a brand is valued. The perception of the university as demonstrating qualities like honesty, sincerity, etc., is one of the symbolic aspects that has a beneficial effect on brand equity. All service attributes (service quality, staff) were found to be significant; Finally, all financial factors significantly and favourably impacted brand equity. This included price (measured in terms of value supplied), excellent quality, and perks (which improved job opportunities).

Overall, the evidence points to the lack of a relationship between consumer qualities and brand equity in higher education. According to the literature (De

Chernatony, 2001; Mourad et al., 2011), brand image-related dimensions were important as drivers of brand equity and awareness-related ones, at least concerning higher education. Brand image-related factors were generally significant, specifically symbolic, service, and financial-related attributes.

Discussion and conclusion

Concluding remarks

The findings of empirical analysis to ascertain the factors that affect brand equity are presented in this paper. The main objective of this research has been to empirically evaluate the conceptual model in higher education to construct a comparative study based on many contextual elements and to understand brand equity in higher education better. The model's construction aimed to identify the factors that influence brand equity in brand strategy. A modified brand equity model was provided based on the theories developed by Keller (1993) and Aaker (1991). This concept stressed brand awareness and image as the two key components of brand equity. Promotion produces the awareness dimension, whereas symbolic attributes—such as brand personality, identity, social perception of the brand, and market positioning—service attributes—such as perceived quality of the educational service, course selection, study method, and quality management—and financial attributes—such as brand range, study method, and quality management—produce the image dimension (relationship between services quality and price and financial stability of the faculty). The model also emphasises the significance of consumer characteristics in socioeconomic aspects influencing consumers' views of brand equity.

Consumer factors have no appreciable influence on concepts about brand equity's awareness dimension or perceptions of brand equity. Promotion activities that were supposed to primarily promote brand equity by raising awareness turned out insignificant. The perception of the university as demonstrating qualities like honesty, sincerity, etc., is one of the symbolic aspects that has a beneficial effect on brand equity. All service characteristics were important; benefits, price, and high quality had a big, good impact on brand equity. Finally, brand equity was significantly and favourably impacted by all financial aspects.

The results of this empirical study imply that choosing a university is significantly influenced by the brand. Therefore, developing and maintaining strong university brands may be crucial in the higher education (Chen, 2008; Vukasović, 2015). The findings offered some support for the proposed model. However, the entire sample revealed that factors connected to brand equity's image were its primary determinants, and consumer variables did not significantly impact brand equity ratings.

Because it proposes specific parameters for marketing strategies and methods and places where research can help help managerial decision-making, conceptualising brand equity from the consumer's perspective is important. This approach reveals two crucial ideas. First and foremost, marketers need to take a comprehensive picture of all brand-related marketing activity and evaluate its varied effects on brand awareness, as well as how brand awareness changes affect more conventional outcome metrics like sales. Second, markets need to understand that the level of brand awareness created by a company's short-term marketing initiatives will significantly impact the long-term effectiveness of all subsequent marketing campaigns for that brand. In summary, managers must be aware of how their marketing initiatives impact consumer learning and, in turn, subsequent recall of

brand-related information because the nature and structure of brand memory will affect the efficacy of future brand tactics (Keller, 1993).

This study's unique value is its empirical contribution, which was achieved by using higher education as an example of service and examining the factors that influence brand equity from the consumer's perspective. This is undertaken specifically to higher education services in Slovenia as an example of an emerging higher education market. This study showed that the customer-based brand equity model might be leveraged as a competitive advantage in the higher education and to direct marketing efforts.

The following theoretical and practical conclusions may be drawn to offer top managers advice for enhancing the equity of their brands. First, building and managing brand equity is one of the key strategic problems in today's competitive climate. The following qualities of a brand should be present for it to have great brand equity: meet customer expectations; be dependable; be consistent over time; be priced to represent its added value; be strategically positioned in the market; and have brand managers who are aware of consumer attitudes (Keller, 2008). Second, marketers working in the higher education sector should understand that building a solid brand reputation is more crucial than raising consumer awareness. Therefore, rather than just increasing their promotional campaigns, businesses should invest more in developing and maintaining the factors that determine the brand image dimension of brand equity. That is to say, if service quality is high in terms of provider, service, and symbolic features, brand equity and a strong brand image will follow. Finally, managers must understand that BE, particularly in the service sector because it serves as a risk absorber, significantly impacts how consumers make purchasing decisions. To position their service in the market and so influence consumer choice, they will benefit from concentrating on creating and sustaining the determinants of brand equity. Keller (2003) affirmed that "brand equity can assist marketers focus, offering them a mechanism to understand their past marketing performance and build their future marketing programs," which is in line with the above (Mourad et al., 2011).

Research limitations and areas for future research

Certain limitations to the current study point the way for further research. First, it is important to remember that the model has only been tested in higher education and in one particular country, so it is best to proceed with caution when extrapolating conclusions from these results. Nonetheless, the analysis in this paper at least offers a framework for future research on service brand equity. The expansion of international HE markets and how it affects brand perception should be the subject of future research. Second, the sample only represents two chosen cities in the country rather than the entire population. Third, whereas other studies could focus on brand equity from other views, such as the financial perspectives, the researchers only consider one brand equity, customer-based brand equity. Finally, the study did not track whether the sample's prospective students enrolled in the faculty they believed to be the finest on the market. The updated framework of the determinants of brand equity in service sectors used in this research offers a significant opportunity to adapt it to services other than higher education. Despite the wide range of studies that highlight brand extension strategy as a primary outcome of brand equity in the product market, it is also noted that more research is still needed to determine the function of brand equity in establishing brand extension strategies in service sectors.

Researchers are urged to reconsider the concept and its dimensions and develop and evaluate new measures utilising multi-country data in light of the drawbacks of Aaker's conceptualisation of consumer-based brand equity. The significance of

researching brand equity internationally has grown due to globalisation. However, little research has compared the construct's effects on various societies or cultures. This indicates that more knowledge is required to comprehend brand equity and how the process affects consumer responses in various countries.

References

1. Aaker, D. (1991), Building Strong Brands, New York, The Free Press.
2. Agarwal, M., Rao, V. (1996), „An Empirical Comparison of Consumer-Based Measures of Brand Equity", Marketing Letters, Vol. 7 No. 3, pp. 237-247.
3. Alhalwaki, H., Mousa, H. A. M. (2019), „Factors affecting the implementation of internationalisation strategies in higher educations institutions: evidence from Bahrain", International Journal of Management in Education, Vol. 13 No. 1, pp. 1-27.
4. Binsardi A., Ekwulugo F. (2003), „International marketing of British education: Research on the students' perception and the UK market penetration", Marketing Intelligence & Planning, Vol 21, pp. 4-5.
5. Byron, S. (1995), „Brand Equity and Market-based Assets of Professional Service Firms", Journal of Professional Services Marketing, Vol. 13 No.1, pp. 3-7.
6. Chen, L. H. (2008), „Internationalisation or international marketing? Two frameworks for understanding international students' choice of Canadian universities", Journal of Marketing for Higher Education, Vol. 18 No. 1, pp. 1-33.
7. Cheng, Y. C., Tam, W. M. (1997), „Multimodels of quality in education", Quality Assurance in Education, Vol. 5 No. 1, pp. 22-31.
8. Cobb-Walgren, C. J., Ruble, C. A., Donthu, N. (1995), „Brand equity, brand preference, and purchase intent", Journal of Advertising, Vol. 24 No. 3, pp. 25-40.
9. De Chernatony, L. (2001), From Brand Vision to Brand Evaluation: Strategically Building and Sustaining Brands, Oxford, Butterworth Heineman.
10. Eldegwy, A., Elsharnouby, T. H., Kortam, W. (2018), „How sociable is your university brand?", International Journal of Educational Management, Vol. 32 No. 5, pp. 912-930.
11. Erdem, T., Swait, J. (1998), „Brand equity as a signaling phenomenon", Journal of Consumer Psychology, Vol. 7 No. 2, pp. 131-157.
12. Girard, T., Pinar, M. (2020), „An empirical study of the dynamic relationships between the core and supporting brand equity dimensions in higher education", Journal of Applied Research in Higher Education, Vol. 13 No. 3, pp. 710-710.
13. Harshani, P. C., Nayak, R., Van Nguyen, L-T. (2020), „The impact of subjective norms, eWOM and perceived brand credibility on brand equity: application to the higher education sector International", Journal of Educational Management, Vol. 35 No. 1, pp. 63-74.
14. Kaushal, V., Ali, N. (2019), „University reputation, brand attachment and brand personality as antecedents of student loyalty: a study in higher education context", Corporate Reputation Review, pp. 1-13.
15. Keller, K. (2003), „Brand synthesis: the multidimensionality of brand knowledge", Journal of Consumer Research, Vol. 29 No. 4, pp. 595-600.
16. Keller, K. L. (1993), „Conceptualizing, measuring, and managing customer-based brand equity", Journal of Marketing, Vol. 57, pp. 1-22.
17. Keller, K. L. (2008), Strategic Brand Management: Building, Measuring, and Managing Brand Equity, Upper Saddle River, New Jersey, Pearson Education.
18. Kent, W. E., Lian, K., Khan, M., Anene, J. (1993), „Colleges' hospitality programs: perceived quality", Cornell Hotel & Restaurant Administration Quarterly, Vol. 34 No. 6, pp. 90-97.
19. Kurz K., Scannell J., Veeder S. (2008), „Willingness to pay: making the best case for institutional value and return on investment", University Business, Vol. 11 No. 5, pp. 31-32.
20. Lockwood, R. C., Hadd J. (2007), „Building a brand in higher education: why business practice-particularly brand strategies – are becoming essential in today's universities", Gallup Management Journal Online, Vol. 12 No. July, pp. 1-6.
21. Lomer, S., Papatsiba, V., Naidoo, R. (2018), „Constructing a national HEbrand for the UK: positional competition and promised capitals", Studies in Higher Education, Vol. 43, pp. 134-153.

