Digitalization through Pandemic Crisis: Effects on Technology, Processes & Human Capital

Ana Gandrita
ISCTE-IUL, Portugal
agandrita@vantagem.com

Bernardo Bastos
Universidade Europeia, XLR8 RMS, Mesosystem Investigação & Investimentos by Spinpark, Portugal
bernardopbastos@outlook.pt

Daniel Mandel Gandrita*
Universidade Europeia, Portugal
daniel.gandrita@gmail.com

Diana Costa
Universidade Europeia, Portugal
1007diana7001@gmail.com

*Corresponding author:

Received: November, 2022
1st Revision: November, 2022
Accepted: December, 2022

ABSTRACT.
Background: Managers worldwide are dealing with an organisational paradigm never seen before due to the coronavirus pandemic, which motivated them to seek more solutions for their business operations continuity. Considering this scenario, one of the solutions was to transform analogue processes into digital to reduce the pressure organisations are going through and surpass a pandemic stage with a beginning that does not have an end in sight. These constraints have led stakeholders to rethink operations continuity processes, the physical distance and emotional distress in their workers, and the look for technology that meets the organisation's needs. **Aims:** Throughout this article, we aim to investigate how the pandemic crisis-affected digital transformation in organisations on three main pillars: Technology, processes, and human capital. **Methods:** As a methodology, we proceeded with systemic literature review principles with an approach to bibliometric analysis to study how the pandemic crisis has affected digital transformation in organisations. **Implications:** Our study contributes to the body of knowledge about the pandemic effects of digital transformation in organisations and practices by giving companies insights on how to surpass digitalisation obstacles and keep prospering both during and after the crisis.
Results: Abandoning old strategies and rebuilding the organisation, the remote work inclusion, and managers leaving old strategies.

Keywords: Digital Transformation, Digitalization, Technology; Processes, Human Capital, COVID-19.

JEL Classification*:* M1, M2, M10, M15

DOI: 10.54933/jmbrp-2022-14-2-3

Gandrita, D. M., Gandrita, M., Bastos, B. & Costa, D. (2022). Digitalization through pandemic crisis: effects on technology, processes & human capital. *Journal of Management and Business: Research and Practice, 14*(2).doi: 10.54933/jmbrp-2022-14-2-3

Introduction

Coronavirus disease (COVID-19), which has emerged and created a public health crisis (Wen et al., 2020), is considered the most significant disturbance pandemic in the last three industrial revaluations (Kumar et al., 2020). This new virus has put the economy at risk by shutting down businesses and putting people's lives on hold (Soto-Acosta, 2020). The emergence and spread of this disease have challenged infrastructures and economies worldwide (Wen et al., 2020).

To the point that the global production system and supply chain is being disrupted by this pandemic (Kumar et al., 2020), and there is an undeniable influence on the environment. Nevertheless, digital transformation can overcome these challenges (Bai et al., 2021). The pandemic impacts are transversal to different areas, such as businesses, the economy, education (schools), and health (hospital systems) (He et al., 2021).

Because of that, a quick transition to the online world was necessary through telework, online education, and telehealth (Richter, 2020). This change can be explained by the need for solid coordination of various resources to cope with the pandemic (He et al., 2021) as digital transformation and innovation enable the prevention of long-term stock-outs and knowledge sharing between teams (Soto-Acosta, 2020). The coronavirus, consequently, acted as an accelerator of this digital transformation (Agostino et al., 2020) and brought, simultaneously but depending on sectors, many challenges for individuals as consumers, for companies as market value creators, and societies as global (He et al., 2021).

According to Faraj et al. (2021, p.1), "This extreme event has effectively subjected organisations to a real-life stress test that has exposed the patchwork construction upholding digitalisation". The pandemic forced society to create innovative practices to overcome the damage to our daily life (O'Leary, 2020) and generated a massive-scale upheaval in organisations (Faraj et al., 2021). Although the impact of digital technologies has been a reality in companies for the last decades and has significantly changed the business model (Liu et al., 2011), the emergence of a pandemic has intensified this reality and made it compulsory.

