This is a previous version of the article published in International Journal of Information Management. 2024, 75: 102746. https://doi.org/10.1016/j.ijinfomgt.2023.102746

TOWARDS ORGANISATION 4.0. AN EMPIRICAL STUDY

Authors: Reyes Gonzalez; Jose Gasco & Juan Llopis.
University of Alicante. Spain

Abstract:
The Digital Transformation of firms is in an incipient stage despite being essential for competitiveness. Hence, the objective of the present study is to analyse which factors are important in the realisation of an Organisation 4.0. To this end we revise the literature to analyse the concept of Industry 4.0, identifying which technologies are necessary for this fourth industrial revolution, and the process of becoming an Organisation 4.0. A model is then proposed with the antecedent variables required for an Organisation 4.0, which include the roles of innovation, business intelligence and digital employees. The model is tested through a sample of 198 firms using the structural equations technique. Although technologies 4.0 have usually been considered as facilitators of innovation, the present study finds the opposite relationship, i.e. that innovation is a necessary antecedence for Organisation 4.0. It is also found that this stimulus is reinforced by Business Intelligence systems and that innovation strengthens the presence of digital employees. However, we have not been able to show how these digital employees contribute to the formation of an Organisation 4.0. More research is needed on the employee knowledge, skills and capabilities required for the implementation of an Organisation 4.0.

Keywords: Organisation 4.0, Innovation, Business Intelligence, Employees, Digitalisation, Empowerment.

1. INTRODUCTION

Digital transformation is everywhere. It is completely redefining organisations all over the world. Every company, irrespective of sector or size (Spanaki, Karafili & Despoudi, 2021), is being inspired to transform its business model to stay competitive (Fernandez-Vidal et al., 2022). Evidence of this is the budget of the *Europa Digital* program, which is around 7.5 billion euros (European Commission, 2021). The objective of this EU budget for the period 2021-2027 is to support the Digital Transformation of European economies and societies. It is designed to develop and financially aid the EU-27 countries in key areas: supercomputing, artificial intelligence, cybersecurity, advanced digital skills and the use of digital technologies in the economy in general (Brodny & Tutak, 2022). Information and Communication Technologies (ICTs) have become a catalyst for social and economic growth, not only in the EU but also at the international level. These technologies are part of practically all aspects of the professional and personal lives of a large portion of the world's population and their correct use is part of the required basic skills in the 21th century (Tulowitzki, Gerick & Eickelmann, 2022). This has clear implications for firms, which have to compete at the global level, and for political leaders, who should view ICTs as crucial tools to reach their regional, national and international development objectives (Gomes & Lopes, 2022).
Digital Transformation is reinventing business through the creation of new and diverse income sources. Firms have made new commercial models and adapted existing models to add value in the digital era. The aim is to become client-centred firms, exploiting the tremendous opportunities offered by digital capacities and innovating through Digital

Transformation (El Hilali, El Manouar, & Idrissi, 2020). Digital Transformation appears to be shaking up the economy and is a strategic priority for the senior management of firms. However, it is still undervalued, despite its organisational, cultural and management dimensions. As with all technological revolutions, Digital Transformation forces firms to question their economic model, organisation, processes, competencies and management (Ramdani & Boudinar, 2021).

Digital technologies are transforming industry, products, processes and operations. The nature of the workplace is changing in organisations that are working with new technologies such as the Internet of Things. The interfaces that connect people and manage work have also been changing. Working at any time or place (e.g., through teleworking) implies that the labour force is more interconnected through computers, cell phones and tablets, as opposed to face to face (Brahma, Tripathi & Sahay, 2020).

ICTs appeared in the second half of the 20th century. So why are we still talking about digitalisation and the Digital Transformation? Firstly, because more and more firms are investing heavily in new digital technologies, experimenting with new possibilities and changing their businesses. Secondly, digitalisation impregnates day-to-day life, both private and professional: people learn through social media, interact with intelligent machines in the workplace, send and receive data through tablets or smartphones and use integrated, shared and updated real time transport systems. Digitalisation is the central motor of the fourth Industrial Revolution (Brunetti et al., 2020).

Firms can base their application of Industry 4.0 on merely industrial technologies and operations, but they can also base their competitiveness on the supply of intelligent services to support and better link with their customers, and to capture information that allows better monetisation of the value of these services (Kamp & Gamboa, 2021). In summary, Industry 4.0 or more accurately, Organisation 4.0, does not only pertain to industrial firms but to all firms, including service firms. Apart from the technical aspects, becoming an Organisation 4.0 can be an interesting opportunity for a large scale firm reorganisation process, making processes, final products and/or services truly intelligent (Wilkesmann & Wilkesmann, 2018). However, following some authors (Pessot et al., 2021, Veile et al., 2020, Santos et al., 2023), Organisation 4.0 is currently at a very early stage in its implementation and can be considered more of a vision than a reality (Rodríguez-Espíndola et al., 2022).

Given that we recognise that the Digital Transformation of firms is in an incipient stage and that it is key to competitiveness, the objective of the present study is to analyse which factors are important to attain the status of an Organisation 4.0. To this end we will review the literature and propose a model that will be tested on a sample of 198 firms, through the structural equations technique.

The rest of the paper is structured as follows: following the introduction, Section 2 presents a review of the literature and develops the hypotheses based on the theoretical background. Section 3 explains the methodology used for the empirical study. Section 4 presents the results of the study, which lead to the discussion and the theoretical and practical implications in Section 5. This section also covers the limitations of the study and future lines of research. Finally the conclusion is presented in Section 6.

2. LITERATURE REVIEW AND HYPOTHESES

2.1. Organisation 4.0

Since the beginning of industrialisation, technological advances have led to paradigm shifts and have had a strong impact on the functional aspects of work at the level of the individual; in retrospect, these shifts can be defined as industrial revolutions. In the 19th century the first Industrial Revolution entailed a transition from manual to mechanised production thanks to developments such as the steam engine. In the second Industrial Revolution, around 1870, electricity increased production through mass production lines. The third Industrial Revolution, at the end of the 1970s, came about through the use of computers by firms, which resulted in more automated production; computers control the machines and are used in all of the firm's administrative processes. In the 4.0 era, the fourth Industrial Revolution, digital technology improves the efficiency and flexibility of production systems through the digitalisation of processes, leading to the concept of intelligent manufacturing (Xu et al., 2021).

However, the terms fifth Industrial Revolution and Industry 5.0 have already been coined. Industry 5.0 recognises the power of industry to achieve social objectives beyond employment and growth, allowing firms to be a focus of prosperity and production while respecting the limitations of our planet through an orientation towards sustainability and placing the wellbeing of workers and society at the centre of the productive process (Maddikunta et al., 2022; Rajput & Singh; 2019). The vision of Industry 5.0 is focussed on people, on how to create systems that are resilient, sustainable and that have people as their main objective (Grosse et al., 2023). This implies that industry is at the service of the wealth of society and that social and environmental considerations should not be left to one side when making business decisions. Moreover, innovation processes should not be limited to the industrial arena but should consider the whole of society, which means that any citizen can play an important role in the processes of innovation and change (Carayannis, & Morawska-Jancelewicz, 2022).

Given that the fourth and fifth Industrial Revolutions currently exist side by side (Xu et al., 2021), this study will restrict itself to the paradigm of the fourth Industrial Revolution and Industry 4.0.

The term Industry 4.0 refers to a vision of a fourth Industrial Revolution (Govender & Adegbite, 2022; Narwane et al., 2021). The aim of this revolution is to produce radical changes in business; not only in manufacturing but also in the service sector, by combining the power of big data, cloud computing and artificial intelligence (Brahma, Tripathi & Sahay, 2020).

