Exploring the impact of Digital Knowledge Management on Technostress and Sustainability

Extended Abstract

Purpose: This research project aims to assess how digital knowledge management affects technostress in workers and how that influences the organization's sustainability. The study applied an in-depth literature review of the following concepts and dimensions, digital knowledge management (acquisition, sharing, and application), technostress (techno overload, invasion, complexity, insecurity, and uncertainty), and sustainability (economic, social, and environmental).

Methodology: After completing the literature review, an online questionnaire was developed and disseminated through social networks. The questionnaire had four sections: classification of the respondent, questions related to knowledge management, technostress, and sustainability. The final sample comprises 454 responses. Firstly, a descriptive analysis of the sample was carried out, and secondly, a structural equation model by the PLS-SEM method was conducted.

Findings: The results show that there is a direct and positive relationship between knowledge management and technostress. This finding means that a higher level of knowledge management of firms causes a greater level of technostress among employees. The close relationship between knowledge management and the firms' sustainability has also been confirmed. The study results have shown that gender does not have a moderating effect on the relationships reported, as there are no significant differences.

Originality: This study is the first to look at digital knowledge management, assessing both the levels of employee technostress and the sustainability achieved by their organisations. Thus, this study could serve as a basis for future research. Additionally, it contributes to the scarce academic literature on technostress and digital knowledge management levels.

Keywords: Digital knowledge management, digital knowledge, technostress, sustainability.

1. Introduction

Implementing ICTs in business has been a challenge, especially in times of crisis, such as the health crisis of 2019 (Bai *et al*., 2021; Bloom *et al*., 2021). To ensure more efficient results and avoid management problems, digital knowledge management has started to be used more intensively (Gupta *et al*., 2022). Digital knowledge management refers to implementing and using ICTs to manage the knowledge and resources of the company digitally. This term is not used very often in academic literature as opposed to "knowledge management" which is widely analysed together with ICTs, digital transformation or digital innovation, among others (De Bem Machado et al., 2022; Gupta *et al*. 2022; Klein and Todesco, 2021). Some academic works have concluded that ICT-related knowledge management is complex since it can affect employees by leading them to stress. Workers' stress caused by using digital platforms or ICTs is called technostress (Brod, 1984; Tarafdar *et al*., 2011). Taking this into account, scholars have identified different creators and inhibitors of technostress (Li and Wang, 2021; Tarafdar *et al*., 2011). The creators are the drivers of technostress and can be identified as techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty (Tarafdar *et al*., 2007). In this sense, technostress inhibitors are drivers that mitigate the impact of Technostress. The literature identifies three inhibitors: a) the possibility of facilitating literacy, b) providing technical support, and c) facilitating and improving workers' skills and performance at work (Li and Wang, 2021).

The use of ICTs in knowledge management has had both advantages and disadvantages. The biggest disadvantage is the relationship between knowledge management and technostress, which can directly affect the company and its proper functioning (Dragano and Lunau, 2020; Ragu-Nathan *et al*., 2008). In recent years, sustainability has been another variable studied concerning knowledge management (Martins *et al*., 2019; Sanguankaew and Vathanophas Ractham, 2019). Studies have identified that knowledge management positively affects sustainable development as it promotes sustainable actions within the company, and can recognize unsustainable operations that are a problem for the company and society in general (López-Torres *et al*., 2019). Taking into account that companies must respect and comply with the objectives of sustainable development, sustainability is one of the critical variables that influence various aspects of the company, in particular stakeholder loyalty and satisfaction, profitability, and sales growth (Alshehhi *et al*., 2018; Harris, 2007; Kim and Hall, 2020).

As such, there is a need to analyse the relationship between digital knowledge management, its negative and positive outcomes, and the sustainability achieved by companies through digital knowledge management (Martins *et al*., 2019; Martínez-Navalon, 2021; Mikalauskienė and Atkočiūnienė, 2019, Ragu-Nathan *et al*., 2008). Moreover, it will also increase awareness of digital knowledge management's importance to avoid market competition problems. Similarly, the importance of gender for technostress, sustainability, and digital knowledge management is not yet thoroughly analyzed. Among the few exceptions, Meinzen-Dick *et al*. (2014) have analysed gender in relation to sustainability, concluding that it moderates actions and decisions related to sustainability.

Therefore, the main objective is to analyse whether digital knowledge management affects the techno-stress of employees and the company's sustainability. Furthermore, it will also explore if gender moderates the studied relationships. To do so, the PLS-SEM method (Partial Least Squares - Structural Equation Modeling) wil be used to achieve the objectives set. In this respect, this study will fill the gap on these issues. As regards results, they highlight that gender does not moderate the proposed variables but that there is a relationship between digital knowledge management and variables such as sustainability and technostress.

Taking this into account, this study will contribute to the academic literature on technostress, digital knowledge management, and sustainability, as these variables have gained interest in recent years (i.e. Li and Wang, 2021; Shaher and Ali, 2020). Similarly, this study may be the first to analyse digital knowledge management, assessing both the levels of employee technostress and the sustainability achieved by their organisations. The importance of analysing these two variables is essential in the academic literature since they both influence the decision-making process and the company's functioning. Therefore, the results of this research can significantly benefit firms, especially managers, when planning business strategies. This paper can serve as a basis for measuring technostress and its relation to sustainability for companies of different sectors, sizes, locations or legal forms. The appropriate development of digital knowledge management allows companies to correct, use and share data at any time, avoiding managerial problems. In addition, the present work helps companies by providing clues on how to comply with sustainable development goals by implementing digital knowledge management. These theoretical and practical contributions underline the importance of the present work.

This study is organised as follows: the first part is the introduction, where the justification for the choice of the topic, objectives, methods, results, and originality of the work are presented. The second section reviews the literature on the three variables studied. The third part analyses and justifies the hypotheses of the study. Next, is the methodology section. Afterward, the results are examined. In the sixth section, the discussion and conclusions are drawn.

2. Literature Background

2.1. Sustainability: Importance and evolution

Sustainability is a concept that has attracted much attention from firms or individuals (Gelashvili *et al*., 2021; Lozano, 2018). Governments or official institutions promote and advise its implementation to achieve a better world for all (Cai and Choi, 2020; Yi *et al*., 2018). Sustainability is composed of three parts, one covering social aspects, the other focusing on economic factors, and the last, environmental sustainability, which focuses on ecological aspects (Mensah, 2019; Purvis *et al*., 2019). Each of these factors is vital for sustainable development, so more and more firms are becoming aware of their activities impact on sustainability.