Overall, organisations have been implementing changes based on innovation to improve their performance in the short term and enhance their operational capabilities and profitability in the long term (Ghobakhloo & Fathi, 2020). Considering these extensive transformations and challenges due to the pandemic, the outlined question was made: How has the pandemic crisis affected digital transformation in organisations?

This document is divided into four chapters. In the first section, a literature review is presented in order to have an overview of digital organisational transformation, especially technology, processes, and human capital. The methods employed are presented in the second and third sections, and the empirical results are discussed. This article's methodology is supported by a bibliometric analysis and a systematic literature review. The last part presents the conclusions, implications, limitations, and suggestions for future studies.

Theoretical background

Organisational digital transformation

Technology

It is well known that the COVID-19 pandemic has disturbed organisations in all parts of the globe (Qadir, 2022; Sohrabi, 2020), reducing interactions to a minimum to prevent the spread of the virus (Mahmood, 2020; Doshi, 2020), especially for groups, for whom discontinuing reinforcement was not an option (Kateb, 2022).

The crisis began to impose external pressures to innovate and find alternatives for organisational continuity because the unprecedented disruptions made the traditional format

impossible to work (Faraj, 2021). In this unsustainable environment, technology plays an important role in controlling, responding to, or handling COVID-19 pandemic outbreaks (Rudrapati, 2022).

This has become an opportunity for managers to test and use new tools in the organisation to find solutions to maintain and continue operations; in that sense, the employed technologies, according to Rudrapati (2022), were (1) Artificial intelligence, (2) Big data, (3) Cloud computing, (4) Virtual reality and Augmented Reality, (5) Internet of things and (6) Cyber-physical systems.

Artificial intelligence which will help to predict the outbreak of COVID-19, help to reduce the risk of spreading (Cardoso, 2021), and acquire the know-how to improve productivity and create new knowledge for the business process (Olan, 2022). By using big data applications, it becomes possible to analyse a large amount of data, can enable business intelligence to provide insights that would allow companies to understand customer needs, improve marketing technology, identify opportunities and problems in real life, and make personalisation possible (Gamaroodi, 2020).

Cloud computing contributes by facilitating people to continue their lives digitally through Google, Teams, Zoom, and other digital platforms during the lockdowns (Wang, 2017). Also, virtual reality provides simulated experiences and training sessions through internet services working based on digital platforms (Thoben, 2017). The Internet of Things (IoT) is an interrelated computing device and digital machine that provide several technological applications with the usage of sensors, Bluetooth, Global Position Systems (GPS), and Radio-Frequency Identification (RFID) through smart devices like phones, watches, and robots, also Augmented Reality (AR), has converged with proximity Business to Consumer (B2C), for a better consumer experience, especially in the industrial society (Bag et al., 2020; Oztemel & Gursev, 2020).

Table 1: Types of technology and their contributions

Author(s)	Technology	Contribution
(Rudrapati, 2022; Cardoso, 2021; Olan, 2022)	Artificial Intelligence	Reduce the risk of spreading, predict the outbreak, improve productivity, and create knowledge for businesses.
(Gamaroodi, 2020)	Big Data	Analyse a large proportion of data, enable business intelligence, customer needs, improve marketing technology, identify opportunities and problems in real life.
(Thoben, 2017; Wang 2017)	Cloud Computing	Google, Teams, and other digital platforms.
(Alguliyev, 2018; Mosterman, 2016)	Cyber Physical systems	Monitoring, controlling, coordinating, and integrating the activity of systems.
(Bag et al., 2020; Gursev, 2020)	Internet of Things	Use of sensors, Bluetooth, global position systems (GPS), radio-frequency identification (RFID).
(Thoben, 2017), (Bag et al., 2020; Gursev, 2020)	Virtual Reality and Augmented Reality	Simulated experiences and training sessions through internet services working based on digital platforms, Proximity to business to business (B2B) and consumer experience.

For last, cyber-physical systems help the organisation monitor, control, coordinate, and integrate systems activity (Alguliyev, 2018). This technology can be helpful in the treatment process, effectively defending and protecting the systems from hackers and ensuring the protection of confidential information (Mosterman, 2016). The introduction of technologies leads to new opportunities in the emergence of new digital businesses or restructuring traditional strategies, but it alters the relationship between customers and companies (Scuotto, 2017). With digitalisation, customers can communicate faster with the organisation, facilitate data exchange (Papa, 2018), and at the same time, force businesses to have attention to their digital reputation.

