Digital Transformation: Prior to and Following the Pandemic

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Introduction

Transforming to digital solutions has been one of the main topics in the fourth industrial revolution (4IR). For almost a decade, digital transformation (DT) has been perceived as a way of business growth, expansion, quality, and sustainability (Shinde et al., 2014). Without any doubt, the COVID-19 pandemic has been one of the most unprecedented events mankind faced in the modern world. Both private businesses and public sectors have been drastically affected. Immediate lockdowns and interruptions, required by authorities and governments, changed the way many businesses and organizations perform. Thus, thinking of undergoing improvements and operating upgrading functionality of an organization or an entity are deemed as supplementary threats (Wuest et al., 2021). Known as the digital revolution, 4IR is more than a technology-driven aspect. It provides opportunities for everyone to use technologies for a human-centered future (Pombo et al., 2018). Thus, many businesses and organizations started transferring to digital solutions. However, the implementation of digital transformation (DT) has been quite slow in different sectors in most cases (Mahmood et al., 2019). Due to the required significant

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adjustments in the institutional model (Voronin et al., 2020), it is difficult to rapidly modify various processes of learning models.

There are many literature reviews about the effects of DT in different sectors before the pandemic hit the world at the end of 2019. The early studies tie up the concept of DT with utilizing digital technologies including Internet of Things (IoT), cloud computing, and data-analytics solutions (Majchrzak et al., 2016; Matt et al., 2015). Some of the papers elevate the concerns to business models, information technology (IT) perspectives consisting of methodologies, applications, and various impacts of digital transformation on businesses (Gebayew et al., 2018; Reis et al., 2018).

On the other hand, the literature reviews assessing the effect of COVID-19 on DT mainly provide an overview of the challenges, possible opportunities, and methodologies used (Shaughnessy, 2018; Van Veldhoven & Vanthienen, 2019). These papers were obviously published after the global lockdown in 2020 and 2021. Nevertheless, there exist some papers, published between 2020 and 2021, assessing the impact of DT in different sectors without mentioning the pandemic.

This chapter emphasizes two important factors for future literature reviews: (I) considering the pandemic timeline for choosing references and articles and (II) including the impact of COVID-19. Otherwise, the validity of the output results can be questionable because the business models, operations, and structures of many organizations have been changed. To accomplish our goals, a systematic literature review is performed about DT and its impacts in different sectors before and after the coronavirus pandemic. The challenges, opportunities, and implementation of DT are described as well.

This chapter is structured as follows: digital transformation and the implications in different sectors are reviewed in section "Systematic Review Approach", in which the systematic review approach used in this chapter is explained. In section "Effects of DT on Different Organizations", the effects of implementing DT in several sectors are presented. Addressing organizational challenges and opportunities caused by the immediate shutdown are discussed in section "Discussion". Finally, the conclusion is made in section "Conclusion".

Systematic Review Approach

This chapter follows the steps introduced by Keele (2007) for performing the systematic literature review. A systematic literature review is conducted to develop research questions on the topic of interest. Query keywords are used to search scholarly databases, browsing articles and papers in different journals and conference proceedings that address research questions. To increase the number of relevant articles, forward search (searches for literature that cited the identified articles) and backward search (searches within the bibliographies of the identified articles) are implemented (Keele, 2007). Finally, exclusion and inclusion criteria are defined to identify the articles that will be included in the review. Preferred Reporting Items

for Systematic Reviews and Meta-Analysis (PRISMA), including identification, screening, eligibility, and inclusion (Moher et al., 2009). In the identification step, answers to the following research questions are considered:

- What are the impacts of DT on different organizations, industries, and business sectors?
- And what are the impacts after the pandemic?
- How important is the COVID-19 timeline in DT's future research?