Many firms use sustainability actions as part of their business strategy as it is related to good performance (Alshehhi *et al*., 2018), increased sales (Harris, 2007), and customer loyalty (Kim and Hall, 2020). It is, therefore, essential to underline the importance of sustainability. First, to guarantee equality and prosperity for the whole population; Second, to improve the quality of life, especially in the least developed countries (United Nations, 2015). Third, to make visible the need and support for quality education for all; Fourth, to promote responsible consumption or bet on renewable energies and economic growth (United Nations, 2015). These goals are based on the United Nations Agenda to be fulfilled by 2030.

However, some studies (e.g., Cernev and Fenner, 2020) have concluded that it is unlikely that all of them will be met by the target date. For this reason, firms and public organizations should promote more sustainable development to raise the awareness of society and firms about the importance of the correct implementation of sustainability (Gelashvili *et al*., 2021).

2.2. Technostress, conceptualisation and relevance

Technological advances have changed the world, underlining the importance of the internet (Saura et al., 2021; Saura et al., 2022a), which has positively impacted the development of new teaching and working skills (Beardsley *et al*., 2021; Chen *et al*., 2021). Technological advances, particularly the ICTs, have significantly changed how communication is used to facilitate the transmission, access, and processing of information in the workplace (Apulu and Latham, 2011). Therefore, workers have had to adapt to the changes in their working habits to be more efficient (Ragu-Nathan *et al*., 2008).

The main advantages of using ICTs have increased work efficiency and productivity, immediate access to information, security, the possibility to work from anywhere, environmental friendliness, access to customer data, the potential to offer innovative and exclusive products and services, etc. (Marín-García *et al*., 2021; Mushtaq *et al*., 2022; Saura *et al*., 2022c; Tarutė and Gatautis, 2014). Still, using ICTs is not only a benefit for workers (De Koning and Gelderblom, 2006; Salanova *et al*., 2013; Tarafdar *et al*., 2011). According to Messenger *et al*. (2017), the disadvantages of using ICTs include increased working hours and work-life balance problems that can cause stress and health problems. Another drawback of using ICTs is their complexity since technological advancements, already implemented in the workplace, require a constant update, which causes stress for workers (Ragu-Nathan *et al*., 2008).

Stress caused by ICTs is known as technostress, which was first defined in the 1980s by Brod (1984, p. 16) as the "modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner." From this date onwards, scholars (Arnetz and Wiholm, 1997; Ayyagari *et al*., 2011; Tarafdar *et al*., 2007; Salanova *et al*., 2013; Wang *et al*., 2008) have applied the concept of technostress to technological stress. Since then, the increase in the use of ICTs and their rapid evolution have caused several adverse effects, such as the lack of knowledge or difficulty in learning in the short term (Sahin and Cklar, 2009). According to Chiappetta (2017), technostress causes two types of negative symptoms: physical and mental. In physical symptoms, it is possible to identify insomnia and sleep-waking, rhythm disorders, muscle tension pain, headache, chronic fatigue, etc. On the other hand, mental symptoms include irritability, depression, behavioral changes, and crying spells. Therefore, technostress impacts both the firm, the employee and their relationships in the work environment, causing absenteeism, a decrease in professional effectiveness, conflict, and isolation (La Torre *et al*., 2019).

In addition, techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty are among technostress's most prominent creators (Tarafdar *et al*., 2007). In this regard, Ragu-Nathan *et al*. (2008) consider techno-overload as the simultaneous handling of different information flows from internal and external sources. Therefore, workers handle more information than before, which requires more efficient and faster work. The techno-invasion is considered the flexibility of ICTs, i.e., the possibility to answer emails or do work at any time, which affects the work-life balance because workers feel that they are not free from ICTs (Li and Wang, 2021).

The rapid advance of technologies makes them more complete, functional, and complex, generating techno-complexity in users (Ragu-Nathan *et al*., 2008). Another creator of technostress is techno-insecurity, when workers are not confident in using ICTs, leading them to think that they cannot cope with the tasks requested and that, in the future, they will be replaced by others (Dragano and Lunau, 2020). Techno-uncertainty is the stress caused by rapid changes occurring in the market, which creates uncertainty among workers regarding what kind of ICTs they will face in the future, all of which can eventually lead to frustration (Ragu-Nathan *et al*., 2008).

To combat technostress, firms employ different inhibitors such as facilitating literacy, providing technical support, or facilitating participation to improve workers' skills, productivity, and performance (Li and Wang, 2021; Ragu-Nathan *et al*., 2008; Tarafdar *et al*., 2011). Thus, technostress is a phenomenon of great interest, especially for firms, as the productivity of stressed workers is low, directly affecting the organization's performance (Ayyagari, 2012). Moreover, technostress increases with age, so it is one of the variables that firms should consider (Berger *et al*., 2016).

2.3. Digital Knowledge Management

In today's world, more and more information needs to be managed correctly to be useful for managers' decision-making. That is why in the late 1990s, there were already studies (Demarest, 1997; Mårtensson *et al*., 2000; Quintas *et al*., 1997) that focused on the importance of knowledge management. Quintas *et al*. (1997, 387) define knowledge management as "the process of continually managing knowledge of all kinds to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets, and to develop new opportunities", which depends mainly on the objectives for which they are intended. However, different stages of knowledge management can be distinguished; The first stage is the collection of information, followed by the second stage, the stage of information storage (Mårtensson *et al*., 2000). According to the authors, the subsequent stages are when information is made available to users (the third stage), and the final stage is when this information is used (the fourth stage).