Some scholars argue that despite the trial opportunities, the digital economy raises some questions about the adaptability of how people and organisations will grow and adjust to this new Era

(Martínez-Caro, 2020). Before the pandemic, it was considered that these changes could be a source of stress between digital champions and the remaining workforce, creating an obstacle to the implementation of new technologies (Del Giudice, 2019). However, today it is known that the pandemic context led to surpassing such constraints as both people and organisations need to adopt new technologies in order to keep operating in such an unforeseen context.

The existing practices become challenged by technology, which can (re)define the profession of the workforce. With this into consideration, organisations need to adapt their digital innovations together with their members and keep in mind that the adoption of digital technology during the present crisis, with the importance of consciously applied transformation, will shape professional identities (Kateb, 2022).

Processes

In an era of flexible schedules, the idea of a digital workplace or remote work is emerging and cementing its way into organisations. As referred to by its predecessor (White, 2012), this paperless office enabled employees to safely continue to work for the economy (Pianese, 2016; Wrycza, 2020 & Gandrita, 2022). However, the conversion to this new reality should be considered by managers because several challenges and risks follow the digitalisation of every process (Adriole, 2017; Horváth, 2019; Vial, 2019).

The nature of these constraints is multifaceted and it is possible to divide them into three categories: (1) market challenges can affect the producer-costumer relationship (Fremont, 2018), an impact on supply chains, the transformation of a business model (Matzler, 2018), and the relocation of the corporation operations in high labour cross countries (Wiesmann, 2017); (2) organisation challenges regarding the inclusion of working from home difficulties (poor internet connections and home environment distractions) (Zhang, 2020), the employer's concern about the flexibility of the organisation (Saks, 2021), the knowledge challenge, and the information-based platforms (Brunetti, 2020); (3) economic and societal changes refer to the impact of environmental sustainability, energy consumption, and energy resource (Brunetti, 2020).

Considering these substantial categories, Cukusic (2021), Kar (2019), Manfreda (2021), Tangi (2021), and Zekic (2021) stated that there is significant importance in becoming digital, which creates an endless possibility for citizens, companies, and governments to interact and create value benefitting all the stakeholders, also learning from the assessments made from smart cities.

Digitalisation calls for new forms of workplace collaboration and communication, it can be understood as the use of data and digital technologies to improve business, create revenue, and transform business processes (Kraus, 2022).

Human Capital

According to Hsu and Wang (2012), human capital should be positioned inside a major variable assigned as intellectual capital, incorporating human capital itself and structural capital. The authors go further and under structural capital, it is placed organisation's capital which is stated to be "knowledge created by and stored in an organisation's information technology systems and processes" (Hsu & Wang, 2012, p.3), and customer capital meaning "the relationships that an organisation has with its customers" (Hsu & Wang, 2012, p.3).

The pandemic has led to a cross-border distance problem, giving numerous constraints and new intra-firm distancing challenges imposed on employees (Caligiuri, 2020), bringing a prefund and immediate effect on organisations and workplaces worldwide (McGuire, 2021). On an economic level, the pandemic effect decreases the manufacturing of goods, causes losses to national and international businesses, and causes a significant slowing down of revenue. On the other hand, the social outcome suffers from the closure of places of entertainment, the social distancing of members, avoiding national and international travelling, etc. (Haleem, 2020).

Thanks to this context, many people work from home, and accordingly, to the survey conducted by Mateescu (2020) 88% of the organisations encouraged or ask employees to work from home, yet Carnevale (2020) and Gai (2020) also discovered that some workers lack informal social engagement, loneliness, isolation, and exacerbated mental health concerns increased exponentially, difficulties that became an increasing struggle to organisations that are trying to find strategies to improve speed, adjust traditional technical methods, and accuracy of information provided for social management (Zhou, 2020).