In order to answer these questions, the applied queries were defined as: "impacts of digital transformation," "implementation" and "digital transformation," and "digital transformation" and "review." The selected scholarly databases included Google Scholar, IEEE Xplore, Web of Science, and ProQuest (PQ). The abstract of an article was navigated for the query keywords. At the end of this step, 172 papers were identified. Duplicated records and articles with unrelated content were removed, resulting in 122 full-text papers in the screening phase. An EndNote library was created with DT-linked subject matters consisting of COVID-19, the education sector, DT reviews, and DT in different sectors. After reviewing the screened articles, we assessed 93 full-text papers for eligibility. In this stage, we evaluated the contents of the papers for possible similarity in their results, applications, and conclusions. Furthermore, the impact of COVID-19 on digital transformation has been the key factor for a paper to be added to the eligible list. Thirty-four studies were excluded from the list because either the pandemic was neglected or the papers represented similar contents. Therefore, a total of 59 full-text papers were submitted for the literature review at the end. Figure 1 depicts the processes of collecting articles in each stage.

Herein, we focus on undergoing the implementation of DT in several domains, considering articles published prior to the pandemic. Papers studied DT before COVID-19 are evaluated, in addition to publications submitted before the pandemic but accepted later in 2020 and 2021. The collected papers were reviewed and classified into relative group sets in the EndNote library. Overviewing of the papers revealed that they were distributed over COVID-19-related papers, the literature review articles, and the application of DT in different sectors. Finally, we clustered the selected papers into four classes: (1) COVID-19, (2) DT and education, (3) DT in different sectors, and (4) DT reviews. Figure 2 presents the number of articles in each category.

Effects of DT on Different Organizations

Companies started investing millions of dollars in information and communication technologies (ICT) during the 1990s (Andal-Ancion et al., 2003). Digitalization of businesses and different organizations has been believed to be the main key toward the 4IR. Using advanced technologies and new equipment for operating businesses are unlike the idea of transforming business processes to digital. In fact, the concept

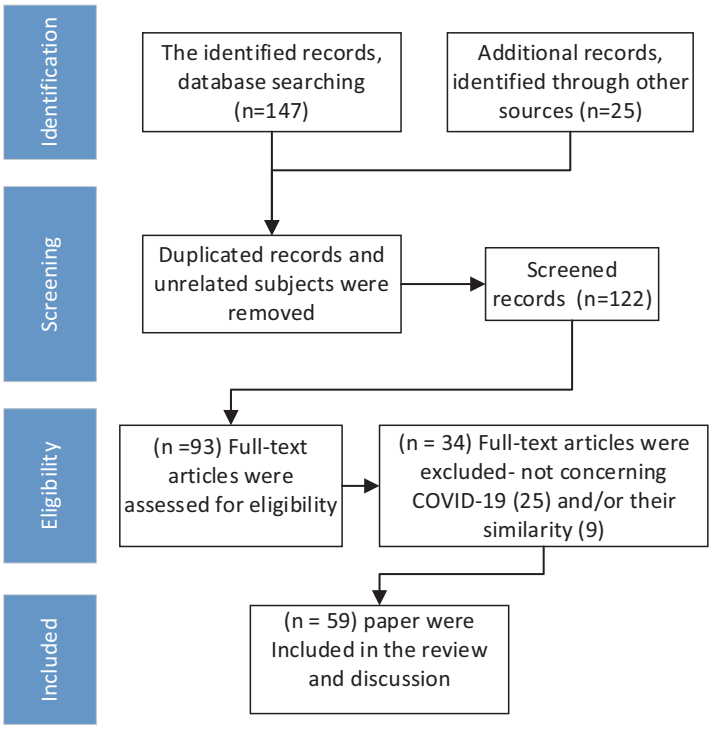

Fig. 1 The systematic literature review based on the PRISMA flow diagram. (Authors' own work)

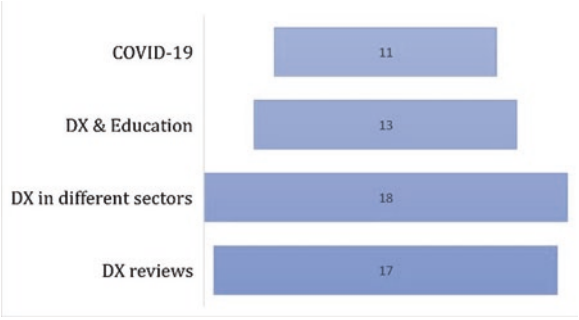

Fig. 2 Breakdown of the papers based on their research interests. (Authors' own work)