Table 1: Relevant literature on Knowledge Management

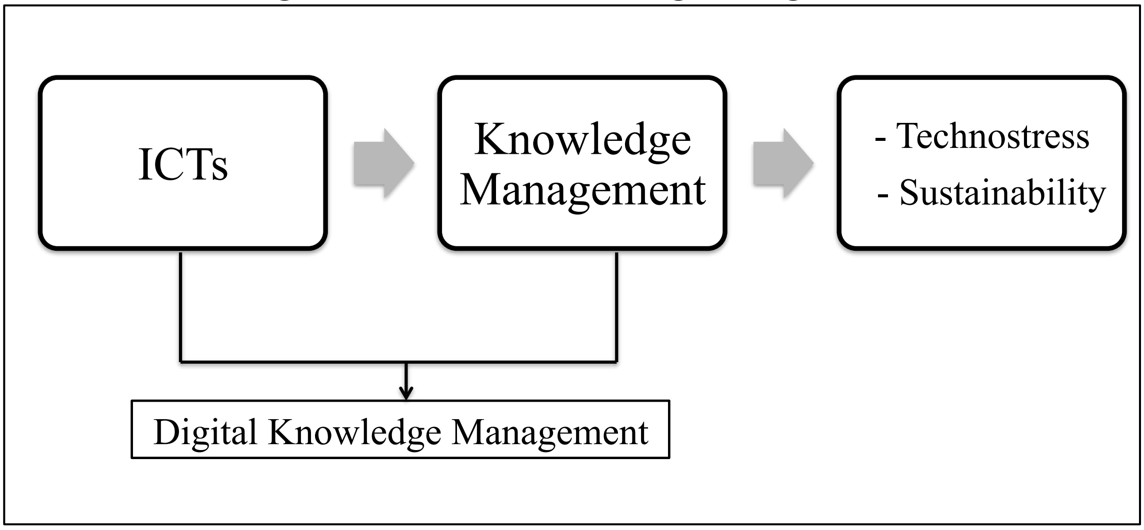
Author(s)	Year	Objectives	Methods employed	Findings/Implications
Quintas *et al.*	1997	Definition and analysis what knowledge management is and what relevance it has to organizations and its users.	Literature review, descriptive analysis of the problem.	- Knowledge management is a key source of organizational advantage. - Theoretical implications to implementation of strategies for developing, acquiring and applying knowledge.
Mårtensson *et al.*	2000	Definition of knowledge management and its domain in theory and practice, point out some problems inherent in the concept.	Extensive literature review, descriptive analysis of the problem.	- Knowledge management is a business strategic tool, even the outcome is difficult to estimate. - Any digitised information is part of knowledge management. The role of ICTs is underlined.
Laspinas	2015	Analysis of technology knowledge management and technostress.	Descriptive analysis. Data collected from 29 librarians.	- Workers are not comfortable with the implementation of technology as it involves change and uncertainty – this generates technostress. - Knowledge managers should organize technology based trainings for their workers.
Hamad	2018	Analyse the role of ICTs in knowledge management	Systematic literature review.	- The integration of ICTs in the company facilitates the knowledge management and systematises organisational

		operations.		processes. - ICTs have proven to be a very important tool to improve and advance knowledge management and its processes within the company.
López-Torres *et al.*	2019	Show the effect of Knowledge Management as a tool to enable sustainable management in firms' operations.	Structural Equation Model. Data collected from 345 SMEs.	- Knowledge management is an effective strategy for firms to produce the necessary transformation towards more sustainable operations. - Organisations of all sizes, but in particular, SMEs, should take into account the sustainable development benefits offered by the correct implementation of knowledge management.
Klein and Todesco	2021	Knowledge management in SMEs during the pandemic and its role in digital transformation opportunities.	Systematic literature review, SWAT analysis.	- Knowledge management is a competitive advantage at the enterprise level. - A change in organisational culture is needed to constantly incorporate new digital technologies due to the increased use of ICTs and their prior knowledge.
Gupta *et al.*	2022	Analisis of emerging knowledge management models for digitalisation.	Systematic literature review, qualitative data analysis from 37 business executives.	- Digital knowledge management is vital to ensure business continuity in an uncertain business environment. - Digital knowledge management can enable managers to manage virtually problems and challenges on an ongoing basis.

Source: own elaboration

Analysing table 1, we see that the first work of Quintas *et al.* (1997) focuses more on the definition of the concept of knowledge management in general. A few years later, Mårtensson *et al.* (2000) started to explore knowledge management related to ICTs, considering that any digitised information is part of knowledge management. Later, Hamad (2018) argues that implementing ICTs in companies improves knowledge management. That is, ICTs have a direct effect on knowledge management, in particular on digital knowledge management. This is because ICTs transform all kinds of information into digital one which can turn into a competitive advantage, ensuring the continuity or survival of the company during times of uncertainty (Klein and Todesco, 2021; Gupta *et al*. 2022). The constant market changes and advances in ICTs positively affect knowledge management since knowledge can be regulated more effectively. However, the ICT changes and developments can also have a negative impact since they can cause stress to employees (Laspinas, 2015) because they have to handle a greater volume of information and adapt to new technologies (Ragu-Nathan *et al*., 2008; Tarafdar *et al*., 2007). Still, not all studies point to only negative effects, several researches (López-Torres *et al*., 2019; Martins *et al*., 2019; Mikalauskienė and Atkočiūnienė, 2019) have identified, for example, a positive relationship between knowledge management and sustainability. By considering the benefits of sustainable development to society, companies and governments would focus more on sustainable knowledge management (López-Torres *et al*. 2019). The relationship between these elements, ICTs, knowledge management, sustainability, and technostress, can be seen in figure 1.

Figure 1. Evolution of knowledge management



Source: own elaboration

In addition, to the importance of knowledge management for sustainability, it is essential to underline the role of knowledge management in business strategies, in the proper functioning of firms, in promoting innovation, or even in project management (Ferreira *et al*., 2018; Klein and Todesco, 2021; Ode and Ayavoo, 2020; Pellegrini *et al*., 2020; Sokhanvar *et al*., 2014). Therefore, knowledge management is a crucial management tool for the adequate development of a firm or country (Mårtensson *et al*., 2000).

After global digitalization, knowledge management has also adapted to a new form of control: digital knowledge management. As stated by Ha *et al*. (2021), the digitization of firms has increased the volume of data from different sources, such as social media, sensors, or machine-to-machine data, among others. Therefore digital knowledge management would digitally incorporate all the stages of knowledge management (Mårtensson et al., 2000). There is rarely a sector of activity today that does not use digital platforms to search, create, store, summarise, interpret and apply the information needed for business (Abdullah *et al*., 2018; Gupta *et al*., 2022; Shaher and Ali, 2020).

According to Shaher and Ali (2020), knowledge management includes acquiring, sharing, and applying information and knowledge, which is fundamental support for organizational innovation. Because of all the advances and innovations, firms are increasingly faced with complex volumes of data from different sources, making it necessary and essential to use digital technologies to manage knowledge digitally (Gupta *et al*., 2022). The work elaborated by Di Vaio *et al*. (2021) points out the critical role of digital innovation in the knowledge management system, ensuring the optimal development of information exchange strategies for decision-making and orienting the firm towards business models that are sustainable and innovative.

3. Hypotheses development

The recent health crisis has highlighted the importance of digital knowledge management as a business management tool (Gupta *et al*., 2022; Klein and Todesco, 2021). Many firms have had to start to operate online from one day to the next, managing all information and activity through ICTs (Abed, 2021; Indriastuti and Fuad, 2020). Hence, interest in digital knowledge management has increased considerably (Wang and Wu, 2021).