The Industrial Revolution 4.0, which is defined by the extensive use of different technologies in all fields, especially the Internet, requires that users have access to data and information wherever they are. Industry 4.0 is a process that generates technological transformations in the design, production and distribution of systems and manufactured products, orientated towards automated and interconnected industrial production. Industry 4.0 can be defined as a technological revolution that redefines the manufacturing industry through the implementation of technologies that can improve the value of supply chain management and its related processes (Tavera Romero et al., 2021; Rodríguez-Espíndola et al., 2022).

In reality, this new revolution and Industry 4.0 are no more than an extension of ICTs (Memon & Ooi, 2021). The concept of Industry 4.0 appeared for the first time in the Hannover Trade Fair of 2011 (Brodny & Tutak, 2022). In 2013 the German government used the term to revolutionise manufacturing processes through digitalisation and automation (Gupta, Singh & Gupta, S., 2021). Industry 4.0 entails that machines work independently, that they communicate with each other to perform predetermined tasks and even that they can customise products according to clients' requirements.

These concepts have a significant impact on not only production processes but also on firms' project management, on the operations and future of regions, and are fundamental to the understanding of the consequent phenomena in the social and economic spaces and even in human resources. Therefore, although it affects industrial firms, it also affects services and all kinds of firms. Moreover, Industry 4.0 is not just about efficiency, but also about sustainability and improving the performance of clean renewable energy, leading to adaptable work environments (e.g., promoting teleworking) and improving financial results and innovation (Tavera Romero et al., 2021; Wilkesmann & Wilkesmann, 2018; Ngetich; Nuryakin & Qamari, 2022). This supposes that Industry 4.0 not only implies the automation and integration of the value chain but that it is also focussed on social, economic and environmental improvements (Gupta, Singh & Gupta, 2021; Laukkanen et al., 2022; Varela et al., 2022).

In summary, Industry 4.0 can be defined as the integration in a holistic system of ICTs, people and machines that manages the flow of merchandise, services and data in a controlled manner, through the business value chain, with operations with a high degree of autonomy and a strong ability to transmit information useful for decision making (Saucedo-Martínez et al., 2018).

The final objective of Industry 4.0 is to facilitate integration in three senses: Firstly, *Horizontal integration* throughout the value chain, considering links with clients, suppliers, intermediaries, distributors, manufacturers, retailers, etc. (Rajput, & Singh, 2019). Secondly, *Vertical integration* within the firm, integrating the different phases of the productive system. The main aim is the intelligent factory with its products and processes, correct administration of inventory, maintenance and faults in the machines, among other aspects, supported by cyber-physical production systems (Xu et al., 2021). Finally, *Integral engineering* for the full useful life of the production cycle (specification, design, development, manufacture, installation, maintenance and repair). Systematic analysis is made of the data obtained throughout the production process, which allows for quick decisions, with following of product or service, with a focus on quality and customer satisfaction (Saucedo-Martínez et al., 2018).

To be part of Industry 4.0 the firm needs to have a wide spectrum of ICTs, which allows the hybridisation of the physical and digital worlds. These technologies form what are known as Cyber-Physical Systems, which integrate physical and internet processes with control and monitoring mechanisms (Govender & Adegbite, 2022; Narwane et al., 2021). The most common technologies in the Industry 4.0 framework include, among others: Big Data, Internet of Things (IoT), Robotics, Artificial Intelligence (AI), Cloud Computing, Augmented and Virtual Reality, 3D Printing, Cybersecurity and Blockchain. Big Data is a technology that analyses massive data sets from various sources to improve decision making, often using data that is complex, heterogeneous and poorly structured (Bresciani et al., 2021). As regards IoT, it connects machines with humans, so that the machines can be controlled from a distance. In this way the IoT allows us to monetise and control the physical world remotely, at the same time obtaining information from it, which is important for risk prevention, maintenance and decision making (Brous, Janssen & Herder, 2020; Li et al., 2019).

With regard to AI, it can be especially useful to improve the decision making processes for complex, ill structured problems that lack transparency and have unclear objectives. These systems explicitly incorporate the knowledge and procedural rules of expert humans in IT programs that allow users to make informed decisions and are useful for solving problems in which clear rules are sufficient. AI systems can also include their own learning through their use, creating new knowledge not explicitly included by human experts (Johnson et al., 2022; Malik et al, 2022). Robots, which are derived from the tools of AI, can interact with humans and understand commands that allow them to make decisions. They differ from more conventional IT systems in their behaviour, autonomy, mobility and their anthropomorphism (Sinha et al., 2020). Robots can perform repetitive and even dangerous tasks with great precision and quality independently of the working conditions (e.g., extreme temperatures) (Erdem & Koska, 2023; Wang et al., 2022).

The technology of Cloud Computing entails large scale external data storage, which gives access to and rapid recall of information. Cloud computing provides different IT infrastructures, such as Software as a Service, that allow us to share information with other interested parties, such as customers (Ghouri & Mani, 2019). Augmented and Virtual Reality consist of real life experiences with virtual objects to improve decision making (Maddikunta et al., 2022).

3D Printing technology produces three dimensional objects through layer by layer printing. 3D printing enables production that is more localised, distributed and reconfigurable, and completely changes supply channels (Santos et al., 2017). Finally, no firms are safe from cyber-attacks these days, hence the necessity of Cybersecurity and Blockchain technologies. Attackers may aim to find industrial secrets, financial data, attack industrial property, etc. Successful cybersecurity consists in frustrating or responding to attacks before they can cause damage (Naseer et al., 2021). Cybersecurity and blockchain are technologies that ensure the safe register of digital operations, thus blockchain can be considered as a large decentralised book that stores the digital registers of an operation in various computers at the same time, so that the register is correct for any interested party (Kshetri, 2021).

The process through which a firm reaches maximum exploitation of the above ICTs, so that it fully assumes the fourth Industrial Revolution and becomes an Organisation 4.0, is also known as Digital Transformation. This Digital Transformation has three phases, the most basic is digitisation, the second is digitalisation, and finally there is Digital Transformation itself. The initial phase of digitisation entails transforming physical data (text, imagines, sounds, etc.) into digital data to automate processes and work flows (El Hilali, El Manouar, & Idrissi, 2020). The second phase of digitalisation consists in transforming business processes, modifying and simplifying previously existing procedures, normally through the automation of tasks. Finally, the third phase of Digital Transformation implies that firms simultaneously adopt digitalisation from various dimensions, such as strategies, organisational structures, operations or business culture (Nicolás-Agustín, Jiménez-Jiménez & Maeso-Fernández, 2022), which not only supposes a large investment in technologies, but also in human resource training (Buck, Probst Marques & Rosemann, 2021; Rodríguez-Espíndola et al., 2022). Digital Transformation is a process of continual change, challenges established patterns and generates fundamental organisational changes (Ackermann, Schell & Kopp, 2021). It is a holistic approach that affects a firm in general, encourages innovation and exploits digital opportunities. This is different to the narrower concepts of digitisation and digitalisation (Peter, Kraft, & Lindeque, 2020).

In the present study, a firm that has assumed Digital Transformation, that is immersed in the Fourth Industrial Revolution or that has adopted the technologies of Industry 4.0 (although as mentioned before not necessarily a firm in the industrial sector), is known as an Organisation 4.0.

2.2. Innovation and Organisation 4.0

Although the literature usually analyses the role of technologies 4.0 as facilitators of business innovation (Skare, de Obesso & Ribeiro-Navarrete, 2023), in reality innovation also favours digitalisation and the establishment of the Organisation 4.0 (Lepore et al., 2023). The long term success of a firm does not only depend on the innovation of its products, but also on the realisation of additional innovations in its business model, both within the firm and outside its corporative limits (Schmidtke et al., 2022). Digital technologies are used more and more in production and services, where they are becoming synonymous with modernity and innovation. The innovations related to digitalisation and the implantation of Industry 4.0 are becoming the economic growth motors of many firms, countries and regions throughout the world. Firms that utilise these technologies and related solutions are becoming more competitive and innovative (Brodny & Tutak, 2022).