22. Mazzarol T., Soutar, G. N. (2008), The Global Market for Higher Education: Sustainable Competitive Strategies for the New Millennium, Cheltenham, Edward Elgar Publishing.
23. Mourad, M., Ennew, C., Kortam, W. (2011), „Brand equity in higher education", Marketing Intelligent and Planning, Vol. 29 No. 4, pp. 403-420.
24. Mourad, M., Meshreki, H., Sarofim, S. (2020), „Brand equity in higher education: comparative analysis", Studies in Higher Education, Vol. 45 No. 1, pp. 209-231.
25. Netemeyer, R. G., Krishnan, B., Pulig, C., Wang, G., Yagci, M., Dean, D., Ricks, J., Wirth, F. (2004), „Developing and validating measures of facets of customer-based brand equity", Journal of Business Research, Vol. 57, pp. 209-224.
26. Palmer, A., Koenig-Lewis, N., Asaad, Y. (2016), „Brand identification in higher education: a conditional process analysis", Journal of Business Research, Vol. 69 No. 8, pp. 3033-3040.
27. Pinar, M., Trapp, P., Girard, T., Boyt, T. E. (2014), „University brand equity: an empirical investigation on its dimensions", International journal of Educational Management, Vol. 28 No. 6, pp. 616-634.
28. Retamosa, M., Millan, A., Moital, M. (2020), „Does the type of degree predict different levels of satisfaction and loyalty? A brand equity perspective", Corporate Reputation Review, Vol. 23, pp. 57-77.
29. Sharma, A. A., Rao, V. R., Popli, S. (2013), „Measuring Consumer-based Brand Equity for Indian Business Schools", Journal of Marketing for Higher Education, Vol. 23 No. 2, pp. 175-203.
30. Sultan, P., Wong, H. Y. (2019), „How service quality affects university brand performance, university brand image and behavioral intention: the mediating effects of satisfaction and trust and moderating roles of gender and study mode", Journal of Brand Management, Vol. 26, pp. 332-347.
31. Temple, P. (2006), „Branding higher education: illusion or reality?", Perspectives: Policy and Practice in Higher Education, Vol. 10 No. 1, pp. 15-19.
32. Vorhies, D. W. (1997), „Building strong brands", Journal of the Academy of Marketing Science, Vol. 25 No. 3, pp. 260-261.
33. Vukasović, T. (2015), „Managing consumer-based brand equity in higher education", Managing Global Transitions, Vol. 13 No. 1, pp. 75-90.
34. Vukasović, T. (2016), „An Empirical Investigation of Brand Equity: A Cross-Country Validation Analysis", Journal of Global Marketing, Vol. 29 No. 5, pp. 251-265.
35. Vukasović, T. (2020), „Knowledge as an important factor in the process of creating brand equity", Int. J. Innovation and Learning, Vol. 28, pp. 139-158.
36. Yoo, B., Donthu, N., Lee, S. (2000), „An examination of selected marketing mix elements and brand equity", Journal of the Academy of Marketing Science, Vol. 28 No. 2, pp. 195-211.

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Strategic Sustainability Orientation Influence on Organizational Resilience: Moderating Effect of Firm Size

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Abstract

Background: Owing to the heaviness of setbacks and shocks companies frequently face from the internal/external business environment, building solid organizational resilience and shifting towards strategic sustainability have become the top demands in today's wavering business world. **Objectives:** This study aimed to determine whether strategic sustainability orientation influences organizational resilience and how this relationship is moderated by firm size. **Methods/Approach:** This study uses a methodology structured around the stakeholder theory and embraces multiple regression analysis grounded on collected data from 124 enterprises in Bosnia and Herzegovina ambience. **Results:** Findings from the research revealed that strategic sustainability orientation significantly and positively influences organizational resilience and its three sub-components: anticipation, coping and adaptation capabilities. Results also uncovered that the Small size firms were significantly diverse from the Large and Medium size firms in terms of the influence of strategic sustainability orientation on three capabilities of organizational resilience. **Conclusions:** In addition to literature enriching in sustainability and organization by supplying empirical evidence of strategic sustainability orientation influence on organizational resilience, this study proposes and validates instruments for measuring strategic sustainability orientation and organizational resilience.

Introduction

As an innovative, affirmative and fast-spreading concept, sustainability is continuously gaining momentousness in an increasing number of companies globally by occupying a central place in its business strategies. McKinsey Global research confirms a novel role of sustainability – as a vital aspect of business planning and strategic course, emphasizing that historically, companies sought to reduce costs and enhance their reputations. Still, today they seek to integrate sustainability into their complete business mission, goals and values (Bonini et al., 2014). The prime idea behind the sustainability concept calls for mutual acting, long-term perspective and a mindset adjustment for creating added value to deal with achieving required financial performances, alarming environmental deterioration (such as global warming, depletion of natural resources, rising pollution, etc.) and social issues (like inequity or diverse diseases).

Accordingly, the strategic sustainability orientation (SSO) implies a proactive manner and commitment to integrating three meaningful concerns (economic/financial, environmental, and social worries) into business decisions (Pagell et al., 2009). Strategic economic orientation is a foundation for vindicating a company's existence by focusing its business activities and decisions on boosting demanded profit. However, there is no dilemma that firms in the 21st century also need to adjust their general strategy to encompass two other important directions (good and fair treatment for people; and solid eco-friendly orientation). Firms committed to accomplishing sustainability are likely to spotlight long-term goals while encouraging more socially accountable activities (Mio et al., 2015). McKinsey Sustainability (2020) reports that using a sustainability strategy diminishes energy/water usage and can greatly cut costs and improve profits by 60 percent. By balancing three sustainability aspects within manifold financial and non-financial objectives, companies strive to reach the point where the interests of shareholders and essential stakeholders collide. There is an intensely close link between business strategy (in other words – vision for strategic business operations, comprehensive mission, making plans and goals); and sustainability concerns. This research paper was structured around the stakeholder theory, which considers the range of interests of core stakeholders in making important company decisions.

Considering that companies operate in an ambiguous and rapidly-changing environment, which makes them extremely fragile and overly sensitive, the real question is - if strategic sustainability orientation leads to overall organizational resilience. Typically, firms encounter intensified competition, troubles with outward core stakeholders' and numerous issues within the firm. Furthermore, they have been dealing increasingly with much wider economic issues, unfavorably transformed political schemes, social/environmental pressures and horrifying pandemic disorders (such as COVID-19). During COVID-19, four distinct concerns in managing core stakeholders distinguished: (1) issues related to working from home (like the accelerated transition to hybrid work options); (2) security concerns (such as - requirements to provide customers with safer shopping conditions in stores); (3) value chain concerns (logistic issues; termination of contracts by large customers; suppliers distance from whom the products are procured); and (4) issues associated with digitization and IT (for example - novel ways of connecting/communicating with core stakeholders) (Ahmić et al., 2021). Despite multiform hardships and threats, whether they are produced by men or nature, every organization tries to overcome them and adapt to further bloom (Stephenson et al., 2010). Resilience observed in the organizational context, as the relatively newish notion, is gradually gaining speed for coping with contemporary risks and changes. This concept is not only related to

rapidly adapting and leaping over the immense spectrum of harsh crises, but likewise, resilience encompasses the anticipating capability of critical future occurrences emerging from progressive trends (Williams et al., 2017). Summarily, Duchek (2020) defined organizational resilience as "an organization's ability to anticipate potential threats, to cope effectively with adverse events, and to adapt to changing conditions".

Even though 90% of top managers globally believe sustainability is meaningful, sustainability strategy is present in merely 60% of firms (MIT Sloan & BCG, 2016). In Bosnia and Herzegovina (B&H), research findings on top managers with pronounced success records showed that their values are aligned with sustainability (especially social sustainability, demonstrating focus on contributing to others' welfare rather than their own), despite highly present conservatism value (Ahmić et al., 2016). The sustainability topics have become progressively substantial on a wider state-level, as well as for various types of companies in B&H. Correspondingly, the United Nations signed together with B&H authorities a cooperation framework for achieving targeted, sustainable development goals in 2021. - 2025. Likewise, organizational resilience occupies an increasingly valuable place worldwide and more and more in B&H. The available data on blocked enterprise accounts in B&H are far from encouraging, where 100.301 firms were blocked in January 2022. (Central Bank of B&H, 2022), what is more than the aggregated number of active enterprises and entrepreneurs in B&H? The year 2020. was the most affected by COVID-19 regarding export, industrial production and tourism in B&H, while the improvements were made in 2021. concerning all three categories (for example, export raised by 35.7% compared to 2020.) (Agency for Statistics – BHAS, 2022a). Recent inflation growth added challenges for enterprises and its key stakeholders in B&H, which influenced the comparing to the same month in 2020. (Agency for Statistics – BHAS, 2022b).