of digital transformation means to use technology for the value added to end-users and increase the performance of the entity. Digital transformation is defined as "the profound transformation of business activities and organizations, processes, competencies and models, for the maximum transformation of the changes and opportunities of a technology mix and its accelerated impact on society, in a strategic and prioritized way" (Gobble, 2018). Digital transformation refers to implementing technological approaches to achieve organizational objectives and improve the performances of different processes. In fact, implementing digital-oriented solutions

defines the most promising characteristic of digital transformation. It introduces innovative approaches to enhance traditional methods (Bogdanby et al., 2020). DT has been applied to various organizations in many businesses (Andal-Ancion et al., 2003), industries (Ustundag & Cevikcan, 2017), healthcare systems (Agrawal et al., 2010), and education institutes (García-Peñalvo, 2021). Therefore, the impacts of transferring from traditional to digital learning systems have been reviewed in numerous studies prior to and following the global pandemic.

Implementation of DT in Different Sectors Prior to the Pandemic

Transformation to the digital world has been utilized by financial institutes and banks for more than a decade. Related to e-banking, an integrative framework is developed and evaluated by Liu, Chen, and Chou (2011) to improve the performance of banking services. Despite challenges, it has been claimed that analysis of both resources/capability and external demands can be reduced by an understanding of the resource fit perspective. Concerning digital banking, Gouveia, Perun, and Daradkeh (2020) address the characteristics of the use of advanced technologies in customer service automation. In healthcare services, digital solutions can increase the quality of care, efficiency, financial performance, affordability, and accessibility (Agrawal et al., 2010). Named the digital economy, the application of drones in construction is perceived as a transformation to the digital world (Mottaeva et al., 2018); whereas, the major elements of the digital economy are reflected through modern consumers and cultural communications including personalized service model, direct interaction between producers and consumers, individual members' contributions, and financial activities focusing on the digital transformation platform. Exploring digital organizations, Shahiduzzaman and Kowalkiewicz (2018) present a "Digital Business Maturity Model." The proposed maturity model measures digital maturity throughout two broad categories, digital capabilities and digital impacts. In terms of organization and business changes, digital transformation offers value to customers and end-users so that new products and services can be developed and commercialized (Stief et al., 2016). The role of IT professionals managing digital transformation projects opens a new research agenda in the human resource management knowledge areas (Cabot & Gagnon, 2021). Garzoni, De Turi, Secundo, and Del Vecchio (2020) introduce a four-level approach to small- and medium-sized enterprises (SMEs) in the adoption of digital technologies including digital awareness, digital requirement, digital collaboration, and digital transformation. In the connection with entrepreneurship, Gavrila Gavrila and De Lucas Ancillo (2021) find that the pandemic has been a negative force for innovation. Businesses can use internal ideas for innovation by utilizing digital technologies and harnessing entrepreneurial approaches (Gunasilan, 2020). The impact of DT on technology entrepreneurship was also explored in a study (Jafari-Sadeghi et al., 2021) based on

three classes: ICT investments, research and development, and patents and trademarks. It provides important implications for business management and practitioners. A survey reveals some concerns about technology that are linked relevant to digital transformation initiatives (Furjan et al., 2020). However, digital transformation needs to be viewed from a strategic perspective instead of a technology-related standpoint (Kane et al., 2015).