The implementation and use of modern digital technologies is a big challenge for all firms, especially for SMEs (Small and Medium-Sized Enterprises), as they usually have more limited resources. A good way to overcome this lack of resources is to carry out open innovations. This concept implies exchanging ideas and solutions among different entities, which gives SMEs the possibility of finding and developing their own solutions. This approach gives opportunities to firms with few resources to cooperate with external institutions in order to acquire and implement technological innovations, which include digital innovations. For SMEs that implement Industry 4.0 solutions, the concept of dynamic open innovation is a great opportunity to transform their businesses (Brodny & Tutak, 2022).

Industry 4.0 is a new industrial landscape characterised by the convergence of digital transformations in intelligent socioeconomic systems. The knowledge intensive nature of the value chain reveals an innovation approach driven by technology and opens new horizons for competitiveness in traditional and innovative industries (Garzoni et al., 2020).

Continual investment in emerging digital solutions are not always viable for firms. Lepore et al. (2023) demonstrate that for SMEs, open innovation facilitates the integration of internal and external knowledge and, thus, enables the successful adoption of technologies 4.0, as these firms are normally faced with financial, management and market barriers to the adoption of these technologies compared to larger firms. It is important to foment a change of mentality and develop a capacity for organisational digital innovation, to understand and analyse the potential impact of new ICTs on the firm, and to align the whole organisation with this new strategic vision. Digital innovation is not just about technological innovation. It is more about innovation of knowledge and cultural attitudes. In this sense, organisations are called to embrace continuous Digital Transformation instead of processes of finite management changes. Digital Transformation is different to the concept of change management: it implies adopting new organisational approaches and new or revised business models for a new perceived vision of the future (Schiuma, Schettini & Santarsiero, 2021).

Given that in this study the adoption of Digital Transformation is referred to as becoming an Organisation 4.0 and as we have seen that innovation drives this type of organisation, we propose our first hypothesis.

H1: Innovation has a direct relationship with Organisation 4.0.

2.3. Business Intelligence, Innovation and Organisation 4.0

The amount of data currently generated in and around a firm is huge, no human brain is capable of processing it all, so technology is needed to process and store it in data banks (Iordache & Iacob, 2019). The aim of Business Intelligence is to collect, store and access data on customers, partners, operations and any other information on changes in the environment. This allows the firm to detect changes in the business ecosystem and, therefore, its use will help it to increase its organisational agility by improving its organisational capacities: performance management capacity, customer management capacity and process management capacity (Ekionea, Nsenga, & Fillion, 2021). Firms have traditionally spent around 80% of their time on data collection and 20% on analysing it (Bossaller & Million, 2023). The objective of Business Intelligence is to reverse these percentages and spend 20% on data collection and 80% on analysing it (Ekionea, Nsenga, & Fillion, 2021).

Quality information is imperative for quality decision making. Quality information comes from a rigorous analysis of historical antecedents and the current environment. Learning from the historical context and the current situation gives a real source of knowledge extraction (Tavera Romero et al., 2021). Intelligence is obtained through intangible assets such as the knowledge of employees, management, interested parties and customers. Knowledge and experience go hand-in-hand with the development of intelligence. The difference between information and intelligence resides in the fact that information is factual and that intelligence is information that has been sifted, distilled and analysed (Ngah, Azman & Khalique, 2022).

Business Intelligence systems use certain technologies to integrate historical and current data registration, to synthesis and transform data into information, to generate knowledge and to exploit it in decision making to improve business strength (Ali, Miah & Khan, 2017). Moreover, these systems can substantially improve the market position of the firm. For example, quality information can help to capitalise investments in marketing; advanced analytical capacities can lead to closer links between a firm and its customers; and predictive capacities allow firms to increase sales potentials (Popovič, Puklavec, & Oliveira, 2019).

INSERT TABLE 1

There are multiple definitions of Business Intelligence systems, as can be seen in Table 1. From this table we define Business Intelligence as an Information System that comprises a group of technologies, processes, methods and practices which capture internal and external data of the firm, using big data, to help management decision making, through information accessed rapidly, efficiently and intuitively, especially information on factors crucial to business success.

Some examples of Business Intelligence technologies are Enterprise Resource Systems (ERP), Online Analytical Processing (OLAP), Cloud Computing and the Internet of Things. The combination of robotics, sensors and connected machines generates huge amounts of structured and unstructured data that can be captured. We call this Big Data Analytics and it refers to the use of big data for Business Intelligence (Ekionea, Nsenga, & Fillion, 2021; Korsen & Ingvaldsen, 2021).

Business Intelligence has a positive and critical influence on innovation (Yang et al., 2022). However, the inverse relationship can be found, i.e., that innovation has a direct influence on Business Intelligence. This hypothesis makes sense as innovation in terms of the use of technologies and tools, and even the underlying philosophy of Business Intelligence, is not fully extended among firms, meaning that it is still an organisational innovation (Salisu, Sappri & Omar, 2021). From this we can propose Hypothesis 2, which establishes a positive relationship between innovation and the implementation of Business Intelligence systems.

H2: Innovation has a direct relationship with Business Intelligence.

In recent years, most global IT investment has been directed towards the development of Business Intelligence systems (Chen & Lin, 2021). Business Intelligence systems support a wide range of internal operations; aspects such as planning, manufacturing and quality control. Specifically, the literature emphasises four improvements that the use of these systems gives to operations management: 1) The information provided by Business Intelligence gives more complete and precise perspectives. 2) The availability of equipment for manufacturing and logistics processes has also improved as a result of the exploitation of Business Intelligence. 3) There are benefits from the use of Business Intelligence in terms of reduced manufacturing waste, which helps firms move towards lean manufacturing. 4) The use of Business Intelligence improves the identification of defective products, which reduces returns (Popovič, Puklavec, & Oliveira, 2019). Moreover, according to Chen & Lin (2021), Business Intelligence systems have a twofold transforming capacity: updating and reengineering. Updating allows these systems to continually create new knowledge for the development of new products or to improve operational processes; reengineering entails learning, using and creating new capabilities to restructure processes and businesses. This transformation process, also highlighted by Chaubey & Sahoo (2021) points, above all, to digital transformation. All of these points show us that Business Intelligence helps in the implementation of an Organisation 4.0.
Moreover, according to Choi et al. (2022), Industry 4.0 is reached not only through automation, but also through the broad application of Business Intelligence and its correct incorporation into production and management systems. Most people recognise the concept of Industry 4.0 as a great opportunity to develop and improve competitiveness, the advance of the technologies of Business Intelligence can contribute to the development of hyper-automation and hyper-connectivity, leading to the beginnings of Industry 4.0, its evolution and performance improvements in other technologies (Tavera Romero et al., 2021).
From all the above we can formulate Hypothesis 3, which proposes a positive relationship between the systems of Business Intelligence and Organisation 4.0.

H3: Business Intelligence has a direct relationship with Organisation 4.0.