Although sustainability has garnered increasing interest among academics, the direct empirical linkage between strategic sustainability orientation and overall organizational resilience in developing countries has not been explored yet. To address the gap in research, this study aspires to collect empirical evidence that leaders' strategic sustainability orientation impacts positively and significantly on overall organizational resilience in Bosnia and Herzegovina context; and moderating effects of firm size on the connection between strategic sustainability orientation and organizational resilience dimensions. More specifically, this study aims to provide an answer to two research questions: (1) "Does leaders' strategic sustainability orientation positively and significantly impact overall organizational resilience (observed through anticipation, coping and adaptation capabilities)?"; and (2) "Do significant distinctions exist in an influence of strategic sustainability orientation on organizational resilience comparing firms of different sizes?".

Accordingly, the next section is covered with a literature review explanation regarding stakeholder theoretical background, strategic sustainability orientation, organizational resilience dimensions and the relationship between mentioned constructs. Further steps include formulating a research framework, development of hypotheses and methodologies presentation. Following the presentation of research results, key findings are discussed, including their implications for theory and practice. A summary of core conclusions, together with study constraints and insights for further research, are provided as a final step.

Literature Review

The literature review provides an underpinning construct for research on top topics of strategic sustainability orientation and organizational resilience.

This research paper was shaped by stakeholder theory, which considers various interests of core stakeholders in the company's value-creation process. Authors Savage et al. (2010) described stakeholders as individuals/groups with a pronounced and justified interest in organization actions which can influence a firm's practices in direct and indirect ways. Furthermore, Benn et al. (2016) revealed that managers view stakeholders in a reciprocal manner – where both parties benefit through performances; while the stakeholders depicted themselves as "someone who is connected to the firm by a vested interest" or "whose provided service is crucial for firm and them". Regarding essential stakeholders, Tantalo et al. (2016) consider five types as core: "workers, customers, owners (shareholders), suppliers and the community".

Landrum (2018) emphasized that a company's sustainability practices parallel stakeholder preferences for sustainable matters. To enhance the probability of achieving competitive, sustainable positioning and firm success in the long run, it is greatly meaningful to balance interrelating and competing for major stakeholders' interests (Edgeman et al., 2014). Laudal (2011) argues that a company must be strategic in its sustainability approach to be successful, which implies the involvement of the whole supply chain. Following stakeholder theory, three main hypotheses were developed by setting a positive link of strategic sustainability orientation with each organizational resilience component (anticipation, coping and adaptation capabilities – observed as three models).

Strategic sustainability orientation

Strategic sustainability orientation (SSO) refers to the magnitude of a firm's proactive and continuous dedication toward the integration of not merely economic priorities but also environmental and social imperatives into business decisions (Pagell et al., 2009). Authors supported mentioned SSO concept by presenting its four pillars: 1) proper alignment of economic sustainability goals with the other two (social & environmental); 2) daily communication about sustainability; 3) implementation of sustainability guiding values in the whole business model; and 4) distribution of accountability for sustainability in every department, including all firm's employees and main supply chain members (Pagell et al., 2009). Enterprises, which are sustainability-oriented, actually endeavor to align the strategic level of key stakeholders' worries related to the environment/society next to the firm's economic targets. Furthermore, environmental and social components need to be integrated into the firm's vision, core values, mission, diverse policies and strategic plans to make strategic management and company self-sustainable, while particular environmental and social objectives must be in regular manner measured and evaluated (Fülöp et al., 2014).

Sustainable economic orientation generally involves a firm's active engagement and consideration of sustainability matters in financial plans/decisions and markets (Emamisaleh et al., 2017). Sustainable social orientation encompasses the company's internal social strategy orientation (such as employees' health, safety and human rights protection, their involvement in the decision-making process, and customer information protection) and external social strategy orientation, focused on providing values for its key stakeholders within the supply chain and broader society (Baumgartner, 2010). Organizations can use the environmental orientation as a tool to, for example, reduce damaging emissions, minimize consumption/forestall spilling of natural resources and recycle waste. Therefore, firms must incorporate environmental concerns into their strategic direction (Linnenluecke et al., 2009). By including environmental issues, firms can considerably reduce their costs in the long-

term, contribute positively to the natural environment and enhance people's lives. In conclusion, sustainability orientation shall constitute strategic orientation at the company level. Its needs to be embedded in the company's philosophy to serve as a basis for operational planning, clear activities and programs (Roxas et al., 2012, p. 464).

Organizational resilience

In highly challenging and changeable times that increasingly characterize today's business environment, organizations need to be capable of predicting, facing and adaptably withstanding unfavorable and unexpected external and internal events and difficult situations. Continuance of business operations can be endangered by various unforeseen natural disasters, financial/economic crises, pandemic diseases (such as covid-19), terrorist attacks, sudden issues with key stakeholders, industrial problems and errors caused by employees or managers. When faced with catastrophic threatening situations, diverse companies react differently – some of them victoriously adjust and keep growing while others show deficiency of right responses and ultimately close down. Organizations, to be and become even more resilient, prepare and plan how to not just survive but continue with great work and prosper in the future.

Many authors have provided diverse concepts and definitions when it comes to defining and determining the complex term of organizational resilience and its core components. Various authors illustrated resilience as an organizational ability:

- o Resilience is "the ability to adapt and strengthen in the face of challenge, trauma, or stress" (Gallos, 2008);
- o Led by process-based research studies, Duchek (2020) defined organizational resilience as "an organization's ability to anticipate potential threats, to cope effectively with adverse events, and to adapt to changing conditions".

The focus of this research paper was on the organizational resilience concept proposed by Duchek (2020), which consists of three dimensions:

1. Anticipation capabilities (comprise three distinctive capabilities: an observation ability of inner/outer changes; being able to pinpoint prospective threats or developments of vital weight; and preparing ability, to the fullest extent, for unforeseen occurrences);
2. Coping capabilities (it is tightly connected to managing crisis and includes two subcategories: the ability to accept to have troubles; and being able to solutions developing/implementing); and
3. Adaptation capabilities (it embraces two capabilities types: "reflection and learning; and organizational change capabilities").

Regarding adaptation capabilities, this dimension was expanded for this paper by including not only abilities but simultaneously adaptation capacity. According to Richtnér et al. (2014), parallel with capability explanation, viewed as a compound of ability and capacity.

Anticipation capabilities

An initial stage of organizational resilience refers to the anticipation, which depicts preventive and proactive steps and actions linked to turbulences, crises and disturbances that might appear inside the company or in its environment. The aforementioned does not denote that if the organization is resilient, it can simultaneously prevent or avoid all failures, damages or potential crises. Crises frequently surprise the business world with their sudden appearance. Companies differ in their ability to predict, see and react to unannounced tumultuous events - some

foresee it faster and more accurately than others and react to it straightway. At the same time, other firms just wait to see what will happen. Weick et al. (2008) viewed anticipation ability as predicting the ability of possible unrestrained and unwanted impacts that are grounded on little distinctions.

Duchek (2020) proposed three particular capabilities as components of anticipation capabilities: an observation ability of inner/outer changes; pinpointing prospective threats or developments of vital weight; and preparing ability, to the fullest extent, for unforeseen occurrences. Regarding observation and identification capabilities, author Duchek (2020) considers them closely related and thus unites them together. The starting point for every organization is to observe and recognize the initial earliest signals of an upcoming crisis and to respond accordingly as quickly as possible, thus, evading its expansion. These capabilities are also depicted in the literature as the acquisition of weak signals (or information on emerging issues) and environmental scanning as an activity of searching for weak signals (Day et al., 2005; Ilmola et al., 2006).

On the other hand, authors Van Trijp et al. (2012) utilized the notion of situation awareness, which they evaluated by six measures: (1) degree of advanced awareness of expectancies, obligations and constraints concerning interested parties, equally inner (employees) and outer (consultants, suppliers, customers etc.); (2) capability to keep an eye out for favorable occasions and prospective crises; (3) degree of growing resource attainability awareness – equally inwardly/outwardly; (4) capability of precisely determining crises and their effects; (5) degree of advanced comprehending what triggers crises; and (6) degree of advanced comprehending of required minimums for operations in terms of recovery.

On top of the ability to observe and identify current internal/external changes and forthcoming crises, it is highly significant for companies to focus on possible future developments. Hillmann et al. (2018) claim that scenario planning practices can help companies consider diverse futures (including what is unrealistic and unthinkable) and ways to manage them. When it comes to preparation capabilities, it is not characteristic only for highly-risky organizations but also for every resilient organization. Organizations are prepared if they are fitted out to handle unannounced disasters and are prepared to benefit from sudden chances (Lengnick-Hall et al., 2009). Preparation capabilities help develop necessary resources during crisis time – such as effective relationships, befitting plans for recovery and joint comprehending (Duchek, 2020). Emergency planning, managing risks and management for business continuity can serve as meaningful insights into the firm's preparation capabilities. Therefore, planning is closely related to the preparation phase, viewed through having manifold competitive action options for responding/adapting to different situations. Through simulation/rehearsal practices, the aims of this kind of plan can be successfully attained (Gibb et al., 2006). Additionally, Chopra et al. (2004) emphasized customer diversification, redundancy in the supplier base and aggregate demand as effective preventive actions.