Collings (2021) describes this crisis as fundamentally a human one, making human resources (HR) leaders the focus in enabling organisations through and ultimately exit the crisis successfully. Given this environment, all organisation's functions started to prioritise and optimise spending or postpone tanks that will not bring any value in the current environment (Donthu, 2020) which companies implement an immediately indefinite freeze turning into online communication, entertainment, and shopping (Donthu, 2020).

This became an opportunity for HR managers to strive for a transparent and fair way of communication about the immediate negative effects of COVID-19 on companies (Rudolph, 2021). From a different and positive perspective, HR can approach this issue as a challenge that can be addressed as a calling for new ways to problem solve, make choices and make decisions, grow, develop and innovate (Watkins, 2020).

Carnevale (2020) explains that due to recent pandemic events, organisations should remain alert and adaptive to unforeseen events, and with the help of human resources management (HRM), the workforce can cope and adjust to their newly altered work environment. HRM continuously needs to manage people in organisations to enable continuity and ensure work-life balance (Gigauri, 2020) and work towards converting analogue information into digital information for processing purposes (Strohmeier, 2020).

Digitalisation needs to be exploited for a broad range of companies' activities (example: payroll or processing to course administration) and to develop HRM strategies (Burbach, 2012) which could establish systematic quality improvements across this department (HR) and work on new approaches (Strohmeier, 2020).

Methodology

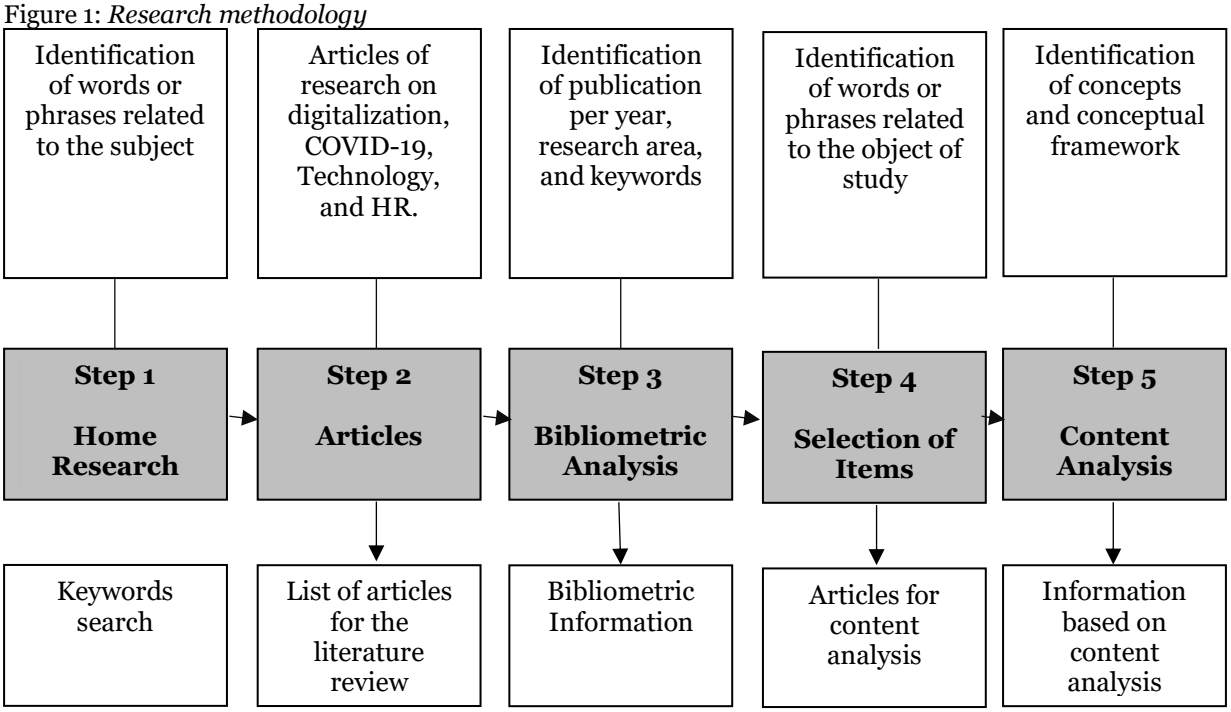
Investigation procedure

To meet the objectives of our research trajectory about the digitalisation effects of the pandemic crisis regarding technology, human capital, and processes, we conduct a bibliometric study to enable a systematic review of the literature of international research journals using the Web of Science (WoS), from 2012 to 2022.