2.4. Organisation 4.0, Innovation and Digital Employees

The fourth Industrial Revolution and the dawn of Organisation 4.0 are undoubtedly related to employees, who we will refer to as Digital Employees. From a positive perspective, Organisation 4.0 provides the opportunity to create a new and better workplace, where workers and their needs are the most important considerations. Knowledge workers can program, organise and produce work environments with wide margins, which results in more autonomy and competencies through the use of the applications developed. Moreover, workers are freed from boring tasks. The new ICTs introduced in Organisation 4.0 not only improve access to information, but also creativity and innovation, which improves decision making and provides balance between family and work life, for example, through teleworking (Malik et al., 2022; Piątkowski, 2020; Wilkesmann & Wilkesmann, 2018).
A negative perspective, on the other hand, sees disadvantages for workers, for example, technology could rule over people, there could be a loss of workers or a change in the role of workers; information security problems, lack of privacy, vigilance and excessive

control over workers; more stress and overworking from the need to manage the changes (Brahma, Tripathi & Sahay, 2020; Memon & Ooi, 2021). It is clear that workers that perform tasks and use technology related skills will be the beneficiaries of digitalisation, while those whose activities can be replaced by technology will be the losers in this fourth Industrial Revolution (Egana-del Sol et al., 2022).

The digital competencies needed by Digital Employees in an Organisation 4.0 have a technical side, which includes experience in programming, analysis of Big Data, robotics and maintenance of intelligent systems. Technicians also need skills, knowledge and understanding of manufacturing processes, combined with skills orientated towards creative problem solving (Nicolás-Agustín, Jiménez-Jiménez and Maeso-Fernández, 2022; Piątkowski, 2020). They also need soft skills: social skills based on communication and cooperation with other workers; permanent learning and learning to learn in a world where knowledge and technologies have shorter useful lives; leadership skills on new projects, adapting to change and proactivity; analytic, critical, creative and innovative thinking as well as performance capacity (Ackermann, Schell & Kopp, 2021; Balakrishnan & Das, 2020; Brahma, Tripathi & Sahay, 2020; Govender & Adegbite, 2022).

Chief among the soft skills needed for the Digital Transformation towards Organisation 4.0 is empowerment. In other words, Digital Employees need the capacity to solve problems and actively participate in decision making (Cichosz, Wallenburg & Knemeyer, 2020; Ivaldi, Scaratti & Fregnan, 2021). Never was there greater need to improve workers' digital competencies than during the lockdowns imposed by Covid-19. Individuals were in a completely different environment, working, carrying out their day-to-day activities and learning mainly remotely. Everyone who could work remotely, even to the point of being their own bosses, should be prepared for independent working, planning their working hours, making optimum decisions, continually acquiring new knowledge and taking on new problems (Bikse et al., 2021) in other words, they should be empowered for autonomy and self-responsibility.

Both the acquisition of digital competencies and empowerment, which we have assumed as key requisites of Digital Employees, are related to innovation. First, digital innovations often arise from base initiatives, which allow creativity, trial and error. It is not the technologies of the Fourth Industrial Revolution that are at the epicentre of change but human resources and employees with digital competences (Carlsson, Olsson and Eriksson, 2022). Second, one of the main concepts behind innovative organisations is employee empowerment, who in turn acquire a sense of the importance of their work in the firm. This leads to changes in working relationships; the more independent workers are, the more creative they are in general. The manager of a self-managing team of this type assumes the role of coach and mentor of the employees, inspiring and motivating the team and helping them achieve their aims (Borowiecki et al., 2021). From this we deduce a direct relationship between the two key aspects of Digital Employees (digital competencies and empowerment) and firm innovation, leading to Hypothesis 4.

H4: Innovation has a direct relationship with Digital Employees.

Employees play a key role by adapting their skills to allow firms to adopt Organisation 4.0 (Lepore et al., 2023), in fact achieving technological advances in the organisation is impossible without the support of workers (Gupta et al., 2020). It seems that Organisation 4.0 will need all the talent of its workers rather than moving towards workerless production processes. This talent is the base on which to adapt to new technologies (Kannan & Garad, 2020). However, although the Digital Transformation of products, services and processes requires employees with digital competencies, many firms do not have them. Some reports indicate that up to 54% of organisations admit that their lack of digital competencies impedes their Digital Transformation (Gilch & Sieweke, 2021). Therefore, there is a need for an appropriate and flexible educational system that allows the development of digital competencies and new skills (Bikse et al., 2021).

Schiuma, Schettini & Santarsiero (2021) propose as a basic factor of Digital Transformation that leaders are capable of empowering their workers, demonstrating trust in their employees, encouraging them to show their talent, propose ideas, take initiatives and solve problems. For example, in the case of Business Intelligence systems, Chaubey & Sahoo (2021) conclude that for them to have a full effect on the firm, workers have to be empowered and able to make data-guided decisions without waiting for orders from their managers. The reason is that perceived trust often stimulates people to perform above expectations. In recent years, as digitalisation has advanced rapidly, the limitations of traditional management are more and more exposed, and the discussion around greater self-management of organisations has resulted in employee empowerment (Ackermann, Schell & Kopp, 2021). Empowerment means that employees are involved with and committed to their organisation. Therefore, one of the biggest challenges for modern management is to create an environment in which information is shared and employees feel involved and empowered (Korsen, & Ingvaldsen, 2021). An important empowerment tactic is to involve employees in continuous improvement by creating an environment of continuous learning that allows employees access to relevant resources, information and knowledge to perform and improve their tasks. It is a form of responsible autonomy through which employees assume an active part in defining their roles, rules and procedures by controlling their own work. It does not mean a complete absence of management, but that the manager facilitates the self-management of problems (Korsen, & Ingvaldsen, 2021).

Given that, according to what we have seen, it is Digital Employees that have digital competencies and empowerment, and given that these features are basic for Organisation 4.0, we propose Hypothesis 5.

H5: Digital Employees have a direct relationship with Organisation 4.0.

Figure 1 represents the model proposed to test our study through the 5 hypotheses.

INSERT FIGURE 1

3. METHODOLOGY

3.1. Instrument development

A survey was used to obtain the primary data to test the proposed model. The survey forms part of a larger study carried out by a consulting and training firm (CEGOS) with which the present study's authors collaborated to find the state of firms in terms of the new environmental realities, among others the new digital realities. Although the study is larger, the items used in the present study can be seen in Table 2.

To prepare the part of the survey included in this study a panel of professional and academic experts in digital transformation was consulted. The professionals were four company directors from various sectors who have been directly involved in the digital transformation processes of their firms. The academics were three university professors with research experience in the areas of Business Management and IT Systems. The authors of the present study proposed a series of measurements for the main variables based on the literature review. From this proposal the panel of experts had a two hour in person debate on the constructs and items. Previous studies recommend a combination of professional (Skarlicki & Folger, 1997) and academic experts (Sireci, 1998) for the preliminary phases of empirical research to ensure content validity (Bobko, Roth & Buster, 2007; Qureshi et al., 2023). Finally, the proposal used to formulate the survey can be seen in Table 2, which shows the constructs, the items and the main references they are based on.

INSERT TABLE 2

3.2. Sample design and data collection

The survey was carried out between the months of March and May of 2022 in the Spanish Autonomous Communities of Valencia and Murcia. This area is characterised by the dynamism of its firms, with its 2019 GDP being 11.84% of the Spanish GDP[1]. The survey respondents were firm general managers. Emails with a link to the online survey were sent to 1000 firm managers that were contacts of CEGOS and/or the panel of experts that helped with the survey design. Various reminders were sent to non-respondents by email and telephone. 220 completed surveys were obtained, of which 198 were considered usable, a response rate of 19.8%. The sample error is 6.2% for a confidence interval of 95% and the assumption that p=q. The firms that answered are representative of the business fabric of the region, characterised by sectorial diversity and a predominance of SMEs. Specifically, 33.84% are industrial firms, 28.79% service providers and 9.09% firms from the ICT sector, with the remaining 28.28% being non-profit making foundations, construction or energy firms, among others. In terms of size, 30.81% are large firms, 27.27% medium and 41.92% small[2].