The study by Klein and Todesco (2021) has pointed out that knowledge management has been fundamental for most firms to survive the crisis and avoid bankruptcy. The correct implantation of knowledge management in the business can have many advantages for firms. Among them can be distinguished; a) The possibility of acquiring knowledge about customers' new demands (Klein and Todesco, 2021); b) Promoting sales turnover growth (Uhlaner *et al*., 2007); c) Using the information for innovation (Hassan and Al-Hakim, 2011); d) Improve the corporate performance (López-Nicolás and Meroño-Cerdán, 2011); e) Use the data to have a sustainable competitive advantage in the market (Mahdi *et al*., 2019).

It should be noted that academic research and business awareness of knowledge management in sustainability contexts has increased in recent years (Martins *et al*., 2019; Sanguankaew and Vathanophas Ractham, 2019). Several papers have studied the relationship between knowledge management and sustainability management (Abbas and Sağsan, 2019; Martins *et al*., 2019; Mahdi *et al*., 2019; Mikalauskienė and Atkočiūnienė, 2019). For example, Mikalauskienė and Atkočiūnienė (2019) found that knowledge management influences creativity, innovation, and human and social knowledge.

Moreover, social knowledge impacts sustainable development and positively influences social and environmental well-being (Mikalauskienė and Atkočiūnienė, 2019). Another study by López-Torres *et al*. (2019) concluded that knowledge management is an essential driver for implementing sustainable actions in the firm, as proper knowledge management helps to understand better and raise awareness about unsustainable operations that represent a global hazard for everyone. Thus, it can conclude that knowledge management drives and has a positive relationship with sustainability. Therefore, the following hypothesis is proposed:

H.1a. *Digital knowledge management has a direct and positive impact on sustainability*

It is also essential to analyze the impact of gender on sustainability and knowledge management as this variable has been found to shape outcomes in different areas of study (Brooks *et al*., 2019; Fisher and Yao, 2017). Meinzen-Dick *et al*. (2014) have concluded that gender moderates the sustainability variable because women are more involved in actions and decisions that favor economic sustainability, while men make decisions that positively affect environmental sustainability. Given the above, the following hypothesis is proposed:

H.1b. *There are significant differences between men and women in the influence of digital knowledge management on sustainability*

Digitization has not been easy for firms (Marciniak *et al*., 2019). With its pros and cons, firms have gradually digitized their internal and external activities to have better performance and more reliable data (Dredge *et al*., 2019; Marciniak *et al*., 2019; Torriero *et al*., 2022). However, it has not been easy for workers, as it has been challenging to adapt to new technologies and work methods (Martínez-Navalón, 2021). Such a challenge is related to technostress, as one of the creators of technostress is the technological advances that make it difficult for employees to learn (Ragu-Nathan *et al*., 2008). In addition, other causes of technostress are insecurity of ICT knowledge and the complexity of using ICTs because there are more and more technologies with many more functions (Tarafdar *et al*., 2007). These drivers of technostress can be derived from digital knowledge management.

A study by Laspinas (2015) on the implementation of digital knowledge management in libraries has found that it impacts the technostress of employees, even if the final result is satisfactory for the firm (better performance, more efficiency). The growing trend of collecting data from different sources to improve data management in the enterprise (Ha *et al*., 2021) can also be stressful for workers as they have to deal with larger volumes of data (Ragu-Nathan *et al*., 2008; Tarafdar *et al*., 2007). Taking all of this into account the following hypothesis is put forward:

H.2a. *Digital knowledge management directly and positively impacts technostress.*

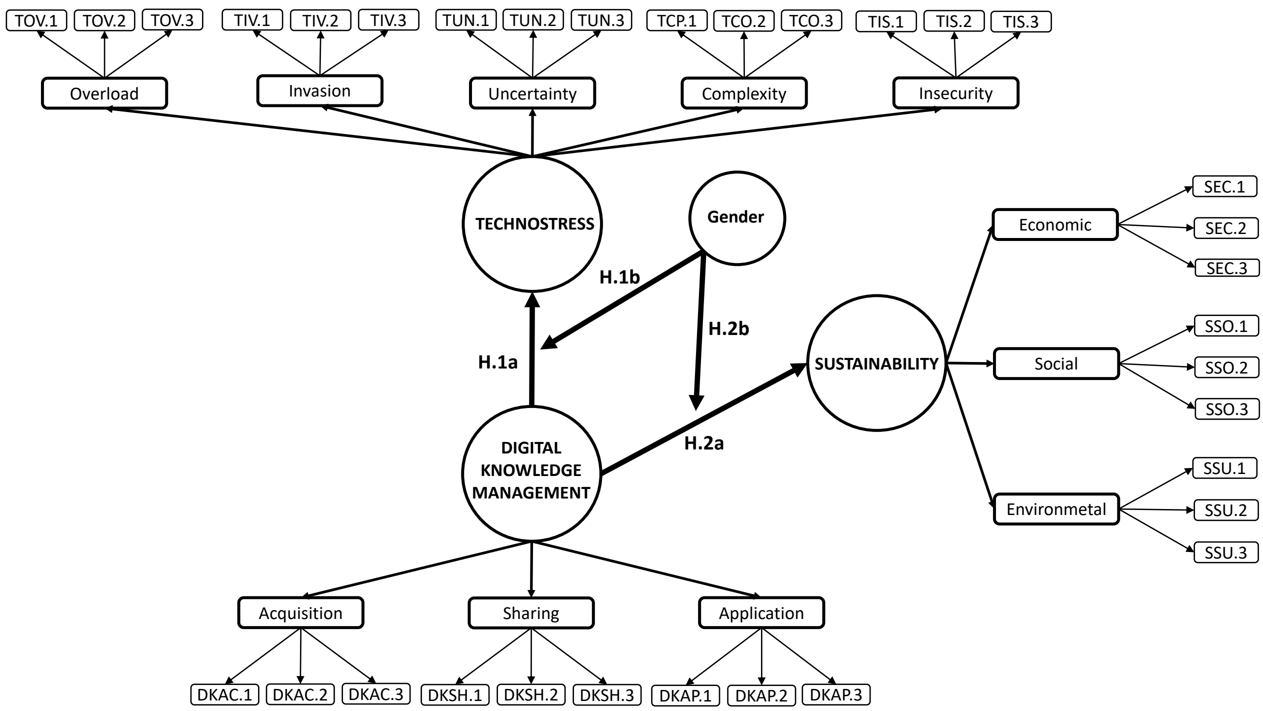
The role of gender in the analysis of technostress must also be explored. A study on using ICTs has concluded that women suffer higher levels of technostress than men

(Çoklar and Sahin, 2011). A recent survey on students' technostress in technology-enhanced learning settings concluded that female students were more susceptible to technostress than male students (Wang *et al.,* 2020). In the same context, Gabr *et al.* (2021) found that technostress is significantly influenced by gender, age, and poor workplace environment among university workers. However, not all studies show gender to have an impact on technostress. Li and Wang (2021), for example, have demonstrated that among the university community, technostress is assumed in the same way by all (i.e., students, teachers…), i.e., there is no difference in relation to gender. Therefore, the following hypothesis is proposed:

H.2b. *There are significant differences between men and women in the influence of digital knowledge management on technostress.*

Although there was no specific literature on gender and its impact on digital knowledge management, sustainability, and technostress, its importance and significance have been recognized in other research areas. Therefore it is expected that all four hypotheses will be accepted. Figure 2 shows the proposed research model.