The search for relevant articles started with WoS by using the keywords related to the study, namely, "Digitalization" AND "COVID-19" OR "Pandemic Crisis" AND "Technology" AND "Human Capital" AND "Processes", giving a total of 852 results. Then, refining the data by management and business categories made it possible to reach a total of 141 articles. The articles were written in English, providing a result of 139 articles, and after we refined by articles as a document type, it was possible to reach 95 results.

Finally, we extended our search into publication titles, and after the refinement and excluding of the research articles that weren't relevant to this study, we reached a total of 92 results.

Figure 1: *Research methodology*



Source: Own elaboration

Table 2: Journals and Number of articles

Journals	No of articles
Annals of Medicine and Surgery	2
Anatolia	1
Asia Pacific Journal of Administration	1
Advances in Developing Human Resources	1
Administrative Sciences	1
BRB Business Research Quarterly	1
Business Information Review	1
British Journal of Management	1
Baltic Journal Management	1
California Management Review	1
Computing Ind.	1
Central European Business Review	1
European Management Review	1
Economic Sciences Series	1
European Business Review	1
FIB Business Review	1
Gender, Work, and Organization	1
Geography and Sustainability	1
German Journal of Human Resource Management	1
Human Resource Management Review	2
Human Resource Management Journal	1
International Journal Surgery	2
Information Management Review	1
Information systems Management	4
IEEE Internet of Things Journal	1

International Journal of Innovative Tech. in Economy	1
Innovation Organization Management	1
International Journal of Information Management	7
Information and Organisation	3
Journal of Business Research	6
JMIR Public Health and Surveillance	1
Journal of Manufacturing Technology Management	1
Journal of Org. Computing and Elec. Commerce	1
Journal of Information Technology	2
International Journal of Construction Management	1
International Journal of Automobilistic Technology	1
Journal of Applied Psychology	1
Journal of Manufacturing Technology	1
Journal of Global Operations and Strategic Sourcing	1
Journal of Knowledge Management	1
Journal of International Business Studies	1
Journal of Science and Technology Policy Management	1
Journal of Strategy and Management	1
Journal of World Business	1
MIT Sloan Management Review	1
Management Learning	1
Management Research Review	1
NMIMS Management Review	1
New Technology and Work and Employment	2
Operations Management Research	2
Public Management Review	2
Perspectives on Science and Practice	1
Technology Analysis Strategic Management	2
Procedia	1
Planning and Control	1
Polish Journal of Management Studies	1
Resources, Conservation and Recycling	1
Research Technology Management	1
Software System Model	1
Sustainable Operations and Computers	1
Tecnovation	2
Technological Forecasting and Social Change	2
TQM Journal	2
Transformations in Business Economics	1
65 Journals	95 results

Inclusion criteria

Regarding this study, peer-reviewed articles were considered a thrust source of knowledge, maintaining out thesis, editorial notes, white papers, thesis, blogs, and books. Therefore, the publications and work related to this study were included in the inclusion criteria corresponding to digitalisation, the pandemic crisis, and the three affected variables.

Exclusion criteria

Considering the exclusion criteria, we rejected several articles that did not present any practical application of theoretical information that contributed to our research or answered our central question. In that sense, we have ruled out the following:

1. Ex1 Articles with a focus on sustainability;
2. Ex2 Articles with specific relation to medicine;
3. Ex3 Articles focus on gender issues;
4. Ex4 Articles with specific relation to marketing.