Coping capabilities

Along with anticipation capabilities, resilience encompasses the organization's abilities to cope, which are substantial for the thriving management of unforeseen critical events (incidents or crises) after they become evident. Coping capabilities are divided into "the ability to accept an existing problem and the ability to develop and implement solutions" (Duchek, 2020). These capabilities involve the application of straightaway or rapid decisions and actions as the right answers to surprising acute events. Problem acceptance is present not merely in an individual's case (individual

resilience in the face of the real world) but in an organizational context, viewed as "the cognitive confrontation" which enables difficult-facing situations and quickly acting. An organization's timely reaction by being the first to release crisis information can reduce negative perceptions and accelerate acceptance (Claeys et al., 2012).

Respond strategies to the crisis can include functional actions and communication; placement of information-oriented toward helping employees and other key stakeholders to avoid damage; and management of the firm's public image (Bundy et al., 2015; Coombs, 2015). Solutions that make sense must be rational, responsible, and understandable with constant feedback among understanding and taking action. Many researchers in the resilience domain have highlighted the importance of collective sensemaking in cognitive function as a component of resilience (Lengnick-Hall et al., 2009; Linnenluecke et al., 2012). In addition to the idea creation in developing solutions during the appearance of unexpected events, coordination mechanisms (both formal and informal) are substantial for making prompt decisions when failures could end with dreadful consequences (Faraj et al., 2006). Therefore, companies must balance formal organizational structures, marked with clearly determined responsibilities for prompt decision making and instant response, and informal features – actions characterized by openness to change, flexibility, creativity and more freedom.

Adaptation capabilities

Adapting to unfavorable circumstances and benefiting from alteration comes as the third phase of organizational resilience, which comprises capabilities that come in two forms: "reflection and learning; and capabilities of organizational change" (Duchek, 2020). Adaptive resilience classically appears after the disaster and requires resilient leadership, extrinsic connections, inside cooperation, past experience-based learning and staff well-being (Nilakant et al., 2014). The reflection process on the experienced critical problem requires the firm to thoroughly and seriously interpret, analyze and explain the specificity of the problem and take precise actions toward its solving. Regarding learning, resilient organizations which rely on learning - create learning environments that are highly trustable and safe (Seville et al., 2015), focus on setting goals towards achieving excellent performance, support learning/development (Robb, 2000) and enable learning and development by building needed structures and mechanisms (Lengnick-Hall et al., 2011). Some important learning manners involve: interaction and collaboration for knowledge exchange/learning from failures (Gressgård et al., 2015), learning indirectly from the experienced incidents of similar organizations in a firm's industry (Madsen, 2009) and learning from other industry's failures might be significant learning source (Crichton et al., 2009) – such as their incident reports, alerts and diverse organization stories.

Organizational change, which comes from a raised level of learning or second-order learning (Sørensen, 2002), leads to the development of novel upgraded norms, values and practices (Duchek, 2020). Change management capabilities are required for transferring freshly developed solutions, based on generated new knowledge, to their single parts. It is significant to highlight that many problems or change resistances can emerge from implementing the latest knowledge. "Studies have shown that two out of three change initiatives fail" (Sirkin et al., 2005), wherefore it is crucial for resilience how the change is managed (Ates et al., 2011). Accordingly, adaptation includes building significant change and overcoming change resistance (Dayton, 2004).

Diverse practices in the domain of change management can be applied to surmount the special resistance manifestations, for example - adequate soft

managerial practices (viewed through effective and striking communication/relationships inside the organization) or by engaging "change agents", who follow the whole change/implementation process and apply their intervention methods and helpful options if it is needed (Jones, 2006). In addition to adaptation abilities, it is highly significant to include also organization's adaptive capacity as the meaningful part of adaptation capability (Richtnér et al., 2014), such as innovation and creativity; internal resources' capacity/capability; governing structures, leadership, and management; getting staff involved and engaged; making decisions in a decentralized and responsive way (Lee et al., 2013).

Strategic sustainability orientation and organizational resilience

The research studies on the relationship between strategic sustainability orientation and organizational resilience are extremely scarce and underdeveloped, while the empirical studies between the two categories still don't exist. Sparse research studies have explored the effects of social and environmental constituents of strategic sustainability on adaptive capacity (observed as a part of organizational resilience). Charrois et al. (2020) found out through interviews and focus groups that some organizations' strategic sustainability development journeys affected their adaptive capacity (viewed as an organizational resilience aspect), moving from a condition of reactivity to a more thoughtful and proactive one that benefits them in manifold modes. Three adaptation capacity elements - trust, continuous learning and common meaning (observed as the force of a shared vision) stood out as the most fostered by strategic sustainability development, while diversity and self-organization were the least fostered by strategic sustainability (Charrois et al., 2020). Authors further highlighted that the human factor of sustainability practices appeared as a strong determinant of adaptation capacity, as human beings gather in all processes of strategic sustainability development to create an imagined future and to discuss how to get there (Charrois et al., 2020). By having developed the five components of capacity for adaptation, an effective social system may, as a learning organism, adapt more smoothly to changing external conditions (Missimer et al., 2017).

Considering that a huge emptiness exists in exploring the influence of the strategic sustainability orientation dimensions on organizational resilience (based on the wider capabilities concept), this study focuses on discovering if specific dimensions of strategic sustainability orientation impact organizational resilience (anticipation, coping and adaptation capabilities) in developing country, such as Bosnia and Herzegovina.

Research framework and research hypotheses

This paper endeavored to explore the influence of strategic sustainability orientation elements on overall organizational resilience and the moderating effect of firm size on this relationship within enterprises in Bosnia and Herzegovina. Following the main objectives, the conceptual model was produced as the empirical research basis.

Figure 1. demonstrates two sections of the proposed conceptual model: strategic sustainability orientation dimensions and its effect on organizational resilience components. Strategic sustainability orientation (SSO), as an independent variable, consists of three orientations: economic, social and environmental sustainability orientations (Pagell et al., 2009). As the dependent variable, organizational resilience encompasses three dimensions introduced by Duchek (2020): anticipation, coping and adaptation capabilities. Regarding adaptation capabilities, this dimension was expanded for this paper by including not only abilities but simultaneously adaptation

capacity, which is following the capability explanation stated by Richtnér et al. (2014), who observed capability as a compound of ability and capacity.

Figure 1
Conceptual model
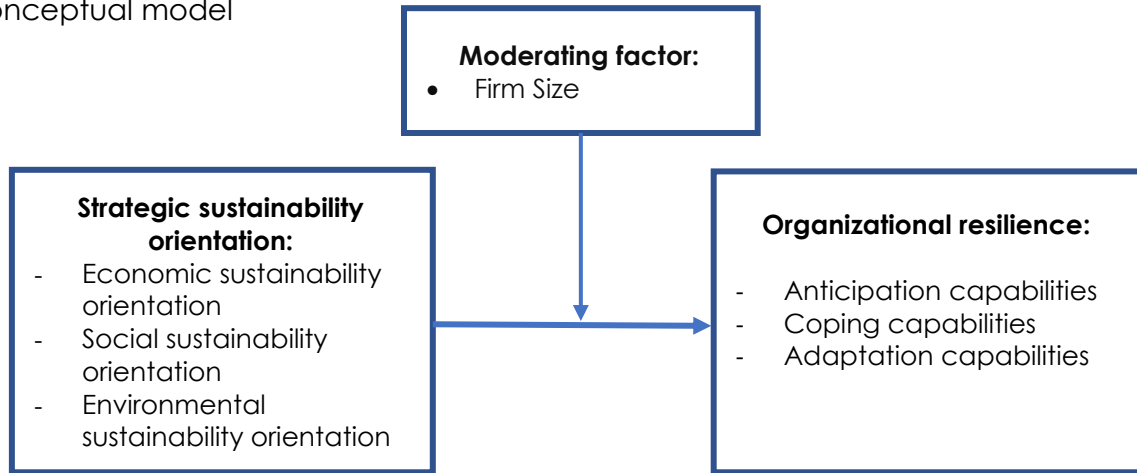
Source: Author's illustration

Research hypotheses were identified on the foundation of the depicted conceptual model, which is as follows:

Hypothesis (1a): Strategic sustainability orientation positively influences organizational anticipation capabilities.

Hypothesis (1b): Strategic sustainability orientation positively influence organizational coping capabilities.

Hypothesis (1c): Strategic sustainability orientation positively influences organizational adaptation capabilities.

Due to the distinctions between how small and large businesses build and employ their strategic assets, firm size is relevant in analyzing the relationship (Jin et al., 2019). Thus, hypotheses for the influence of firm size on the relationship between strategic sustainability orientation and organizational resilience are as follows:

Hypothesis (2): There are significant distinctions in the influence of strategic sustainability orientation on organizational resilience comparing firms of different sizes.