Figure 2. Research Model



Source: own elaboration

4. Methodology

4.1. Materials

The semi-structured self-report questionnaire composed of three parts has been applied. The first part contained the demographic questions of the respondents. In the second part, a control question was made to the respondents: - *Do you need digital elements daily for your work performance?* The third part was composed of 33 questions about the study variables. The measurement scale used in this study is constructed using the following literature review: Technostress (Bondanini *et al*., 2020; Tarafdar *et al*., 2010; Gelashvili *et al*., 2021); Sustainability (Oláh *et al*., 2018), and Digital Knowledge Management (Ağan *et al.,* 2018). The measurement scale used for the sentiment analysis (Matas, 2018) was a 5-point Likert-type scale ranging from strongly disagree (1) to strongly agree (5). The Likert scale is the most widely used in social science studies (Ferraris, et al. 2020) since measuring the intensity of the respondent's feelings is very important (Martínez-Navalón *et al*., 2020).

4.2 Data collection and sampling

The questionnaire **for data collection** was applied online through social networks (Facebook and Twitter) and by email using google forms. The sample was obtained in the central Spanish provinces of Madrid and Castilla-La Mancha, employing convenience sampling (Andrade, 2021). The online questionnaire was sent to workers in different teleworking companies.

The online questionnaire was available between the 3rd and 19th of February, 2022. The total number of questionnaires collected was 485, of which only 454 were considered valid (see Table 2).. The two main reasons for eliminating 31 questionnaires came from the fact that some were incomplete, while others claimed they did not work with digital elements in their daily lives. Next, a descriptive analysis of the respondents' profile was made.

Table 2: Sample Characteristics (n = 454)

Classification Variable	Variable	Frequency	Percentage
Gender	Male	212	46.70%
	Female	242	53.30%
Age	<18	2	0.44%
	18-25	128	28.19%
	25-35	130	28.63%
	35-55	106	23.35%
	55-67	88	19.38%
	>67	0	0.00%
Degree of education completed	Primary education	2	0.44%
	Secondary education (ESO)	8	1.76%
	Secondary education (Bachillerato)	82	18.06%
	Vocational education	64	14.10%
	Bachelor's degree	148	32.60 %
	Master's degree	140	30.84%
	Ph.D.	10	2.20%
Occupation	Private sector worker	255	56.17%

Public sector worker	134	29.52%
Self-employed	55	12.11%
Student	10	2.20%

Source: own elaboration

The descriptive analysis of the sample shows that 53.30% were female respondents. The majority of the respondents had between 25-35 years. Regarding the respondents' level of study, 32.60% have undergraduate studies, and 30.84% have a Master's degree. Finally, regarding the current occupation of the respondents, 56.17% are employees in the private sector, 29.52% are employees in the public sector, and only 12.11% are self-employed.

4.3. Data analysis

The variance-based structural equation method is used in the measurement analysis and in validating the hypotheses raised in the study. This method is known as Partial Least Squares (PLS) (Hallak *et al.,* 2018). This technique makes it possible to determine and analyze the estimation of the model proposed taking into account the dependent and independent variables that form it (Cachón Rodríguez *et al.,* 2019). It also makes it possible to calculate and mediate the sizes of the effects, whether direct or indirect, that the variables have on each other (Hair *et al.,* 2019).

This method is justified because it is one of the most widely used and complex techniques for analyzing composite models. This technique allows for measuring latent variables and estimating structural models (Henseler et al., 2009; Hair *et al.,* 2018). Another reason for its use is that this technique enables the analysis of complex models like the one presented in this study, which contains reflective and formative variables (Saura *et al.,* 2022b).

The PLS-SEM technique is highly used in social sciences and novel studies based on analyzing variables obtained through social networks (Saura *et al.,* 2022b) and in studies where relationships between variables are lacking. This approach is highly technological in studies such as those of Hair *et al.* (2019), Henseler *et al.* (2009), and Hair *et al.* (2018). Specifically, Hair *et al.* (2009) analyzed the advantages and disadvantages of using the PLS technique, significantly demonstrating the use of this methodology for studies such as the one developed in this work.

The SmartPLS 3.0 software was used for the analysis. Such software, whose reliability has been well-proven and is widely used in social science research (*Del-Castillo-Feito et al.,* 2019).

5. Results

Before starting with the analysis of the proposed model, it is helpful to consider the process since this is a model which has multidimensional variables and hypotheses that require a multi-group moderator analysis. First, a validation analysis of the measurement scale must be conducted. This analysis has two phases; in the first phase, the items that make up the dimensions are confirmed. Subsequently, the items are grouped to form a dimension and validated (Hair *et al*., 2014, 2018, 2019). After the measurement scale is validated, hypotheses H.1a and H.2a are analyzed, and the model's effects are measured. Finally, the multi-group moderation analysis is carried out, where the analysis of invariance (MICOM) is first performed. Then hypotheses H.1b and H.2b are analyzed and validated with the most current and severe criterion, "Permutations" (Hair *et al*., 2020).

5.2. Measurement Model

As mentioned above, the study of the proposed model is analyzed in several phases. Firstly, an analysis of the scale of measurement of the multidimensional variables of the study is carried out (Hair *et al*., 2019). The first validation step is performed on the first-order model, where the dimensions of the multidimensional variables display the items (Liengaard *et al*., 2021). Once the first-order items have been validated, they are grouped into dimensions. The second-order model comprises the main variables (digital knowledge management, technostress, and sustainability) and their grouped dimensions.

In this model, the dimensions in the first-order model and the variables in the second-order model are reflective. This characteristic indicates that specific analyses are made to validate the measurement scale, as seen in tables 2, 3, 4, and 5. The analyses applied for this type of variable are individual reliability, composite reliability, convergent validity, and discriminant validity. Tables 3 and 4 show the analyses performed for the first-order measurement and scale validation.