3.3. Non-response bias

A cross-sectional study can imply non-response bias (Behl, 2022; Zheng et al., 2021). To examine this potential problem, first a student's t-test was used to analyse the average difference between the first 20 and the last 20 responders and they was no significant average difference. Second, following the recommendations of Wagner & Kemmerling (2010), responder firms were compared to non-responders according to their sectorial and size characteristics, and no inconsistences were observed, meaning that through the two methods used it can be confirmed that non-response bias is not a problem in this study.

3.4. Data analysis technique

The hypotheses have been tested through a Structural Equations Model (SEM), using the Partial Least Squares (PLS) technique. This technique is useful when making a one-step analysis of a model that relates a latent variable with its observable variables, with the

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[1]We use 2019 as a reference year as it was the last full calendar year before Covid-19, to give an idea of the economic importance of the Communities of Valencia and Murcia compared to the rest of Spain. GDP in 2019 in Spain 1,244,375,000 €, in the Valencia Community 115,407,021 € and in the Murcia Community 32,287,218 €.

[2]To find firm size we use the number of employees: under 50 employees for small firms, between 50 and 250 for medium firms, and over 250 for large firms (OECD, 2023).

structural model, which relates the latent variables with each other. Moreover, the PLS technique has the advantage of not needing uniformity in the measurement scales (Sosik, Kahai and Piovoso, 2009). The PLS-SEM technique is suitable for studies with relatively small samples and exploratory research methods (Hair et al., 2014; Kineber et al., 2023). Structural equation models have been repeatedly used in research in the area of management and, specifically, in studies on IT systems and management of technologies (e.g. Ahmad Amouei, Valmohammadi & Fathi, 2023; Gonzalez, Gasco & Llopis, 2015; Gupta et al., 2020; Jia et al., 2022; Sinha et al., 2020; Wang et al., 2022). In this study we use the SmartPLS 3.0 program to carry out the SEM analysis.

4. RESULTS

4.1. Goodness of fit

First we test the goodness of fit. The model has a good fit, as can be seen in Table 3. To find this result we used various goodness of fit measures proposed by Henseler (2018) and available in the PLS software (Henseler, Hubona & Ray, 2016), which were obtained after employing the bootstrap technique[3].
The evaluation of the SRMR index gives a satisfactory value of 0.049, which is below the 0.08 proposed by Hu & Bentler (1998) as a measure of goodness of fit. We also observed that the SRMR indices, $\mathbf{d_{ULS}}$ (Unweighted Least squares discrepancy) and $\mathbf{d_G}$ (Geodesic discrepancy) are below the bootstrap based on 5000 replacements, at 95% (below Hi95 and Hi99). This means that the discrepancy between the empirical matrix and the model correlation matrix is not significant, indicating a good goodness of fit index. Therefore, the data do not contain more information than the model (Henseler, Hubona & Ray, 2016).

INSERT TABLE 3

4.2. Measurement Model

In our model all the compounds are measured in B mode (formative mode), meaning that we then analyse any potential multicollinearity and the size of the weights and factorial loads (Table 4).
Multicollinearity is analysed through the Variance Inflation Factor (VIF) following Diamantopoulos, Reynolds & Simintras (2006). If the VIF is below 3.3 there is no multicollinearity (Petter, Straub & Rai, 2007).
In our study there is only one construct above 3.3, although only very slightly. We have not eliminated it from the model as all the other indicators have a VIF below 3.3, with some below 3. We also observe that all the factorial loads are quite high, above 0.5 (Hair et al., 2014) and as shown by their P values, they are significant. The majority of the indicator weights are also significant.
When we analyse the indicators with the largest weights in the case of Innovation we find Inno4 (innovation in technologies) followed by Innov2 (innovation in processes).
In the case of Business Intelligence, the largest indicator is InteNego1 (mechanisms to exploit intelligence information).

[3]We carried out a complete bootstrapping analysis and the percentile method for two tails.

For Digital Employees, the largest indicator is EmpDig1 (degree of development of digital competences).
For Organisation 4.0, the largest indicators are Org4.0 1 (automation of production), followed by Org4.0 3 (installation and use of the cloud for data storage).
The factorial loads should be above 0.5 and there are two below this figure (org4.0 6 and org4.0 7), which also have low factorial weights. However, we find that all the factorial loads are significant (from the bootstrap analysis). Moreover, a large part of the factorial weights are significant [4]. We should add that even if an item contributes little to the variance of a formative construct it should be included in the measurement model (Roberts & Thatcher, 2009) because removing a formative indicator implies eliminating part of the information of the construct. We can, therefore, validate the measurement model.

INSERT TABLE 4

4.3. Analysis of the Structural Model

To analyse the structural model (Table 5), we first checked for multicollinearity between the antecedent variables using a VIF analysis. In our case we find a value below 3.3 (Petter, Straub & Rai, 2007) for the three antecedent variables, meaning that there is no multicollinearity.
We used the Bootstrapping technique, with 5000 replacements [5] to calculate the t statistic, which measures the significance of the coefficients of model B (coefficients' path). We found that 4 of the 5 hypotheses are confirmed.
We also calculated the variance explained by antecedent variables with regard to the dependent variable, and we found that Innovation has the strongest influence on Orgon4.0, much more than Business Intelligence. Given that Digital Employees has no significant relationship with Organisation 4.0 (the only unconfirmed hypothesis) we can discount any contribution to its variance. We used the Cohen F^2 statistic (1988) to find the size of the effect, in other words, the degree to which an exogenous construct contributes to the explanation of an endogen. We found that the F^2 of the Innovation-Organisation 4.0 hypothesis was the largest (above 0.35). The effect of Business Intelligence on Organisation 4.0 is small (below 0.15) and for Digital Employees there is no effect as this hypothesis is not confirmed.

INSERT TABLE 5

The results of the structural analysis confirm 4 of the 5 hypotheses of the model. Innovation produces 3 positive effects, insofar as it foments the implementation of Business Intelligence systems, leads firms to have digital employees and is an antecedent to the Organisation 4.0. Moreover, the fact that a firm uses a Business Intelligence system

[4]To calculate the significance of the factorial weights and loads (last two columns of the table) we carried out a bootstrapping analysis with 5000 replacements, 2 tails, basic percentile method.

[5] Basic method with one tail.

plays a very important role in the establishment of an Organisation 4.0. However, the role of digital employees in the formation of the Organisation 4.0 has not been confirmed

4.4. Predictive Capacity of the Model

The predictive capacity of the model (Table 6) refers to its ability to predict future observations. To calculate it we used the PLS predict algorithm (Shmueli et al., 2019).
We found that the model has a good predictive capacity as all the Q2 are above zero. We also made a linear regression model (LM) that regresses all the exogenous indicators to predict each endogenous indicator.
Errors were calculated for both the PLS model (theoretically sustainable), and the LM model. The results for the PLS model should show lower prediction errors than the LM model. Therefore, the PLS-LM errors should be negative.
The prediction errors calculated are Root Mean Squared Error (RMSE), which we use when there is symmetry in the errors, and Mean Absolute Error (MAE), which we use when there is asymmetry. In our study only the indicators Orgon4.0 5, 6 and 7 present asymmetry.
Following the protocol of Shmueli et al. (2019) we can say that the model presented has a medium-high predictive value in total. For the constructs Business Intelligence and Digital Employees, the predictive values are high, and for the endogenous construct Orgon4.0 it is medium-high, as of the seven available indicators, six of them (86%) have smaller errors in the PLS model than in the LM model, the exception being Orgon4.0 7. The model has predictive capacity despite there being one unconfirmed hypothesis.