Methodology

Sample description

Sampling: Enterprises of different sizes based in Bosnia and Herzegovina were the target population in this research study. The primary source to collect information was the list of 400 companies' profiles from Bosnia and Herzegovina that have existed on the business scene for more than five years (have active bank accounts; no blocked accounts), provided by professional consulting provider TRON Systems. The companies were sorted by size (number of employees), using the classification of firm size suggested by the Agency for Statistics of Bosnia and Herzegovina ("0-49 = small firms; 50-249 = medium firms; and >250 = large firms"). Companies' leaders were selected to fill the questionnaire since they deal with strategic matters in companies, which also encompasses strategic sustainability orientation. Leaders or top managers for this research included: directors/CEO/general managers, branch managers, and managers who belong to top management teams and participate in strategic decision-making (Ahmić, 2016).

Data collection: In all, questionnaires were sent to 240 companies by e-mail; and some of the selected firms were contacted face-to-face (by delivering a questionnaire). In addition to the first e-mail, a second e-mail (as a reminder) was sent two weeks later, and a phone call was made as the third reminder. Finally, the research sample in this study included 124 companies of different sizes in Bosnia and Herzegovina (response rate of 51.66%). Respondents' profiles (managers and companies involved) are presented in table 1.

Table 1
Structure of the sample

Sample distribution		Percentage
Respondent profile	Director/CEO/Executives	42%
	Branch managers	37%
	Members of the top management team	21%
	Total	100% (N=124)
Enterprise size (number of employees)	1-49	44%
	51-249	30%
	Over 250	26%
	Total	100% (N=124)
Type of activity sector	Manufacturing sector	27%
	Commerce sector	42%
	Service sector	31%
	Total	100% (N=124)

Source: Author's work

Regarding the respondent profile, most leaders (42%) worked as directors/CEOs/Executives, a large group of leaders worked as branch managers (37%), and 21% of respondents among leaders worked as a member of top management teams.

Regarding company size, the greatest number of organizations belonged to the group of small enterprises (44%); 30% of companies were medium-sized, while 26% referred to large enterprises with more than 250 employees. Concerning the activity sector type, the largest portion of organizations fell under the category of commerce sector (42%), 31% of enterprises were in the service sector, whereas 27% of firms belonged to the manufacturing sector.

Research instrument description and reliability

This survey was based on a questionnaire designed by the author for this research purpose to gather data about strategic sustainability orientation and organizational resilience in enterprises operating in Bosnia and Herzegovina. The questionnaire was divided into three segments. The first questionnaire's segment incorporated information regarding strategic sustainability orientation. The second segment of the questionnaire involved information considering organizational resilience: anticipation, coping and adaptation capabilities. The items for strategic sustainability orientation were formulated as a result of a combination of research conducted by Munoz et al. (2015); Pagell et al. (2009), and Blackburn (2008), while the questions for organizational resilience were created based on theories and similar research by Prayag et al. (2018), Duchek (2020) and Lee et al. (2013). Grounded on a 5-point Likert scale, all items were accordingly measured, where offered numbers indicated (1 –disagree, 5 – absolutely agree). The third segment of the questionnaire comprised basic demographic information about leaders (respondent's age, gender and the present position in the

company) and basic firm information (sector of activity; and firm size). Research instrument details are demonstrated in Table 2.

Table 2
Research instrument details

Constructs	Code	Items
Independent variable – Strategic sustainability orientation		
Economic orientation	EO_1	The mission statement of our firm emphasizes financial performance importance
	EO_2	We are committed to increasing our market share
	EO_3	All employees are informed about the firm's financial priorities
	EO_4	We are committed to increasing return on investment and profitability that improves the lives of everyone connected to our firm
	EO_5	In making operational decisions, we take short-term productivity results into consideration
Environmental orientation	ENO_1	Environmental performance is an important part of our firm's mission statement
	ENO_2	Our company is dedicated to reducing pollution
	ENO_3	We communicate to all employees our firm's ecological priorities
	ENO_4	We assess the impact of operational decisions on the environment
	ENO_5	We must make responsible use of natural resources, regardless of our business nature
Social orientation	SO_1	Our company's mission statement stresses the importance of employee well-being
	SO_2	We support social philanthropy at our firm
	SO_3	We promote the practice of fair, non-discriminatory, non-exploitative and respectful treatment of all employees in hiring/work processes
	SO_4	In our business, we always operate legally and ethically
	SO_5	We evaluate the impact of our operational decisions on society
	SO_6	In our firm, dealing with customers and suppliers fairly is a must
Dependent variable – Organizational resilience		
Anticipation capabilities	ANC_1	We proactively (in advance) monitor what is happening in our sector and inside the company to receive early warnings of upcoming problems
	ANC_2	Our company can detect and recognise future critical developments, potential crises and their consequences
	ANC_3	We actively maintain contacts and connections with other companies and key stakeholders so that we can rely on each other and work together in crises
	ANC_4	We are focused on customer and supplier diversification
	ANC_5	We have prepared formal plans on how to act when various dangers/risks happen
	ANC_6	Our organization is committed to practising and testing its emergency plans to ensure they are effective
Coping capabilities	CC_1	We are successful during the crisis in finding a balance between the existing formal organizational structure and crisis management/communications team inclusion
	CC_2	We quickly ensure smooth business continuity by keeping the workforce and key stakeholders rightly informed about handling emerging problems
	CC_3	Working cooperatively makes it easier to effectively and efficiently manage priorities, resources, and options and to produce fruitful solutions

	CC_4	We provide support to our customers (from an apology for caused inconvenience to affected product replacements/refunds, discounts or new guarantees)
Adaptation capabilities	ADC_1	Our firm's priority is sharing knowledge among employees on how to respond to unexpectedly grown problems
	ADC_2	Our organization maintains reserve stocks and sufficient resources to absorb some sudden changes
	ADC_3	If our company was prevented from operating for several months, the connections we have with suppliers and customers would help us recover quickly
	ADC_4	If key people were unavailable, there are always others who could satisfactorily fill their role
	ADC_5	We are known for our ability to use knowledge in novel ways
	ADC_6	We incorporate the most important lessons from the crisis (its causes, consequences and solutions) into the company's regulations, norms, values and practices

Source: Author's work

Cronbach alpha reliability analysis was conducted to uncover the internal consistency of derived factors (table 3.). Every underlying factor in the strategic sustainability orientation and organizational resilience construct had a Cronbach alpha value greater than 0.7, showing the acceptable level of consistency amongst inner factors and well-reliable constructs (table 3).

Table 3
Constructs' reliability

Variables	Total number of items	Cronbach Alpha
Economic orientation	5	0.891
Environmental orientation	5	0.855
Social orientation	6	0.862
Anticipation capabilities	6	0.901
Coping capabilities	4	0.823
Adaptation capabilities	6	0.851

Source: Author's work

Results

Data in this research were analyzed using exploratory factor analysis, Pearson correlation matrix, and multiple regression analysis.

Exploratory factor analysis

Applying varimax rotations, exploratory factor analysis was performed for examining the validity of data structure and extracting the dimensions of strategic sustainability orientation construct and organizational resilience construct. Both Kaiser-Meyer-Olkin statistical tests (over 0.5) and tests from Bartlett (with a statistical significance of 1%) displayed that further factor analysis was adequate for the data. As an outcome of Varimax rotation, which was converged in five iterations, three factors were extracted as part of the strategic sustainability construct, with eigenvalues higher than one and average variance explained at 70.57, labelled as (1) economic orientation; (2) environmental orientation; and (3) social orientation (Table 4).

Regarding the dependent variable – organizational resilience, three factors were extracted from the Varimax rotation matrix, converged in five iterations, which explained 71.09 per cent of the observed variance (with eigenvalues above one).

Based on the total of 16 items, these three factors of organizational resilience construct were named: (1) anticipation capabilities, (2) coping capabilities, and (3) adaptation capabilities (Table 5).

Table 4
Factor analysis of strategic sustainability orientation construct

Dimensions	Variables	Mean	Components		
			EO	ENO	SO
Economic orientation (EO)	EO_1	4.65	0.901		
	EO_2	3.66	0.865		
	EO_3	3.38	0.773		
	EO_4	4.04	0.874		
	EO_5	3.85	0.832		
Environmental orientation (ENO)	ENO_1	3.02		0.675	
	ENO_2	3.15		0.702	
	ENO_3	2.73		0.606	
	ENO_4	2.95		0.613	
	ENO_5	4.22		0.825	
Social orientation (SO)	SO_1	4.37			0.841
	SO_2	4.31			0.825
	SO_3	4.03			0.782
	SO_4	3.63			0.766
	SO_5	3.54			0.733
	SO_6	4.51			0.857
Eigenvalues			3.473	2.321	1.167
% Explained variance			35.251	23.443	11.877
Cumulative % explained variance			35.251	58.694	70.571

Notes: Extraction method - Normalization of the Principal Components Rotated Method (Varimax with Kaiser)
Source: Authors' work

Table 5
Factor analysis of organizational resilience construct

Dimensions	Variables	Mean	Components		
			ANC	CC	ADC
Anticipation capabilities (ANC)	ANC_1	4.51	0.802		
	ANC_2	3.89	0.715		
	ANC_3	4.05	0.861		
	ANC_4	4.41	0.857		
	ANC_5	3.85	0.625		
	ANC_6	3.44	0.620		
Coping capabilities (CC)	CC_1	4.15		0.755	
	CC_2	4.41		0.723	
	CC_3	4.08		0.714	
	CC_4	4.18		0.718	
Adaptation capabilities (ADC)	ADC_1	4.30			0.814
	ADC_2	4.01			0.761
	ADC_3	3.82			0.752
	ADC_4	4.24			0.713
	ADC_5	3.76			0.688
	ADC_6	3.65			0.634
Eigenvalues			3.236	2.017	1.822
% Explained variance			32.471	20.213	18.408
Cumulative % explained variance			32.471	52.684	71.092

Source: Author's work

Since all extracted factors of strategic sustainability and organizational resilience construct had values greater than 0.50 (Table 5), they were retained for further research.