Table 3: Measurement items first-order

Constructs	Items	Correlation Loading	CA	CR	rho_A	AVE
Technostress						
Overload	TOV.1 I feel forced by the use of digital tools to work faster.	0.901***	0.847	0.906	0.872	0.764
	TOV.2 I feel forced by the use of digital platforms to do more work than I can handle.	0.9***				
	TOV.3 I feel forced by the use of digital platforms to work longer.	0.819***				
Invasion	TIV.1 I spend less time with my family due to the use of digital platforms.	0.885***	0.782	0.869	0.85	0.69
	TIV.2 I have to keep up with my work during my free time due to the use of digital platforms.	0.753***				
	TIV.3 I feel that my personal life has been invaded as a result of using digital platforms.	0.849***				
Complexity	TCO.1 I don't know enough about digital platforms to handle my work satisfactorily.	0.824***	0.883	0.925	0.999	0.805
	TCO.2 I need a lot of time to understand and manage new technologies.	0.955***				
	TCO.3 I often find it too complex to understand and manage new technologies.	0.908***				
Insegurity	TIS.1 I feel a constant threat to my job security because of new technologies.	0.815***	0.835	0.898	0.876	0.747
	TIS.2 I do not share my knowledge with colleagues for fear of being replaced.	0.881***				
	TIS.3 I feel threatened by more technologically savvy colleagues.	0.895***				

Uncertainty	TUN.1 In my organisation, new technologies are constantly being used to work.	0.833***	0.763	0-862	0.778	0.677
	TUN.2 In my organisation, there are constant changes in the ICT equipment we use for work.	0.784***				
	TUN.3 In my organisation, there are frequent updates to the digital platforms we use to work.	0.849***				
Sustainability						
Economic	SEC.1 The organisation in which I work or study tries to do its best to be productive.	0.862***	0.874	0.922	0.88	0.798
	SEC.2 The organisation in which I work or study tries to continuously improve the quality of the services it offers.	0.916***				
	SEC.3 The organisation in which I work or study tries to build long-term relationships with its stakeholders to ensure its long-term success.	0.901***				
Social	SSO.1 The organisation in which I work or study helps to improve the quality of life in the community.	0.877***	0.765	0.864	0.785	0.681
	SSO.2 The organisation in which I work or study helps to solve social problems.	0.842***				
	SSO.3 The organisation where I work or study treats employees fairly (does not discriminate).	0.751***				
Environmental	SSU.1 The organisation in which I work or study values and protects the environment.	0.872***	0.831	0.899	0.831	0.748
	SSU.2 The organisation in which I work or study develops active recycling policies.	0.885***				
	SSU.3 The organisation where you work or study has anti-pollution awareness campaigns.	0.836***				
Digital Knowledge Management						
Acquisition	DKAC.1 My organisation facilitates the acquisition of digital knowledge.	0.900***	0.853	0.912	0.854	0.775
	DKAC.2 My organisation facilitates the acquisition of new digital skills based on existing ones.	0.918***				
	DKAC.3 My organisation uses feedback from projects to improve the following projects.	0.819***				
Application	DKAP.1 My organisation applies the digital skills learned from the experiences.	0.885***	0.886	0.929	0.889	0.814
	DKAP.2 My organisation uses the digital knowledge gained to improve efficiency.	0.915***				
	DKAP.3 My organisation applies learned digital knowledge to solve new problems.	0.906***				
Sharing	DKSH.1 My organisation designs processes to facilitate digital knowledge sharing between the organisation and individuals.	0.865***	0.820	0.893	0.827	0.735
	DKSH.2 My organisation has a reward system for sharing digital knowledge.	0.819***				
	DKSH.3 My organisation facilitates digital knowledge sharing between individuals.	0.887***				

Note: CA = Cronbach's alpha; CR = Composite reliability; rho_A = Dijkstra-Henseler indicator; AVE = Average Variance Extracted;

***p-value<0.001

Source: own elaboration

The first analysis is individual reliability, which studies loadings (λ). According to Hair *et al*. (2014), all loadings above 0.4 are accepted if you have a significant weight on the variable. In the first-order model all items meet this criterion. The second criterion applied is composite reliability, where Cronbach's Alpha is analyzed using the Nunnally and Bernstein (1994) criterion, which sets the cut-off at 0.7. In this study, all the variables meet this criterion. The third analysis is the ratio (rho_A). This criterion is considered the only measure of constant reliability and sets its cut-off at 0.7 (Dijkstra and Henseler, 2015). The third analysis is the average variance extracted (AVE), where all variables must be greater than 0.5. Such analysis indicates that at least the variable must explain 50% of the variance of the underlying construct (Hair *et al*., 2018; Martínez-Navalón *et al*., 2019). In this study, all the variables fulfill this criterion (Table 2). Finally, the discriminant validity study must be carried out to validate the first-order model's scale. In this analysis, the Heterotrait-Monotrait (HTMT) is analyzed. This criterion, which analyses confidence intervals, should not exceed a value of 0.9 (Dijkstra and Henseler, 2015; Hair *et al*., 2019). In this instance, all indicators are below the cut-off index; therefore, the measurement scale proposed in the first-order model is validated.

Table 4: Measurement of the fist-order model (discriminant validity)

Heterotrait-Monotrait Ratio (HTMT)											
	DKAC	DKAP	DKSH	SEC	SSU	SSO	TCO	TIV	TOV	TUN	TIS
DKAC											
DKAP	0.892										
DKSH	0.79	0.7									
SEC	0.605	0.603	0.528								
SSU	0.423	0.491	0.442	0.53							
SSO	0.613	0.618	0.557	0.81	0.529						
TCO	0.078	0.076	0.216	0.171	0.228	0.151					
TIV	0.247	0.176	0.254	0.164	0.147	0.101	0.284				
TOV	0.203	0.106	0.339	0.173	0.217	0.06	0.412	0.748			
TUN	0.571	0.605	0.566	0.582	0.395	0.542	0.334	0.243	0.301		
TIS	0.181	0.093	0.285	0.068	0.17	0.204	0.779	0.419	0.471	0.42	

Note: DKAC = Digital knowledge Management Acquisition; DKAP = Digital Knowledge Management Application; DKSH = Digital Knowledge Management Sharing; SEC = Economic Sustainability; SSU = Environmental sustainability; SSO = Social Sustainability; TCO = Technostress complexity; TIV = Technostress Invasion;TOV = Technostress Overload; TUN = Technostress uncertainty; TIS = Technostress Insecurity.

Source: own elaboration

Once the first-order measurement scale has been validated, the items of the dimensions are grouped. This grouping gives rise to the second-order model. The variables in this model also have a reflective character, so the same analyses that have been carried out in the first-order model are applied (Tables 5 and 6).