INSERT TABLE 6

5. DISCUSSION

Our model proposes analysing the antecedents of an organisation's digital transformation to become an Organisation 4.0. We have shown that innovation is a key factor of an Organisation 4.0, with innovation being broadly defined to include technological, process, organisational, management and business model innovations. In this sense, our study agrees with the conclusions of Lepore et al. (2023) and inverts the theses of other studies that analyse the inverse relationship that technologies 4.0 lead to innovation (Skare, de Obesso & Ribeiro-Navarrete, 2023; Kin & Ha, 2023).
Moreover, the effect of innovation is reinforced by the role of both Business Intelligence systems and digital employees. The most innovative firms are those that establish Business Intelligence systems; this hypothesis has not been tested in previous studies (the inverse relationship has been analysed) (Yang et al., 2022), therefore, this is a contribution made by our study. Business Intelligence systems also help to implement an Organisation 4.0, as shown in earlier studies (Choi et al., 2022), as they have a twofold transformation capacity in that they can continually create new knowledge to improve products and processes while transforming processes and business through learning and the acquirement of new capabilities (Chen & Lin; 2021; Chaubey & Sahoo, 2021; Ratia, Myllärniemi & Helander, 2019). Business Intelligence systems have a demonstrated ability to transform firms, as affirmed by Chen & Lin (2021), these systems facilitate the adoption of new organisational structures, moderate and redistribute resources, generate knowledge to develop new strategies, improve both strategic analysis and the

implementation of new strategies. This study has shown that this transformation process can be digital transformation.

Employees also play a vital role in an Organisation 4.0. (Ackermann, Schell & Kopp, 2021; Carlsson, Olsson and Ericksson, 2022; Skare, de Obesso & Ribeiro-Navarrete, 2023). One of the main problems faced by firms today is the lack of sufficiently trained employees, in this study referred to as digital employees. Digital transformation increases the complexity and degree of abstraction of problems to be resolved by firms, making digital capacities necessary for digital transformation. Accordingly, we have shown that the most innovative firms have employees with the characteristics of Digital Employees, which in our case are based on two aspects, possession of digital capacities and being empowered. The studies of Gelaidan, Houtgraaf & Al-kwifi (2022) and Al-Sabi et al. (2023) analyse the direct relationship through which employee empowerment leads to innovation, we have analysed and shown the inverse relationship. Similarly, Wang et al. (2023) found that digital capacities lead to innovation, while we have analysed the inverse relationship. Therefore, the finding of a direct relationship between firm innovation and the existence of digital employees is another contribution of this study.

Finally, despite the previous studies that have found the importance of digital employees to digital transformation (Aranda Jiménez et al., 2023; Jani, Muduli & Kishore, 2023; Lang et al., 2023; Murphy, 2023), we have not been able to show that digital employees are vital to an Organisation 4.0, this is undoubtedly a limitation of this study that will be commented on later.

Digital Transformation is nothing new. Since the end of the 1950s, digital technologies have been used all over the world to facilitate strategies and operative changes in different sectors. However, although there has been over half a century of research and practice in this field, these initiatives are notoriously difficult to implement (Li, 2020).

Recent advances such as big data, artificial intelligence and cloud computing, among other technologies, legitimise fashionable phrases like digitalisation and Digital Transformation, hailing the birth of a new era in ICTs. Digital Transformation is everywhere, all firms in all sectors are affected by it. Information, knowledge and processing capacity are now permanent and ubiquitous; and the growing connections between people, objects, devices and systems are changing the conditions under which individuals, firms and societies live and operate (Brunetti et al., 2020).

Firms adopt digital technologies with little preparation from the organisational point of view, as they see Digital Transformation as only advanced digitalisation rather than a continuous process of change, adaptation and improvement. Alternatively, it is a process of organisational change in which the firm, at all levels, develops new ways of using technologies to innovate products, services and business processes (Savastano, Cucari, Dentale, & Ginsberg, 2021). This study defines an Organisation 4.0 as one which has carried out Digital Transformation.

The accelerated rhythm of change provoked by digitalisation tends to overload the conventional management hierarchy (Ackermann, Schell & Kopp, 2021). The challenges around adopting these new era 4.0 technologies are innumerable, due to lack of qualified labour with sufficient technical knowledge, financial limitations, lack of information management strategy, limited comprehension of investment returns, resistance to the adoption and adaptation of existing business models and practices to these technologies and the lack of strategy and alignment in relation to business priorities and the technological needs of the organisation (Rodríguez-Espíndola et al., 2022). Managers should take on these challenges if they want to be up to date and not miss the boat of the innovative Organisation 4.0. Moreover, not having a digitalised product or service does not necessarily stop a firm from having digitalised processes, with the same applying to

not having automated forms of data collection and making correlations between them, i.e., Business Intelligence, in order to obtain valuable information and knowledge for the firm (De Lucas Ancillo et al., 2022) and for its Digital Transformation.
The sociotechnical focus of Industry 4.0 has made fashionable the idea that organisations should seek the best, rather than the cheapest. This implies that intelligent factories and the Organisation 4.0 are configured as highly complex, dynamic and flexible systems and that employees are empowered to control technologies and make decisions (Xu et al., 2021), not that they perform the same tasks as technology but that they use it to achieve business improvements.

5.1. Theoretical Contributions

Among the academic contributions of this study is the proposal of a theoretical model that explains the requirements to become an Organisation 4.0. Business environments are becoming more complex in the context of Industry 4.0. Therefore, firms need advanced innovations and technologies to respond rapidly in these dynamic markets (Rodríguez-Espíndola et al., 2022). Innovation is the bedrock of an Organisation 4.0 and, as shown by our empirical analysis, it is an essential variable for Digital Transformation. Also, value is increasingly created in industries based on knowledge, where mangers rarely have all the experience necessary to solve all the organisational problems. Consequently, all the individuals at all levels need to move the organisation forward by supplying information and ideas (Ackermann, Schell & Kopp, 2021). This information and the ideas that should flow through firms are structured in a Business Intelligence system which, as seen in the model, is another key variable for firm success, and as seen in the empirical analysis, will be enabled when the firm is more innovative. Moreover, the study of Nicolás-Agustín, Jiménez-Jiménez & Maeso-Fernández (2022) has the limitation of only studying the role of human resources in digitalisation processes in manufacturing firms, so it is important to expand the study, as in the present paper, to firms from other sectors. Organisations are developing concrete policies to integrate the labour force in the processes of Digital Transformation and thus reach the state of Organisation 4.0 (Gupta, Singh & Gupta, 2021). This study refers to human resources as Digital Employees and hypothesises that they are necessary to achieve an Organisation 4.0. However, the empirical study shows that although the Innovation-Digital Employees hypothesis is accepted, the Digital Employees-Organisation 4.0 hypothesis is not accepted, meaning that the study has not been able to demonstrate that Digital Employees are a key antecedent variable in the process of Digital Transformation.
This could be due to the way this variable has been measured. As characteristics of Digital Employees the present study included digital competencies and empowerment. The literature has shown how empowerment is key to the autonomy and self-responsibility needed by an Organisation 4.0 (Korsen & Ingvaldsen, 2021), but there could be other personal and social characteristics (Bikse et al., 2021) such as problem solving, creative thinking, communication skills, emotional intelligence, multiculturalism, leadership and management skills, which are not included in the present study and should be considered when analysing Digital Employees. To date, research on the knowledge, skills and competencies needed by workers for the implementation of Organisation 4.0 has been scarce (Pejic-Bach et al., 2020) and should be extended in future studies.