Investigating an enterprise's digitalization, Andriushchenko, Buriachenko, Rozhko, Lavruk, Skok, and Hlushchenko et al., (2020) recommend recognizing five main factors to understand the situation in which an enterprise involved in DT: (I) definition of the business strategy, (II) engaging insiders, (III) customer focus, (IV) recognition of workers' experiences before changes, and (V) implement the silicon valley management system at the enterprise. In another research (Bican & Brem, 2020) examining sustainability and DT, it is stated that digital transformation is affected by margin pressure, speed of change within respective business activities, customer focus, and proximity. As an example from the manufacturing industry (Sanchis et al., 2019), the virtual factory open operating system (vf-OS) platform is introduced, managing the overall network of a collaborative manufacturing and logistics environment. The paper claims that it helps IoT devices, humans, and software applications to communicate and interoperate without a glitch in the interconnected environment. The results of the study by Lombardi and Secundo (2020) introduce promising research domains in the context of corporate reporting including: digital technology for corporate information management and decision-making processes; digital technologies as a tool of stakeholder engagement and sustainable reporting practices; and digital technologies as a way to address earning management, corporate social responsibility, accountability, and transparency. Digitalization of entrepreneurial organizations, its opportunities, and challenges in the tourism sector experienced in the Republic of Serbia are described in Simic (2020). The paper presents prospects as well as avoiding or successfully handling potential challenges. In a literature review (Nadkarni & Prügl, 2020), it is stated that the pace of transformation, the culture and work environment, and the middle management perspective are substantially underdeveloped.

Compared to the private sector, public institutions have been practicing digitalization to improve the performance of their essential services to the public. The results of a study on digital government by Alvarenga, Matos, Godina, and C. O. Matias (2020) indicate a growing number of publications addressing DT in Public Administration. Lack of knowledge about the concept and untrained employees originate from unsuccessful knowledge management, which according to the paper is the critical key in DT. Among different organizations in the private sector, digital transformation has been practiced by higher education institutions the most. In the education sector, digital transformation means to establish a collaborative, active, self-directed, and engaging model from a knowledge-transfer model (Selinger et al., 2013). Performing DT in an educational system can improve the learning outcome of students alongside productivity in teaching and administrative works of faculty members (Castro Benavides et al., 2020). In another paper (Androutsos & Brinia, 2019), DT has been used to propose a pedagogy enhancing

innovation, collaboration, and co-creation of students. In addition to this study, Demartini, Benussi, Gatteschi, and Renga (2020) state four major benefits of implementing DT in an educational system including access to information, availability of content, creativity and digital production, and collaboration and sharing. Still, there are studies focusing on the use of ICT in higher education (Santos et al., 2019), instead of transforming the business model. In connection with the latter, the application of digital technologies and social media is perceived as DT (Secundo et al., 2020). In an exploratory study at Qatar University (Younis et al., 2020), the potential growth related to digital entrepreneurship and the educational institute is examined. Likewise, there is a paper by Asmar and Badr (2020) that highlights the design of accessible and inclusive technologies that can be used for people with learning disabilities.

Post-Pandemic and Digital Transformation

The manufacturing industry and related companies have been influenced by the pandemic at different stages of manufacturing. Wuest et al., (2021) depict these stages including R&D, sourcing, manufacturing, assembly, logistics, sales, usage, after-sales services, repair and maintenance, remanufacturing, recycling, and disposal. Various clusters in manufacturing such as automotive, pharmaceutical, aircraft, defense, and household products experience distinct disruptions regarding those stages. Reviewing DT in the Russian economy, Kharlamov, Raskhodchikov, and Pilgun (2021) indicate that "...33% of the total number of Russian companies in the first half of 2020 suffered losses of more than 1.5 billion rubles, 46% of *representatives* of business structures announced a decrease in demand for their products or services." In the case of manufacturing, transforming to digital solutions means automation of processes in the production line and utilizing robotics, in order to comply with stay-at-home orders (Wuest et al., 2021). Installations of these advanced systems are time-consuming and require a huge amount of investment. In a study, digital entrepreneurial-based SMEs in the post-era of COVID-19 are investigated (Purbasari et al., 2021). Lack of accurate and specific policies regulating the content in the digital world may ascertain conflicts with social norms and consequently business operations.

Travel and relocation restrictions, social distancing, and governments' regulations to control the spread of the coronavirus have hammered private and public sectors to adopt DT, even more than before the outbreak. Due to the magnitude and vertiginous halt of operation, many organizations and businesses confronted unlike experiences, surely depending on where they were in implementing DT. Among different public sectors, the operation of educational systems and health institutions by far is the most crucial than other counterparts during the pandemic. While healthcare systems were obviously excluded from the lockdown, most education sectors had to close their doors to the public across the globe. Thus, the consequences of interrupting operations are occurred to the scholars, while hospitals experienced an

overwhelming amount of work in their everyday business operations. In this environment, healthcare sectors cannot tolerate extra pressure by implementing new organizational development or any changes including digital transformation. However, educational institutes along with many organizations in the private sector need to undertake immediate actions to respond to the unforeseen event. Across the globe, private sectors also had to comply with governments' rules. It means that even if improving performance and added value throughout DT were not the private sectors' concerns, now, they may envision it as a solution to overcome their present hurdles.