Main research hypothesis testing

Before testing hypotheses by multiple regression analysis, correlation analysis was conducted, which revealed the existence of a significant correlation between the three orientations towards sustainability (coefficients of correlation varied from 0.451 to 0.702; a 1% and 5% significance level). These results indicated that the regression analysis outcome could be significantly affected by multicollinearity among independent variables. To investigate this possibility, we calculated Variance Inflation Factors (VIFs) in this study. As shown in Table 6., all VIF values are below 4 (the permissible range of VIF), providing evidence that multicollinearities do not interfere with regression outcomes.

To determine if strategic sustainability orientations are associated with organizational resilience, hypotheses testing ("H1a, H1b, and H1c") was done using regression analysis. Three multiple regression models were constructed with three orientations of strategic sustainability as the independent variables: economic, environmental and social orientation, while each model's dependent variables were: anticipation, coping and adaptation capabilities.

As it is summarized in Table 6., the use of strategic sustainability orientation affects organizational resilience statistically significantly in all three multiple regression models. The first multiple regression model represents the influence of strategic sustainability orientation on anticipation capabilities: This regression model's R-square is 0.558, meaning that strategic sustainability orientation components can explain 55.8% of the variance in anticipation capabilities. Two strategic sustainability orientations (economic and social orientation) depict a significant impact on anticipation capabilities at a confidence level of 1%, whilst the environmental orientation also shows a significant impact - but at a confidence level of 5%. Anticipation capabilities are impacted most significantly by economic orientation, posting a beta coefficient of 0.49. The second most impactful component is social orientation, followed by environmental orientation with coefficient values of 0.37 and 0.21.

Table 6
Regression analysis results in the influence of strategic sustainability orientation on organizational resilience

	Organizational resilience			
	Anticipation capabilities	Coping capabilities	Adaptation capabilities	
R	0.747	0.579	0.688	-
R2	0.558	0.335	0.473	-
df	124	124	124	-
Sig.	0.000	0.001	0.000	-
	Coef.	Coef.	Coef.	VIF
Constant	1.082	0.874	1.155	-
Economic orientation	0.496***	0.381**	0.573***	2.643
Environmental orientation	0.212**	0.113	0.242**	2.215
Social orientation	0.378***	0.224**	0.341***	2.441

Notes: n = 124; * Statistically significant at 10%; ** Statistically significant at 5%: *** Statistically significant at 1%
Source: Author's work

The second multiple regression model describes the influence of strategic sustainability orientation on coping capabilities: This regression model's R-square is 0.335, meaning that strategic sustainability orientation components can explain 33.5% of the variance in coping capabilities. Two strategic sustainability orientations (economic and social orientation) depict a significant impact on coping capabilities at a confidence level of 5%, whilst an environmental orientation does not display a statistically significant effect on coping capabilities. Coping capabilities are the most significantly impacted by economic orientation based on the beta coefficient of 0.38; continuing with social orientation – has a beta coefficient of 0.22.

The third multiple regression model illustrates the influence of strategic sustainability orientation on adaptation capabilities: This regression model's R-square is 0.473, meaning that strategic sustainability orientation components can explain 47.3% of the variance in adaptation capabilities. Two strategic sustainability orientations (economic and social orientation) depict a significant impact on adaptation capabilities at a confidence level of 1%, whilst the environmental orientation also shows a significant impact at a confidence level of 5%. Adaptation capabilities are the most significantly impacted by economic orientation based on the beta coefficient of 0.57, continuing with social orientation (with a beta coefficient of 0.34) and environmental orientation ($\beta=0.24$).

Summarily, strategic sustainability orientation statistically positively influences organizational resilience, even if the impact varies for different orientations. Accordingly, hypotheses H1a and H1c are completely confirmed, considering a positive and statistically significant influence of strategic sustainability orientation on organizational anticipation and adaptation capabilities. Furthermore, hypothesis H1b was mostly confirmed regarding a positive and statistically significant influence of strategic sustainability orientation on organizational coping capabilities (only environmental orientation didn't show a statistically significant impact).

Testing moderating effects of firm size on the strategic sustainability orientation

Utilizing firm size to analyze the relationship between strategic sustainability orientation and organizational resilience, the H2 hypothesis will be tested in this section.

A regression analysis using pooled samples and dummy variables for medium-sized and large-sized organizations is conducted to make a comparison of the effect of strategic sustainability orientation on organizational resilience among three diverse firm-size groups (Table. 7). Based on the results of the analysis, the Small size firms are significantly diverse from the Large and Medium size firms in terms of the influence of strategic sustainability orientation on anticipation, adaptation and coping capabilities.

Regarding anticipation capabilities, the effect of economic orientation is stronger in Medium and Large firms than in Small ones (with coefficients of 0.482 and 0.538, respectively (at 5% significance)). Moreover, the influence of social orientation on anticipation capabilities is similarly stronger in Medium and Large enterprises than in Small ones (coefficients: 0.226 and 0.324, respectively (at 5% significance)). About coping capabilities, Large enterprises have a weaker effect on environmental (Coefficient: -0.061) and social orientation (Coefficient: -0.153) at 5% of significance in comparison with Small firms.

Regarding adaptation capabilities, Medium firms demonstrate stronger economic orientation (Coefficient: 0.218 at 10% significance) than Small firms. Furthermore, Large

enterprises show a greater effect on economic and social orientation (Coefficients: 0.472 and 0.319, at 5% significance) than Small firms.

Regarding the distinctions in the influence of strategic sustainability strategy on organizational resilience, significant distinctions exist in its impact on three-size enterprises (regarding economic, environmental and social orientation). Based on the presented results, hypothesis H2 is confirmed.

Table 7
Regression analysis among three diverse firm size groups of the influence of strategic sustainability orientation on organizational resilience

	Organizational resilience		
	Anticipation capabilities	Coping capabilities	Adaptation capabilities
R	0.831	0.672	0.815
R2	0.691	0.451	0.664
R2 Adjusted	0.535	0.311	0.453
df	124	124	124
Sig.	0.000	0.002	0.001
	Coef.	Coef.	Coef.
Constant	0.873	1.472	1.125
M	0.718	0.369	0.403
L	1.325	0.114	0.817
Economic orientation	0.371	0.152	0.073
Environmental orientation	0.236	0.062	0.030
Social orientation	0.189	0.147	0.142
M x Economic orientation	0.482**	0.204	0.218*
M x Environmental orientation	0.263	0.121	-0.098
M x Social orientation	0.226**	0.191	0.205
L x Economic orientation	0.538**	0.383	0.472**
L x Environmental orientation	0.441	-0.061*	0.151
L x Social orientation	0.324**	-0.153**	0.319**

Notes: n = 124; * Statistically significant at 10%; ** Statistically significant at 5%: *** Statistically significant at 1%; M-medium sized firms; L-large firms
Source: Authors' work

Discussion

Part one of this research study focused on discovering if the top managers' strategic sustainability orientation affects organizational resilience positively and statistically significant. A regression analysis revealed that strategic sustainability orientation significantly and positively influences organizational resilience and its three sub-components: anticipation, coping and adaptation capabilities. This indicates that top managers must broaden their business orientations to strengthen organizational resilience by involving economic priorities and environmental and social imperatives of sustainability orientations. Concerning previous studies, Murray (2020) revealed in his study that sustainability-focused organizations have a better chance of surviving when faced with a crisis. Therefore, economic, environmental and social orientations must be part of the firm's core mission statement – as the clear purpose of its serious business operations. Secondly, firms must transmit all three strategic sustainability orientations into real and continuous commitment and daily communication between top managers and employees.

Additionally, economic, environmental and social orientations must be incorporated into operational decisions and monitored as key performances to achieve organizational resilience. Even though economic orientation showed a

higher influence on organizational resilience than the other two orientations, social orientation was similarly important to achieving the overall resilience of the organization, emphasizing the importance of key stakeholders' involvement in the firm's strategic orientation. Among the most influential social orientation' variables were: fairly dealing with customers and suppliers, pronouncing employees' well-being as part of the firm's mission and social philanthropy support. Other studies, such as the one by Paulraj (2011), proved that sustainable supply management leads to organizational resilience.