5.2. Implications for Practice

The present study has implications for both management and workers as well as for training centres and public administrators.
Digital transformation is an irreversible process for firms of all sectors, and to reach the status of an Organisation 4.0 it is not necessary to be an industrial firm, any firm can integrate digitalisation into its products, its services and its processes while connecting with the value chains of its stakeholders, whether they are customers, suppliers or other agents necessary to its processes of creation, production and/or distribution. Digitalisation improves the flexibility and efficiency of productive processes and links with stakeholders, while operational transparency in the business environment entails less restrictive control by public bodies, which results in more agile business transactions.
Management should be aware that innovation is a basic antecedent of digital transformation; open innovation allows firms to obtain the resources and capacities necessary for the full integration of technology in their firms. Moreover, digital transformation and becoming an Organisation 4.0 requires innovation in business models, new organisational structures, new strategic visions; it does not just imply the introduction of technologies to be more efficient or faster but an organisational and business reinvention. In this sense, top management can play a key role in moulding a culture orientated towards technology, which includes values orientated towards digital transformation. Management should promote an atmosphere that puts innovation first, where workers feel motivated to suggest ideas that might arise from their day to day tasks or from challenges set by management when they wish to improve and restructure established processes. Innovation can come from within the firm but also from connections with stakeholders, especially customers and suppliers.
Equally, management should recognise the important role of Business Intelligence systems as antecedents of digital transformation, as these systems not only collect information but also internal and external experiences of the firm (of workers, managers, customers, suppliers, etc.), that help the better implementation and exploitation of Technology 4.0. Business Intelligence systems can contribute to the development of hyper-automatization and hyper-connectivity, which are necessary to be considered an Organisation 4.0. Moreover, these systems should be exploited through an awareness of the value of information and of culture orientated towards not only technology but also towards information and data, which seems basic but is still not established in many firms. Business Intelligence systems can help improve trust and collaboration between team members, by providing more internal and external information with which to make decisions. They can also help to empower workers, who can make more decisions without having to constantly depend on supervision from management.
The role of workers is also vital to digital transformation, hence the importance of management, especially HR departments but also Organisational and ICT managers, providing their workers with the capacities and skills necessary to implement and exploit ICTs. Apart from the necessary technical and digital knowledge, hard skills such as programming, Big Data analysis, robotics or maintenance of intelligent systems, there is also a series of soft skills that have to be taught and promoted, such as communication skills, cooperation, learning to learn, permanent learning, proactivity, adaptation to change, creativity and empowerment, among others. These skills can be learnt and developed within the firm but workers should also be responsible for themselves if they want to remain employable in the rapidly changing digital world. Training and education institutions, including universities, should educate and train future employees in these capacities and knowledge, and especially, prepare them for continuous learning and change management.

Public education institutions should foment the use of digital technologies in their study programs, promoting entrepreneurial ICTs experiences for students' final year projects, even for courses that are not focussed on ICTs. Collaboration between public education institutions and firms, for example through work experience, should be the foundation for the continual orientation of both sides (firms and education centres) towards the need for training and application areas of ICTs knowledge. Moreover, educational institutions should not restrict their studies to young people but should employ systems such as life-long learning online courses or Moocs to update the digital skills of older workers. Digital illiteracy can leave many citizens and firms outside the competitive environment and should be eradicated at all costs.
Public administrations should help firms in their digital transformation processes if they do not want to be overtaken by organisations from other countries or regions that are further developed in this area. Their efforts should be based on financial aid, the diffusion of the advantages of technologies, fomenting their use and on improving education and training in technologies. Public institutions should also regulate digitalisation to avoid negative repercussions for workers and the general public. Employment legislation should protect workers' rights from possible job losses or significant changes to working conditions due to digitalisation. Aspects such as lack of privacy, information security risk and excessive vigilance of workers and/or citizens should be progressively regulated as organisations of all types go deeper into digitalisation.

5.3. Limitations and Future Research

This study has various limitations, firstly it is based on the results of a survey of general managers of firms from a specific geographical area, although they include firms from different sectors and of different sizes. Only collected the responses of general managers were collected, but those of HR managers, ICT managers and even production managers could be important for later study on Organisation 4.0. Secondly, the results of the theoretical model could not confirm the Digital Employees-Organisation 4.0 hypothesis. Despite this limitation the empirical model presents high predictive power, which indicates that taking other observations in the future, it could be trustworthy model, in other words, all the variables and hypotheses included in the model should be borne in mind to achieve an Organisation 4.0. Thirdly, the study is based on data obtained at a single moment in time, this limitation could be resolved through a longitudinal analysis. Previous research on digitalisation is also based on cross-sectional studies (Sinha et al., 2020; Gupta et al. 2020).
Often firms cannot invest heavily due to a lack of finance so it is necessary for them to have access to public subsidies or loans to be able to make investments that can lead them to a more advanced state of Organisation 4.0 (De Lucas Ancillo et al., 2022). Moreover, from a technical point of view, the lack of standardised interfaces leads to isolated intelligent solutions, which leads to fragmentation into different systems (Wilkesmann & Wilkesmann, 2018), and impedes Digital Transformation and the achievement of an Organisation 4.0. Therefore, future research should analyse the role of agents in the environment (such as the public sector or even the ICT supply sector) in the making of an Organisation 4.0. Worth special mention is the role played by public institutions, in terms of financial aid for digitalisation, establishing the educational foundations to prepare future employees to adopt and implement new technologies, the regulation of the relationships between new technologies and employees and the regulation of technological standards (Pejic-Bach et al., 2020; Ghouri & Mani, 2019; Sinha et al., 2020). The human factor has always been basic in the processes of change, and of course

in Digital Transformation. It is necessary to continue investigating the characteristics of Digital Employees and what their role should be so that this process towards Organization 4.0 does not fail. In addition, given the relationship between Organization 4.0 and Sustainability (Valera et al., 2022; Laukkanen et al., 2022), it is of great importance to continue analysing this link.

6. CONCLUSION

The purpose of this study was to analyse the necessary background for the company to achieve digital transformation and become an Organization 4.0. Although there are many studies on the digital transformation of firms and many of them have analysed the role of human resources (Brahma, Tripathi & Sahay, 2020; Gilch & Sieweke, 2021; Govender & Adegbite, 2022; Gupta, Singh & Gupta, 2021; Jani, Muduli & Kishore, 2023; Kannan & Garad, 2020; Piątkowski, 2020), not many have included innovation and business intelligence as antecedents of the Organisation 4.0, and, therefore, this study contributes to closing this gap. Despite the efforts of international organizations, such as the European Community, to help with this digital transformation, many companies have still not achieved more than a slight digitization of some of their processes in an unconnected way. For this reason, it is necessary to continue investigating the factors that affect Digital Transformation. Being innovative is a requirement in this process, the most innovative companies are managing to be an Organization 4.0, but it is not enough. Innovation lays the foundations for companies to have good Business Intelligence systems and for employees to be truly Digital Employees (with digital skills and empowered), and both factors in turn will help Organization 4.0. The model proposed in this study has shown a high predictive power, although it should be further explored in the future with more research, which expands and improves the antecedent factors to achieve Organization 4.0.