The key factor regarding the pandemic is that various businesses and organizations in different sectors practically implemented digital transformation. Practicing the digital layout of usual business operations has helped them to accelerate the transition from traditional to digital processes. As presented in a study (Kharlamov et al., 2021), 57% of business representatives noticed the stimulation of DT within their companies, 38% experienced changes in management and corporate culture, and 29% noted a reduction and reorganization of ineffective components of their business processes. Intelligent systems are being applied to prevent the spread of coronavirus by using cell phones and drones to track and detect affected people. Furthermore, utilizing advanced technologies such as AI-based methodologies provides prospects to mitigate the negative effects of the pandemic on manufacturing and supply networks. The application of such technologies increases connectivity, transparency, and visibility (Wuest et al., 2021). In a paper, DT is perceived as having practical implications offering tools and techniques to adapt during the pandemic (Klein & Todesco, 2021).

When COVID-19 hit the world, about 1.8 billion students were affected due to institutional closures in reaction to the pandemic (Ngwacho, 2020). Its destructive impacts entailed all educational systems and academic organizations around the world to perform remote learning and consider digital transformation as the only option to continue schooling. Remote learning and online courses have been employed in many private and public education systems already (Bogdanby et al., 2020). Most of them have experienced numerous hardware-based and/or software-centered technologies to deliver remote schooling before, although they have never been forced to apply DT in a short period of time for the entire educational system. In fact, the digitalization of educational organizations started unwillingly without any initiatives and prior planning. In this case, a significant number of educational organizations and businesses started digital solutions immediately. Reviewed in Ngwacho (2020), educational challenges amid the pandemic for students in Kenya are described in 13 terms correlating educational and socioeconomic concerns about homeschooling.

In a comparable survey performed in higher education institutes in Saudi Arabia (Abdulrahim & Mabrouk, 2020), using digital technologies has been seen as a catalyst for improving productivity, learning outcomes, and a safe environment during the lockdown. The need for utilizing technologies to deliver online learning has

compelled educational entities to accelerate digital transformation. The results of a paper, studying the education system in South Africa during the lockdown (Mhlanga & Moloi, 2020), present successful accomplishments toward digital transformation. Private institutions were involved in helping the government of South Africa create TV/radio/desktop platforms for offline schooling platforms. As a result, the solution motivated public schools and higher education institutes to practice other forms of digital technologies. The role of COVID-19 in applying DT and leading to establish a new norm in the scholarly journals and publication sector (Hayashi, 2021) highlights the benefits of digital applications in scholarly communication, preprint, peer-review, and open science transforming into online journals. In a framework proposal (Garcez et al., 2021), the intensified DT changes due to the pandemic are perceived as an opportunity for academic entrepreneurship. In another work, a survey was conducted in a Hungarian higher education institute among the Computer Science and Information Technologist students of Eszterhazy Karoly University (Bogdanby et al., 2020) to determine the impact of DT. The results indicated that shifting to digital education was preferred to the traditional approach. However, there have been technical difficulties for some students in this manner. In a survey conducted in Saudi Arabia's universities (Omar & Almaghthawi, 2020), it has been found that data governance is an effective tool in the implementation of digital transformation processes in higher education institutions. To create an innovative business model in a higher education system, Rof, Bikfalvi, and Marquès (2020) focus on the existence of tensions in the current business models.