Table 5: Measurement constructs of second-order model

Constructs	Dimensions	Correlation Loading	CA	CR	rho_A	AVE
Technostress	(TOV) Overload	0.783***				
	(TIV) Invasion	0.668***				
	(TCO) Complexity	0.70***	0.734	0.79	0.899	0.51
	(TIS) Insecurity	0.722***				
	(TUN) Uncertainty	0.815***				
Sustainability	(SEC) Economic	0.719***				
	(SSO) Social	0.863***	0.76	0.862	0.781	0.678
	(SOM) Environmental	0.863***				
Digital	(DKAC) Acquisition	0.919***	.867	0.919	0.867	0.79

Knowledge Management	(DKAP) Application	0.896***
	(DKSH) Sharing	0.851***

Note: CA = Cronbach's alpha; CR = Composite reliability; rho_A = Dijkstra-Henseler indicator; AVE = Average Variance Extracted; ***p-value<0,001

Source: own elaboration

As seen in tables 5 and 6, all the items and variables comply with the criteria applied. The model's measurement scale is validated, and the relationship between the variables and the model's predictive capacity can be measured.

Table 6: Measurement of the second-order model (discriminant validity)

	Digital Knowledge Management	Sustainability	Technostress
Digital Knowledge Management			
Sustainability	0.775		
Technostress	0.446	0.333	

Source: own elaboration

Tables 5 and 6 show how all the second-order and reflective items meet the different criteria for validation of the measurement scale. To this end, they have passed the same analyses carried out in the first-order model. Individual reliability with loadings (λ) greater than 0.4. Composite reliability was analyzed using Cronbach's Alpha and the Nunnally & Bernstein (1994) criterion with a cut-off of 0.7. The ratio (rho_A) with data greater than 0.7 (Dijkstra and Henseler, 2015). The average extracted variance (AVE) of the constructs exceeds 0.5 (Hair et al., 2018; Martínez-Navalón et al., 2019). The discriminant validity measured with the Heterotrait-Monotrait (HTMT) analysis that sets valid values below 0.9 (Dijkstra and Henseler, 2015; Hair et al., 2019) is also fulfilled. Therefore, the measurement scale proposed in the second-order model is validated.

5.3. Structural Model Analysis

Before carrying out the structural analysis of the model, it is essential to analyze each of the endogenous variables' antecedent variables. This analysis allows us to identify if there are any possible multicollinearity problems. For this purpose, the structural VIFs are analyzed, which must be less than 5 (Hair *et al*., 2014). All the "VIF" indicators have a value of 1, so there is no multicollinearity, and the model can be studied. Next, a bootstrapping of 50,000 samples is performed to provide t-statistics and standard errors (Hair *et al*., 2020).

Table 7 shows the analysis of part of the hypotheses put forward. In this analysis, the first two hypotheses are studied. The hypotheses of the relationship between variables. The H.1a examines the relationship between digital knowledge management and technostress, and H.2a the relationship between digital knowledge management and sustainability. Both hypotheses are validated, with remarkable results showing a strong, direct, and positive relationship. In both hypotheses, there is a high degree of relationship confirming the relationship proposed in the study.

Regarding the variance explained (R2), sustainability has a medium predictive power, while technostress has a slightly lower. The effect size (f2), which shows how the exogenous variable explains the endogenous variable, has a significant effect.

Table 7: Comparison of hypotheses of the relationships in the model

	Path Coeff (ℬ)	Statistics T (ℬ/STDEV)	f^2
H1a. Digital Knowledge Management → Technostress	0.481***	16.063	0.35
H2a. Digital Knowledge Management → Sustainability	0.632***	18.27	0.666

R^2: Sustainability=0.4; Technostress= 0.231 ***p-value<0,001

Source: own elaboration

The relationship studied in "H.1a" has an influence of 0.48 and a high significance, showing that Digital Knowledge Management influences technostress. Similarly, it can be seen how the relationship studied in "H.2a" Digital Knowledge Management with sustainability has a higher value than the previous one, with 0.68 and a high significance.

5.4 Multi-Group Moderating Effect

Finally, a multi-group moderator analysis was conducted regarding H.1b and H.2b. This analysis aimed to find significant differences in the relationships between the gender of the respondents. As such, a prior assessment included the measurement invariance test of the variables using the MICOM analysis (Hair *et al*., 2019; Henseler *et al*., 2016; Rasoolimanesh *et al*., 2017). Table 8 shows that the sample meets a partial measurement invariance.

Table 8. Results of Invariance Measurement Testing Using Permutation (MICOM)

		Compositional Invarience			Equal Mean Assessment			Equal variance assessment			
Constructs	Configural Invariance	C=1	Confidence Interval	Partial Measurement Invariance Established	Differences	Confidence Interval	Equal	Differences	Confidence Interval	Equal	Full Measurement Invariance Established
DKM	SI	1	(0.999/1.000)	SI	0.107	(-0.205/0.185)	SI	-0.276	(-0.274/0.282)	NO	NO
Sustainability	SI	0.997	(0.999/1.000)	SI	0.014	(-0.195/0.180)	SI	-0.131	(-0.315/0.267)	SI	SI
Technostress	SI	0.992	(0.980/1.000)	SI	-0.163	(-0.190/0.176)	SI	-0.153	(-0.251/0.242)	SI	SI

Note: DKM = Digital knowledge Management

Source: own elaboration

Partial invariance is satisfied because three of the four steps are fulfilled. Step one satisfies configurational invariance since the two models are the same. Step two is fully satisfied since there is no difference between the weights of group 1 and group 2, and both are significant. Step three includes two parts: In step 3a, all variables' equality of variances is met. However, in step 3b, the equality of means was not met since Digital Knowledge Management does not satisfy it. Thus, being a partial invariance.

Once partial measurement invariance has been achieved, we proceed to perform the multi-group moderator analysis by means of "permutations". This analysis is the most current and strict for analyzing possible significant differences between the samples studied (Gelashvili *et al*., 2021).