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Table 1: Definitions of Business Intelligence

Author	Definition
Ali, Miah & Khan, 2017	Business Intelligence is an information system (IS) that integrates process and technology to drive decision making for managers and end users. It plays an important role in the analysis of the business environment and facilitates decision making to gain competitive advantages arising from frequent and uncertain environmental changes.
Ekionea, Nsenga, & Fillion, 2021	Business Intelligence supports the decision making of many organisations by helping them to make good decisions on time, gain competitive advantage and maintain a long term distinctive strategy in turbulent environments.
Iordache & Iacob; 2019	Business Intelligence is the process of using technologies, programs, and applications to collect, combine and analyse data and the subsequent presentation of this information. This helps the senior management of a firm, including executives and managers, to make well informed important business decisions.
Kitsios & Kapetaneas, 2022	Business Intelligence guarantees that managers at all levels can obtain correct and opportune information that they need to improve and speed up their decision making; it is a management philosophy or strategic objective that entails the collection of unprocessed data, determination of the authenticity and trustworthiness of the data, analysis of the data and storage and diffusion of the analysed data.
Popovič, Puklavec, & Oliveira, 2019	We define Business Intelligence systems as quality information in well-designed data storage, along with software tools that allow users access to, effective analysis of and intuitive presentation of correct information. Allowing them to take correct actions or decisions.
Rane, Narvel & Bhandarkar, 2020	Business Intelligence provides managers and their teams with new tools to improve data processing and, therefore, their decision making becomes more efficient.
Ratia, Myllärniemi & Helander, 2019	Business Intelligence is a group of techniques, technologies, tools, practices and methods that allow business data analysis in order to provide a deeper understanding of business and the market, thus leading to appropriate firm support.
Salisu, Sappri & Omar, 2021	As it is an Information System, Business Intelligence promotes decision making through the control, collection and incorporation of unstructured and unorganised data; the management of massive data bases like big data; the provision of searches, prognostics, monitoring and ad-hoc analysis of solutions; and the support of advanced information technologies to discover new knowledge for end users
Tolman, Olsen & Lewis, 2014	Business Intelligence is an Information System capable of showing key performance indicators that affect the success of a firm. Firms depend on its capacity to successfully implement information system strategies that lever the hidden gems that business intelligence professionals can extract from their data.

Table 2: Constructs Measurement

Construct	Item	References
Innovation	Assess how innovation is usually carried out in your company (where 1= it is not carried out at all and 5= it is carried out totally) Innov1: Innovating products and services Innov2: Innovating processes Innov3: Innovating Business models Innov4: Innovating technologies Innov5: Innovating organizational structures Innov 6: Innovating management mechanisms	Schiuma, Schettini & Santarsiero, (2021) Yang et al. (2022)
Business Intelligence	BusInte1: In the day to day of the organization, multiple data are generated. To what degree are they being used? Rate from 1 to 5 being 1) There is no specific information management 2) There are some initiatives to exploit the information available 3) There are some information exploitation models (eg commercial through a CRM, or operational with SAP) 4) We have a Big Data model that allows us to exploit the information related to the client 5) We have a Big Data model that allows us to exploit information related to customers and employees	Rane, Narvel & Bhandarkar, (2020) Popovič, Puklavec, & Oliveira (2019).
	BusInte2: In general, how often are the data from your organization's main activity updated? Rate from 1 to 5 being 1) There is no specific frequency 2) Monthly, Quarterly or higher 3) Weekly or Fortnightly 4) Hourly or Daily 5) Online	
Digital Employees	DigEmp1: To what degree are digital skills developed among the people in your organization? Rate from 1 to 5 being 1) The competencies (skills) required by people to carry out their duties are not defined 2) The competencies are defined, but with minimal or no presence of aspects related to digitization 3) Digital skills are approximately 25% of the skills required 4) Digital skills are approximately 50% of the skills required 5) Digital skills are one of the key points in skills development	Malik et al. (2022) Gupta, Singh & Gupta (2021) Kannan & Garad (2020)
	DigEmp2: To what degree do people in the Organization have empowerment (delegation of powers) to make decisions in the development of their activity? Rate from 1 to 5 being 1) People do not have clear powers 2) People have marked responsibilities and powers 3) There are some cases of unregulated empowerment 4) There are good empowerment practices 5) We have a corporate empowerment model	
4.0 Organization	Assess the following measures according to their degree of implementation in your organization, with 1 = Not implemented at all and 5 = Fully implemented 4.0Org 1: Automation of production/operations 4.0Org 2: Automation of physical or information warehouses 4.0Org 3: Installation and use of the cloud for data storage 4.0Org 4: Digital interconnection of everyday objects with the network 4.0Org 5: Leveraging external computing power through blockchain 4.0Org 6: 3D Printing 4.0Org 7: Development of Virtual reality and Augmented reality	Garzoni et al. (2020) Choi et al. (2022) Narwane et al. (2021)

Table 3: Model Goodness of Fit

Index	Estimated Model	Hi95	Hi99	Saturated Model	Hi95	Hi99
SRMR	0.049	0.050	0.055	0.048	0.049	0.054
d_{ULS}	0.360	0.378	0.456	0.350	0.370	0.452
d_G	0.108	0.125	0.145	0.105	0.125	0.145

Table 4: Weights and Loadings Factors

	VIF	Weights	Loadings	P Value Weights	P Value Loadings
Innov1	1.918	0.162	0.690	0.257	0.000
Innov2	1.921	0.345	0.808	0.008*	0.000
Innov3	2.198	-0.060	0.602	0.687	0.000
Innov4	1.800	0.509	0.875	0.000*	0.000
Innov5	3.399	-0.053	0.650	0.740	0.000
Innov6	2.919	0.311	0.756	0.037*	0.000
BusInte1	1.290	0.650	0.893	0.000*	0.000
BusInte2	1.290	0.512	0.820	0.003*	0.000
DigEmp1	1.031	0.780	0.868	0.000*	0.000
DigEmp2	1.031	0.504	0.640	0.016*	0.001
4.0Org 1	1.741	0.471	0.749	0.001*	0.000
4.0Org 2	1.824	0.200	0.698	0.153	0.000
4.0Org 3	1.357	0.390	0.520	0.003*	0.000
4.0Org 4	1.758	0.016	0.606	0.911	0.000
4.0Org 5	1.665	0.316	0.689	0.053	0.000
4.0Org 6	1.694	0.184	0.441	0.154	0.000
4.0Org 7	1.743	-0.008	0.493	0.950	0.000
* significance $p < 0.05$ (2 tails)					

Table 5: Analysis of the Structural Model

	VIF	B	t (Pvalue)	Explai. Var. %	R^2	F^2	Hypot.
Innovation	1.354						
Business Inteligence	1.224				0.177		
Digital Employess	1.181				0.146		
4.0 Organization	-				0.410		
Innov→BusInte		0.420	6.923 (0.000)				Yes
Innov→DigEmp		0.382	5.702 (0.000)				Yes
Innov→4.0Org		0.576	8.445 (0.000)	35.309		0.415	Yes
BusInte →4.0Org		0.184	2.381 (0.009)	7.378		0.047	Yes
DigEmp→4.0Org		-0.106	1.084 (0.139)	-		-	No

Table 6: Predictive capacity of the model

	PLS			LM		PLS-LM	
	RMSE	**MAE**	**Q²_predict**	**RMSE**	**MAE**	**RMSE**	**MAE**
BusInte1	1.008	0.774	0.105	1.014	0.778	-0.006	-0.004
BusInte2	1.306	1.132	0.102	1.319	1.134	-0.013	-0.002
DigEmp1	1.339	1.117	0.085	1.366	1.138	-0.027	-0.021
DigEmp2	0.983	0.830	0.048	0.990	0.829	-0.007	0.001
4.0Org 1	1.091	0.806	0.169	1.102	0.814	-0.011	-0.008
4.0Org 2	1.118	0.856	0.139	1.141	0.880	-0.023	-0.024
4.0Org 3	1.082	0.800	0.095	1.103	0.803	-0.021	-0.003
4.0Org 4	1.252	0.993	0.121	1.277	1.009	-0.025	-0.016
4.0Org 5	0.993	0.710	0.137	0.986	0.720	0.007	-0.010
4.0Org 6	0.997	0.669	0.077	0.979	0.676	0.018	-0.007
4.0Org 7	0.960	0.699	0.098	0.959	0.693	0.001	0.006

Figure 1: Proposed Model