Characteristics of Different Organizations Transferring to Digital

The impacts of digital transformation can be measured by considering several attributes involving (I) technology and data, (II) people and management, and (III) product and services interacted across an organization's environments (Shahiduzzaman & Kowalkiewicz, 2018). The criteria for the digital impacts are defined as eight indicators: vision, leadership, governance, innovation, culture, shared value, business agility, and revenue resilience. The indicators for digital capabilities measure the strength of the organization's digital foundation to derive value from technology. Using Internet domain registration analysis as an indicator for innovation and entrepreneurship initiatives, Gavrila Gavrila and De Lucas Ancillo (2021) present a parameter that can be deployed for measuring the success of the DT implementation. Studying multiple case studies in a paper, Priyono, Moin, and Putri (2020) show that transferring to digital solutions for SMEs depends on the level of digital maturity in which they are. Strive toward long-term achievable ICT integration strategies is suggested by Ngwacho (2020), adopting policy initiatives incorporating digitalization in education, training, and research.

Discussion

The main concern in implementing digital transformation is to provide an effective and efficient solution that can operate predefined technologies. As posited in different sections of this chapter, the definition of DT and one's perception, of what it really means, can change the deployment of DT in an entity. Evaluating the full text of the collected papers reveals the challenges and opportunities of implementing DT in different sectors before and after the pandemic. Moreover, it reveals the important timeline of announcing the global pandemic, January 2020 (WHO, 2020). Hence, we take into account this timeline as a criterion for measuring the validity of a research study in the research domain of digital transformation. Figure 3 emphasizes the papers, from the group sets, published prior to and following the global lockdown starting in 2020.

As depicted in the figure, 36 papers from the collected list were published prior to the pandemic from 2003 to the end of 2019; whereas 34 papers were published after the timeline.

Obviously, there is no correlation between DT and COVID-19 before 2020. However, there are still many articles and literature reviews published in 2020 and even 2021 focusing on digital transformation without mentioning the pandemic. The reason is that the process of publishing a paper for most journals, from the submission to and acceptance for publication, is very time-consuming. Nevertheless, COVID-19 has reshaped many organizations' environments, and previous strategies and provided solutions for implementing DT cannot be trusted. Although many challenges and opportunities remain valid, the approaches implemented prior to the pandemic should be validated.

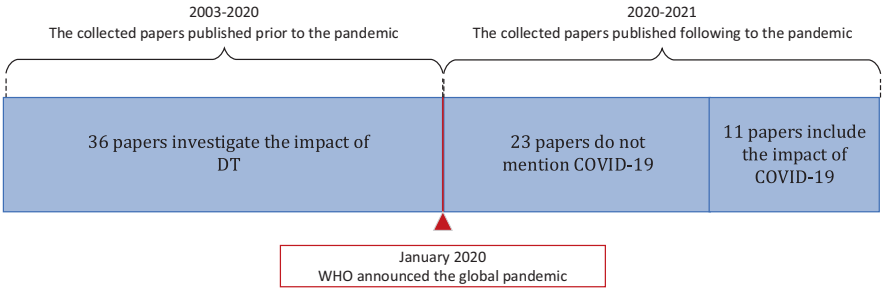

Fig. 3 Breakdown of the collected papers published pre- and post-pandemic, and including/excluding COVID-19. (Authors' own work)

Conclusion

We address the importance of the pandemic on DT-related studies, claiming that a great number of challenges, opportunities, and strategies, provided by researchers for implementing DT prior to the pandemic, must be modified and reevaluated. The epoch following COVID-19 would be ever-changing, and previously envisioned approaches require some adjustments. The organizational architectures of many businesses in different industries have been changed. So that solutions presented in pre-pandemic papers for implementing DT projects, or post-pandemic without noticing the event, cannot be applied. Employing digital technologies in several industries and businesses have already been performed during the pandemic. Unlike our counterparts, we deem opportunities linked to the DT implementation meanwhile.

Using papers before and after the event in the PRISMA, section "Systematic Review Approach", helped us to highlight studies that include COVID-19 in the papers. In addition, we described the characteristics of DT projects with regards to the post-COVID epoch. We recommend that decision makers in the public sector should reassess their pre-pandemic policies regarding DT implementation due to changes in the business model and organizational architecture. Now, managing DT projects requires using project management approaches which address organizational changes caused by the pandemic. However, in the private sector and especially small-size businesses, where organizational architectures are more flexible for alterations, they can benefit from the pandemic and accelerate the transition.

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