The regression results of this research study displayed that anticipation and adaptation capabilities are more affected by strategic sustainability orientation than coping capabilities. Economic, environmental and social sustainability orientations proved to be more statistically significant for anticipation and adaptation capabilities. Regarding anticipation capabilities, all three sustainability orientations manifested their high importance in observing and recognizing initial earliest signals of forthcoming potential crisis and preparing efficient plans for responding promptly – by evading its expansion. Concerning adaptation capabilities, economic, environmental and social orientations have a statistically significant impact on adapting to unfavorable situations and benefiting from occurring changes. This is especially evident in its effect on sharing knowledge among employees on how to respond to unexpected problems; long-term satisfactorily filled jobs; and maintenance of sufficient resources and reserve stocks to cope with sudden changes. Top managers' strategic sustainability orientation effect is also important concerning three other adaptation capabilities variables: supporting stable connections from suppliers and customers; utilizing knowledge in novel ways; and incorporating meaningful lessons learned from crisis into the company's regulations, norms, values and practices. A research study by Charrois et al. (2020) found that some organizations' strategic sustainability development journeys affected their adaptive capacity (viewed as an organizational resilience aspect), moving from a condition of reactivity to a more thoughtful and proactive one that benefits them in manifold modes.

Concerning coping capabilities, economic and social orientation showed positive and statistically significant influence on coping capabilities. In contrast, environmental orientation impact – even though it was p- wasn't significant for coping capabilities. Accordingly, economic and social orientations proved to be important when a crisis appears – by quickly ensuring smooth business continuity by keeping the workforce and key stakeholders informed about handling emerging problems. Additionally, these two orientations demonstrated their significant impact on providing customer support (from an apology for caused inconvenience to affected product replacements/refunds, discounts or new guarantees); and balancing the existing formal organizational structure and crisis management/communications team inclusion. Economic and social orientations were also meaningful for cooperative work during the crisis, making it easier to effectively and efficiently manage priorities, resources, and options and produce fruitful solutions. Firms' specific priorities may explain the insignificant influence of environmental orientation on coping capabilities for solving urgent problems when faced with a crisis (financial – cutting costs, improving profit; and social focus – on calming and encouraging employees and relationships with other key stakeholders). Another possible explanation is the lack of managers specialized in efficient environmental management who would deal with eco-issues even during a crisis.

Part two of this research study aimed to determine if there are significant distinctions in the influence of strategic sustainability orientation on organizational resilience by

comparing firms of different sizes. Based on the analysis results, the Small size firms were significantly diverse from the Large and Medium size firms in terms of the influence of strategic sustainability orientation on anticipation, adaptation and coping capabilities. More specifically, my research study' regression findings revealed that regarding anticipation capabilities, the effect of economic and social orientations was stronger in Medium and Large firms than in Small ones. It may be explained by Large and Medium firms' greater resources and investment in proactively 'within the firm' and sector monitoring, gathering information on future critical developments and efficient formal plan preparations on how to act when various dangers/risks happen.

Concerning the coping capabilities, the Large enterprises demonstrated a weaker effect of environmental and social orientation than Small firms. The explanations for this finding may be found in the fact that smaller companies are generally more flexible in dealing with organizational change due to their simpler formal organizational structure and better coordination – which allow them to faster implement effective solutions in response to the crisis and achieve wide acceptance. Concerning adaptation capabilities, Large enterprises showed a greater effect on economic and social orientation than Small firms. A large organization's abilities, greater reserve stocks and resources may justify the former. Similarly, the Medium firms also demonstrated stronger economic orientation than Small firms.

Conclusions

The present study examined the effects of strategic sustainability orientation on organizational resilience and how this relationship is moderated by firm size. The hypotheses were tested using multiple regression techniques, which revealed that strategic sustainability orientation (which encompassed economic, environmental and social orientation) significantly and positively influences organizational resilience. Its three sub-components are anticipation, coping and adaptation capabilities. This indicates that top managers must broaden their business orientations to strengthen organizational resilience by involving economic priorities and environmental and social imperatives of sustainability orientations.

In anticipation capabilities, all three sustainability orientations stressed their importance in observing early signs of potential crisis, recognizing them, and preparing efficient plans for proper response. Regarding adaptation to unfavorable situations and taking advantage of change occurrences, strategic sustainability orientation also showed a significant statistical impact. Moreover, about coping capabilities (when a crisis appears), economic and social orientation demonstrated a positive and statistically significant impact on it. In contrast, environmental orientation had a positive impact but was not statistically significant. The second part of this study assessed whether firms of different sizes differ from the impact of strategic sustainability orientation on overall organizational resilience. Results of the analysis uncovered that the Small size firms were significantly diverse from the Large and Medium size firms in terms of the influence of strategic sustainability orientation on anticipation, adaptation and coping capabilities.

In addition to enriching sustainability and organizational literature, this study proposes and validates instruments for measuring strategic sustainability orientation and organizational resilience. Furthermore, this study provides evidence of the empirical relationship between strategic sustainability orientation and organizational resilience from the developing country's perspective. For organizations, managers and stakeholders, this means reconsidering and reshaping their strategic sustainable way of doing business to strengthen resilience capabilities by including economic and

applicable social and environmental directions. This demonstrates the possibilities of designing high-capability resilient organizational systems.

In this study, the core limitation is linked to the relatively slight size of the sample regarding gathered data, as the research is in the early development stages. Therefore, future research possibilities could explore a larger sample in diverse countries by involving specific industries or aspects of future sustainability matters or organizational resilience in greater detail than presented here. Another future research proposal investigates the influence of digitalization and artificial intelligence on enhancing the resilience and sustainability of enterprises.

References

1. Agency for Statistics of Bosnia and Herzegovina (2022a), "Economic Statistics. BiH International Trade in Goods Statistics, January-December 2021", Vol. 12, No. 12, pp. 1-32.
2. Agency for Statistics of Bosnia and Herzegovina (2022b), "Economic Statistics. Producer Price Index in Bosnia and Herzegovina in December 2021", Vol. 11, No. 12, pp. 1-10.
3. Ahmić, A. (2016), "The influence of top manager's personal values on sustainable business success of SMEs in Bosnia and Herzegovina", Doctoral Thesis, Sarajevo, School of Business and Economics Sarajevo.
4. Ahmić, A., Skopljak, L. (2021), "Problems and responses of small and medium enterprises in Bosnia and Herzegovina to COVID-19 related to the management of key stakeholders", in Proceedings of the 21th International online Conference of International University Travnik, pp. 149-159.
5. Ahmić, A., Šunje, A., Kurtić, E. (2016), "The influence of top manager's personal values on sustainability of SMEs in developing countries", Journal of Corporate Governance, Insurance, and Risk Management (JCGIRM), Vol. 3 No. 1, pp. 27-49.
6. Ates, A., Bititci, U. (2011), "Change process: A key enabler for building resilient SMEs", International Journal of Production Research, Vol. 49 No. 18, pp. 56015618.
7. Baumgartner, R. J. (2010), Nachhaltigkeitsorientierte Unternehmensführung: Modell, Strategien und Managementinstrumente, München, Rainer Hampp Verlag.
8. Benn, S., Abratt, R., O'Leary B. (2016), "Defining and identifying stakeholders: Views from management and stakeholders", South African Journal of Business Management, Vol. 47 No. 2, pp. 1-11.
9. Blackburn, W. R. (2008), The sustainability handbook – the complete management guide to achieving social, economic and environmental responsibility, Washington, Environmental Law Institute.
10. Bonini, S., Bové, A. T. (2014), "Sustainability's strategic worth", available at https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/sustainabilitys-strategic-worth-mckinsey-global-survey-results (09 November 2021)
11. Bundy, J., Pfarrer, M. D. (2015), "A burden of responsibility: The role of social approval at the onset of a crisis", Academy of Management Review, Vol. 40 No. 3, pp. 345-369.
12. Central Bank of Bosnia and Herzegovina (2022), "Report on blocked accounts in the Unified Register of Accounts of the Central Bank of Bosnia and Herzegovina", available at https://www.cbbh.ba/Home/GetTableAttachment?contentId=3d115c44-25ff-4f84-8591-22c9e90e87f5&lang=bs (04 February 2022)
13. Charrois, S., Decoodt, E., Rocha, P. (2020), "The impact of strategic sustainable development on the adaptive capacity of organisations", available at https://www.diva-portal.org/smash/get/diva2:1441724/FULLTEXT02.pdf (15 December 2021)
14. Chopra, S., Sodhi, M. (2004), "Managing risk to avoid supply-chain breakdown", MIT Sloan Management Review, Vol. 46 No. 1, pp. 53-61.
15. Claeys, A. S., Cauberghe, V. (2012), "Crisis response and crisis timing strategies: Two sides of the same coin", Public Relations Review, Vol. 38 No. 1, pp. 83-88.
16. Coombs, W. T. (2015), Ongoing crisis communication: Planning, managing, and responding, 4th ed., Thousand Oaks, Sage.