Table 9. Multigroup hypothesis testing of moderation between male and female

Relationship	Path Coefficient Male	Female	Differennce	Confidence Interval (2,5% ; 97,5%)	P-value	Supported
H.1b. DKM → Sustainability	0.585	0,686	-0.001	(-0.135 ; 0.138)	0.136	NO
H.2b. DKM → Technostress	0.482	0.486	-0.005	(-0.122 ; 0,119)	0.28	NO

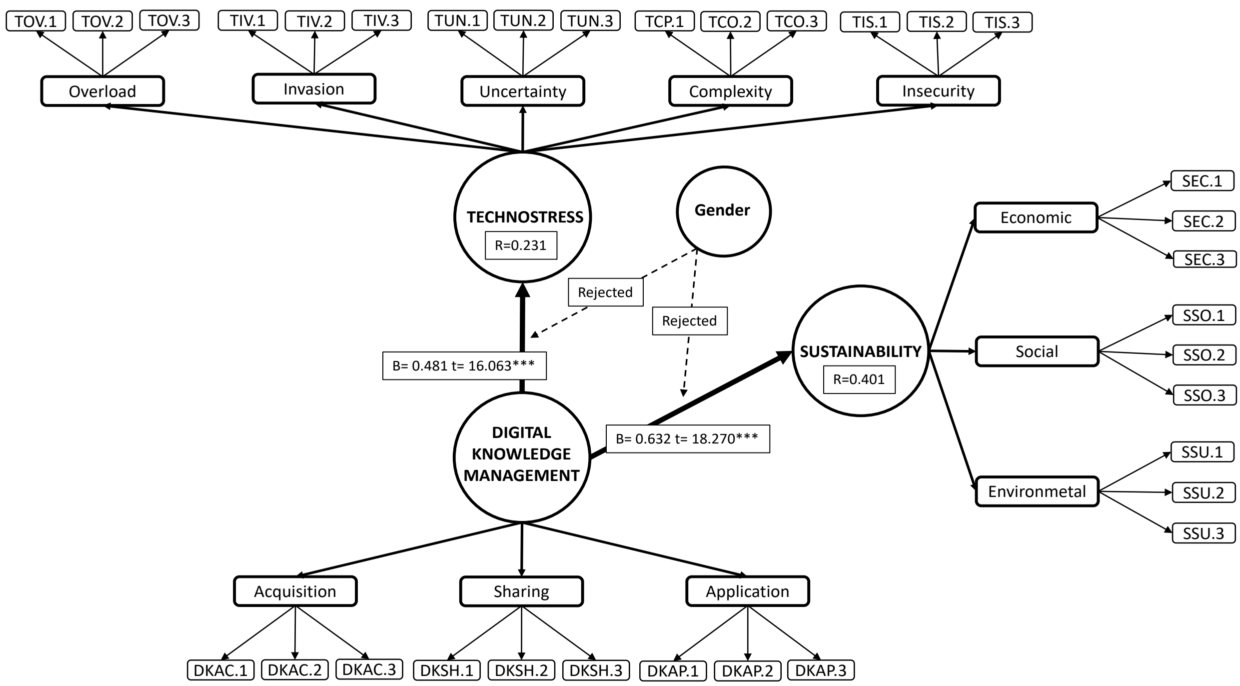
Note: DKM = Digital knowledge Management

Source: own elaboration

Because the Path Coefficient is outside the confidence interval and is not significant, it motivates the rejection of the hypotheses because the difference between men and women in the relationships studied is not significant.

In table 9, where the analyses are visualized, hypotheses H.1b and H.2b are rejected as the permutation analysis shows no significant differences between males and females.

Figure 3. Final Model



Source: own elaboration

As seen in figure 3, hypotheses H.1a. and H.2a. have been accepted. Whereas hypotheses H.2a. and H.2b. have been rejected.

6. Discussion and Conclusions

This research aimed to analyze the impact of digital knowledge management on the technostress of employees and the firm's sustainability. The results have shown a positive and direct relationship between knowledge management and technostress. This finding means that when the level of knowledge management of firms is higher, a higher level of technostress is caused. Such result can be justified as Ha *et al*. (2021) point out that firms must manage more information. This information comes from different sources, making knowledge management more complex. In effect, then, the amount of information can make the stress level caused by the use of technologies increase among workers, as complexity and overload cause technostress.

This investigation also found a direct and positive relationship between digital knowledge management and firms' sustainability. This outcome means that sustainability can increase if the firm has a high level of digital knowledge management. Considering these results, H1.a and H2.a are accepted, and the relationship of the variables has a very high level of significance.

The study results have shown that gender does not have a moderating effect on the relationships reported, as there are no significant differences. On this basis, hypotheses H1.b and H2.b have been rejected. Therefore the sample can be grouped without differentiating by gender. The results of this study are significant at both academic and business levels. The result of these hypotheses runs against what has been found in previous literature (Gabr et al., 2021; Meinzen-Dick et al., 2014; Wang et al., 2020).

However, it is in line with the study of Li and Wang (2021), which revealed that gender did not affect the technostress of university workers.

6.1. Theoretical contribution

This study has the following contributions to the academic literature: (i) The paper contributes to the academic literature, as it is one of the first in the area of management to analyse the relationship between ICTs and knowledge management, which together become digital knowledge management. (ii) The relationship between the variables digital knowledge management and technostress indicates that the more complex knowledge management is, the more workers' stress caused by the use of ICTs increases. (iii) The use of digital knowledge management contributes to environmental sustainability, in particular the possibility of accessing more information will generate more awareness of the actions taken by the company. In addition, the use of digital knowledge management is more environmentally friendly than traditional knowledge management.

Therefore, this study has a significant contribution and several theoretical implications, since this model has not been previously validated nor applied in the academic literature. Therefore, this study contributes to the extant literature by offering a study on the impact of digital knowledge management on technostress, a variable widely studied in recent years but not from the knowledge management perspective.

6.2. Managerial implications

The practical implications of this study highlight the digital knowledge management role, stressing that technostress is a critical aspect of business management. Since there are increasing digital resources every day, ICTs are continuously improving, and this makes digital knowledge management more complex, causing technostress, and affecting sustainable business objectives (Ferraris, et al., 2018). These objectives are considered essential to business strategy, growth and performance. Therefore, managing complex and high-volume digital resources requires supervision to avoid future business problems. That is why business management should consider the following reflections: (i) Good digital knowledge management is key to controlling the technostress of the employees. In addition, firms must have good digital knowledge management because the technostress of the employees harms the firm, and (ii) Good digital knowledge management in the firm strongly influences social, economic, and environmental sustainability. Therefore, following the United Nations' recommendations (Cernev and Fenner, 2020), firms can improve sustainable development by investing in digital knowledge management. (iii) It would be desirable for organizations to implement knowledge management systems in a non-disruptive way. Workers should receive small pills that do not involve major changes in their habits to avoid creating technostress. (iv) Organizations should invest in management software and apps that facilitate adaptations to new ICTs. (v) The use of new ICT systems for digital knowledge management will avoid the use of written documents helping sustainability to some extent.

6.3. Limitations and future research directions

This work is not free of limitations. Firstly, the sample size since the respondents are from inland communities in Spain, results of the study cannot be generalized. In addition, a comparative multicultural investigation could contrast the results obtained. Secondly, another limitation of the study is that due to the novelty of the subject, the theoretical framework on which the present study is based is exploratory; no previous studies analyse the three variables studied together. We must also consider the limitation of the convenience sample, which means that results cannot generalize to the whole of Spain. Therefore, future lines of research should focus on eliminating these limitations, using different research methodologies to give more robustness to the models proposed.

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