Results and Discussion

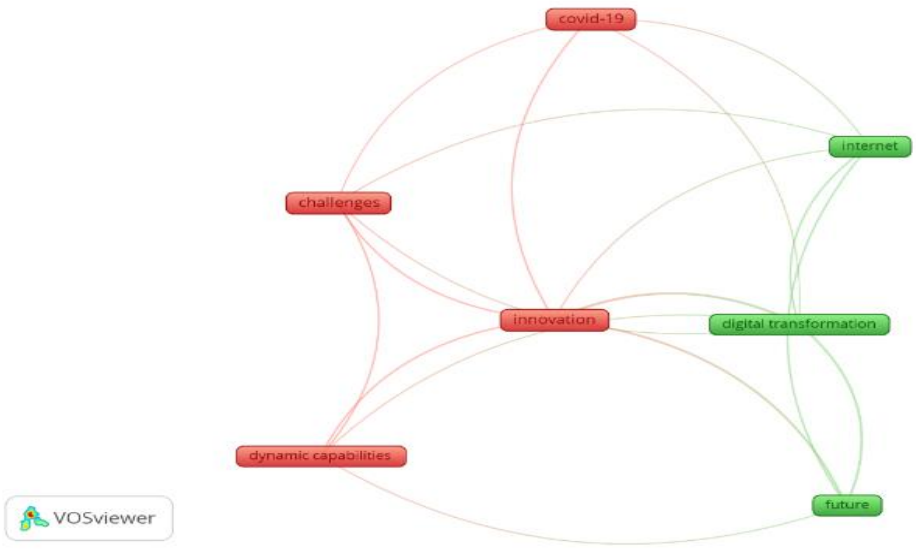
The COVID-19 pandemic changed companies' landscape, making organisations (re)focus on their goals and future perspectives. However, the pandemic also brought several opportunities for the use of technological applications and tools like (1) artificial intelligence, (2) big data, (3) cloud computing, (4) virtual reality/ augmented reality, (5) IoT, and (6) cyber-physical (Rudrapati, 2022).

The pandemic boosted the remote work trend leading organisations to reshape their processes for telework. Adopting the digital format will reshape organisations and their processes, creating new businesses or rebuilding old strategies. Also, it brings new and more practicable ways of communicating with clients, facilitating data exchange, changing the way workers see their profession, remote work, and shaping professional identities (Kateb, 2022¸ Papa, 2018; Scuotto, 2017).

The effect of the pandemic also had a tremendous weight on human capital due to the closure of places and considerably decreasing manufacturing and productivity (Haleem, 2020), as people were pushed to work from home and led (Mateescu, 2020) to furloughs and layoffs. Human capital also felt that social distancing brought loneliness, and isolation, exacerbated mental health, and a lack of informal social engagement (Carnevale, 2020; Gai, 2020).

Although this crisis is fundamentally a human one (Collings, 2021), organisations need to adjust their processes to ensure that people have a work-life balance (Gigauri, 2020) and work towards the conversion from analogue to digital for processing purposes (Strohmeier, 2020). However, constraints in processes can affect the relationship between producer-costumer (Fremont, 2018), difficulties in working from home (Zhang, 2020), and economic/societal changes (Brunetti, 2020).

Figure 2: Keywords analysis



Source: VOSviewer software

As moving forward in our results, we could also conceptualise the evolution and dynamics of the bibliometric studies through VOSviewer software (Fig. 2), namely the keyword analysis. The process begins by uploading an RSI file with the following parameters: (1) co-occurrence, (2) full counting, and (3) keywords. The result led us to a minimum of 5 occurrences per keyword, 21 keywords included in the threshold, giving a result of 428 total link strength.

The created network leads us to realise that the clusters were influenced by digital transformation. The cluster (digital transformation) highlighted the attachment to the internet and the future not disregarding the remaining variables. The main red cluster (Covid-19) alerts us to the existing organisational/social/transformational challenges that exist every day, and it becomes necessary to continue to innovate to overcome the challenges in the future and contribute to digital transformation. For last, the dynamic capabilities model continues to be a reference in rebuilding, integrating and reconfiguring internal and external resources/competences.

Conclusions, implications, Limitations, and Further studies

The literature database acquired from the systematic search was categorised with a focus on digitalisation throughout the pandemic, assuming the effects on the three areas of our study: (1) technology, (2) processes, and (3) human capital. Considering the data collection for the research, it becomes clear that there is an intrinsic relationship between them.