17. Crichton, M. T., Cameron G., R., Kelly, T. (2009), "Enhancing organisational resilience through emergency planning: Learnings from cross-sectorial lessons", Journal of Contingencies and Crisis Management, Vol. 17 No. 1, pp. 24-37.
18. Day, G. S., Schoemaker, P. J. H. (2005), "Scanning the periphery", Harvard Business Review, Vol. 83 No. 11, pp. 135-148.
19. Dayton, B. W. E. (2004), "Managing Crises in the Twenty-First Century", International Studies Review, Vol. 6, No. 1, pp. 165-194.
20. Duchek, S. (2020), "Organisational resilience: a capability-based conceptualisation", Business Research, Vol. 13 No. 1, pp. 215-246.
21. Edgeman, R., Eskildsen, J. (2014), "Modeling and assessing sustainable enterprise excellence", Business Strategy and the Environment, Vol. 23 No. 3, pp. 173-187.
22. Emamisaleh, K., Rahmani, K. (2017), "Sustainable supply chain in food industries: Drivers and strategic sustainability orientation", Cogent Business & Management, Vol. 4 No. 1, pp. 1-18.
23. Faraj, S., Xiao, Y. (2006), "Coordination in fast-response organisations", Management Science, Vol. 52 No. 8, pp. 1155-1169.
24. Fülöp, G., Hernádi, B. H. (2014), "Sustainability Accounting: a Success Factor in Corporate Sustainability Strategy", International Journal of Economics and Management Engineering, Vol. 4 No. 1, pp. 1-21.
25. Gallos, J. V. (2008), "Learning From the Toxic Trenches: The Winding Road to Healthier Organizations - and to Healthy Everyday Leaders", Journal of Management Inquiry, Vol. 17 No. 4, pp. 354-367.
26. Gibb, F., Buchanan, S. (2006), "A framework for business continuity management", International Journal of Information Management, Vol. 26 No. 2, pp.128-141.
27. Gressgård, L. J., Hansen, K. (2015), "Knowledge exchange and learning from failures in distributed environments: The role of contractor relationship management and work characteristics", Reliability Engineering and System Safety, Vol. 133, pp. 167-175.
28. Hillmann, J., Duchek, S., Meyr, J., Guenther, E. (2018), "Educating Future Managers for Developing Resilient Organisations: The Role of Scenario Planning", Journal of Management Education, Vol. 42 No. 4, pp. 461-495.
29. Ilmola, L., Kuusi, O. (2006), "Filters of weak signals hinder foresight: Monitoring weak signals efficiently in corporate decision-making", Futures, Vol. 38 No. 8, pp. 908-924.
30. Jin, Z., Navare J., Lynch, R. (2019), "The relationship between innovation culture and innovation outcomes: exploring the effects of sustainability orientation and firm size: The relationship between innovation culture and innovation outcomes", R&D Management, Vol. 49 No. 4, pp. 607-623.
31. Jones, O. (2006), "Developing absorptive capacity in mature organisations: The change agent's role", Management Learning, Vol. 37 No. 3, pp. 355-376.
32. Landrum, N. E. (2018), "Stages of corporate sustainability: integrating the strong sustainability worldview", Organization & Environment, Vol. 31 No. 4, pp. 287-313.
33. Laudal, T. (2011), Determinants and impacts of corporate social responsibility: A market centric approach, Stavanger, University of Stavanger.
34. Lee, A. V., Vargo, J., Seville, E. (2013), "Developing a Tool to Measure and Compare Organisations' Resilience", Natural Hazards Review, Vol. 14 No. 1, pp. 29-41.
35. Lengnick-Hall, C. A., Beck, T. E. (2009), "Resilience capacity and strategic agility: Prerequisites for thriving in a dynamic environment", in Nemeth, C. P., Hollnagel, E., Dekker, S. (Eds.), Resilience engineering perspectives, Vol. 2, Preparation and restoration, Aldershot, Ashgate Publishing, pp. 39-70.
36. Lengnick-Hall, C. A., Beck, T. E., Lengnick-Hall, M. L. (2011), "Developing a capacity for organisational resilience through strategic human resource management", Human Resource Management Review, Vol. 21 No. 3, pp. 243-255.
37. Linnenluecke, M. K., Griffiths, A., Winn, M. (2012), "Extreme weather events and the critical importance of anticipatory adaptation and organisational resilience in responding to impacts", Business Strategy and the Environment, Vol. 21 No. 1, pp. 17-32.
38. Linnenluecke, M., Griffiths, A. (2009), "Corporate Sustainability and Organisational Culture", Journal of World Business, Vol. 45 No. 4, pp. 357-366.

39. Madsen, P. M. (2009), "These lives will not be lost in vain: Organisational learning from disaster in U.S. coal mining", Organization Science, Vol. 20 No. 5, pp. 861-875.
40. McKinsey Sustainability (2020), "How the E in ESG creates business value", available at https://www.mckinsey.com/business-functions/sustainability/our-insights/sustainability-blog/how-the-e-in-esg-creates-business-value (20 October, 2021)
41. Mio, C., Venturelli, A., Leopizzi, R. (2015), "Management by objectives and corporate social responsibility disclosure", Accounting, Auditing & Accountability Journal, Vol. 28 No. 3, pp. 325-364.
42. Missimer, M., Robért, K.H., Broman, G. (2017), "A strategic approach to social sustainability - Part 2: A Principle-based definition", Journal of Cleaner Production, Vol. 140 (Part 1), pp. 42-52.
43. MIT Sloan & BCG (2016), "2016 Sustainability & Innovation Global Executive Study and Research Project", available at https://sloanreview.mit.edu/projects/investing-for-a-sustainable-future/ (10 February, 2021)
44. Munoz, P., Dimov, D. (2015), "The call of the whole in understanding the development of sustainable ventures", Journal of Business Venturing, Vol. 30 No. 4, pp. 632-654.
45. Murray, J. (2020), "HSBC: Companies Focused on Climate Change "outperformed" as Virus Spread", available at https://www.greenbiz.com/article/hsbe-companies-focused-climate-change-outperformed-virus-spread (25 May 2021)
46. Nilakant, V., Walker, B., Van Heugten, K., Baird, R., De Vries, H. (2014), "Research note: Conceptualising adaptive resilience using grounded theory", New Zealand Journal of Employment Relations, Vol. 39, No. 1, pp. 79-86.
47. Pagell, M., Wu, Z. (2009), "Building a More Complete Theory of Sustainable Supply Chain Management Using Case Studies of 10 Exemplars", Journal of Supply Chain Management, Vol. 45 No. 2, pp. 37-56.
48. Paulraj, A. (2011), "Understanding the relationships between internal resources and capabilities, sustainable supply management and organisational sustainability", Journal of Supply Chain Management, Vol. 47 No. 1, pp. 19-37.
49. Prayag, G., Chowdhury, M., Spector, S., Orchiston, C. (2018), "Organisational resilience and financial performance", Annals of Tourism Research, Vol. 73 No. C, pp. 193-196.
50. Richtnér, A., Löfsten, H. (2014), "Managing in turbulence: How the capacity for resilience influences creativity", R&D Management, Vol. 44 No. 2, pp. 137-151.
51. Robb, D. (2000), "Building resilient organisations", OD Practitioner, Vol. 32 No. 3, pp. 27-32.
52. Roxas, B., A. Coetzer (2012), "Institutional environment, managerial attitudes and environmental sustainability orientation of small firms", Journal of Business Ethics, Vol. 111 No. 4, pp. 461-476.
53. Savage, G. T., Bunn, M. D., Gray, B., Xiao, Q., Wang, S., Wilson, E. J., Williams, E. S. (2010), "Stakeholder collaboration: Implications for stakeholder theory and practice", Journal of Business Ethics, Vol. 96, pp. 21-26.
54. Seville, E., Van Opstal, D., Vargo, J. (2015), "A Primer in Resiliency: Seven Principles for Managing the Unexpected", Global Business and Organizational Excellence, Vol. 34 No. 3, pp. 6-18.
55. Sirkin, H., Keenan, P., Jackson, A. (2005), "The hard side of change management", Harvard Business Review, Vol. 83 No. 10, pp. 108-118.
56. Sørensen, J. B. (2002), "The strength of corporate culture and the reliability of firm performance", Administrative Science Quarterly, Vol. 47 No. 1, pp. 70-91.
57. Stephenson, A., Seville, E., Vargo, J. (2010), Benchmark Resilience: A study of the resilience of organisations in the Auckland Region: Resilient Organisations Research Report, Auckland, The Resilient Organisations Research Group.
58. Tantalo, C., Priem, R. L. (2016), "Value creation through stakeholder synergy", Strategic Management Journal, Vol. 37 No. 2, pp. 314-329.
59. Van Trijp, J. M. P., Ulieru, M., Van Gelder, P. H. A. J. M. (2012), "Quantitative modeling of organisational resilience for Dutch emergency response safety regions. Proceedings of the Institution of Mechanical Engineers", Journal of Risk and Reliability, Vol. 226 No. 6, pp. 666-676.

60. Weick, K., Sutcliffe, K. (2008), Managing the Unexpected: Assuring High Performance in an Age of Complexity, San Francisco, Jossey Bass Publishers.
61. Williams, A., Eke, B., Anyanwu, S. (2017), "Innovation and organisational resilience: A study of selected food and beverage firms in Port Harcourt", International Journal of Advanced Academic Research, Social & Management Sciences, Vol. 3 No. 6, pp. 1-15.

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