The evolution of digitalisation and its increasing usage is undeniable, but the emergence of a global pandemic has inevitably accelerated these processes around the world. Countries found themselves in lockdown and organisations needed to find momentary solutions to proceed with their business as well as to implement remote work as the new normal. Investing in new technologies that met certain needs was necessary to ensure that workers could keep their jobs, reducing the crisis effects.

Throughout the development of this essay, there was a mindset mutation as overall processes were understood. Digitalisation has brought a new checklist of needs for corporations and has implied by (Bastos, 2022), that hybrid networks may affect supply chain sustainability, as mentioned in the literature review. During the period, many workers were sent back home, some were able to do their work, but others did not. Regarding the production itself, it cannot be made remotely or even those companies who have opted to do it in a hybrid prospect have decreased, as expected, their production scale. Overall, digitalisation is seen as a major tool to provide services – which was suitable for many companies that were able to keep the activity going even within a crisis period – but it is not production friendly in this sense.

These technologies were accompanied by new processes, which still need improvement due to the short time of implementation. Although a solution has been found, the truth is that not all individuals have been satisfied with this response from companies. Social distancing has highlighted the lack of commitment of some workers and the loneliness. These drastic changes bring their mental health concerns. New strategies had to be created in companies through digitalisation to meet these new needs of employees. It should be noted that this reality has not been possible for all types of businesses.

Companies were forced to rethink plants' layouts due to the social distancing implied by the pandemic. As a solution, remote work was enforced for organisations to continue their business operations. Considering the unpredicted changes, digitalisation brings numerous benefits and gives its contribution to organisational growth. As McGuire (2020) stated, this virus brings a refund and immediate effect on organisations and workplaces worldwide. In that sense, we determine that is up to the human capital to rise above and give answers that can bring clarity to strategies, to co-workers, and the future of the organisation.

Theoretical and practical implications

This study contributes to the body of knowledge by combining digitalisation with technology, processes, and human capital during the pandemic. When evaluating the theoretical contribution of this research, it is essential to remember that the empirical results originate from the global and real-life context of the companies and therefore contribute to managers' and entrepreneurs' understanding of the weight of the pandemic crisis through technology, processes, and human capital. The path to digitalisation improved workers' lives regarding remote work and how the processes need to change and be re-arranged, as well as the emotional salary, which is possible to assess what are the talents in the organisation and what is needed to preserve them.

Our research also contributes to practitioners and also to organisational management. On a practical level, we postulate that organisations need to consider that human capital needs the right tools to be motivated to ensure a good work-life balance, integration and for the HR to continue their work in searching for more ways to increase workers value and as a result increase the organisation profile. Technology must be inserted into the new reality equation and developed to achieve a competitive advantage. As a result, the increase and access in several areas like healthcare, communication, flexibility in working, etc., allows companies to understand more quickly stakeholders' needs and act upon them. Although it is necessary to review and re-structure, Processes contributed to technology and human capital unity and achievement of organisational goals providing new organisations with the opportunity to gain new dimensions and expand to new businesses and new sources of revenue.

Study limitations

The main limitation of our work is that this study makes a narrative presentation of results that the authors previously collected. Although this was a justified seriation, the articles used in this review were based on specific databases and keywords. These searches are always very sensitive since studies with slightly different contributions may be left out depending on the words used.

Nevertheless, no review, even a systematic review, can guarantee finding all articles relevant to the topic under study. Including data (qualitative or quantitative) from other databases may improve the results of this review in a future analysis.

Further studies

This pandemic context has undoubtedly changed how organisations see the world and how they structure strategies to be more effective and continue their business activity. On a positive note, although companies are passing through high degrees of uncertainty, digital tools found new ways to be utilised and revolutionise the way processes are made, the perception of human capital, and the continuous use of technology.

In this context, it is proposed the following future academic research challenges:

- To study what strategies are used by organisations to cope with COVID-19 variants and what effect had on their stakeholders;
- To study the characteristics and outcomes of COVID-19 on global markets;
- To study how COVID-19 changes the dynamic between departments inside the organisation.

Acknowledgement

We would like to thank every author referenced in this research paper and their given contributions.

References

Alguliyev, R., Imamverdiyev, Y., and Suhostat, L. (2018). Cyber-physical systems and their security issues. *Comput. Ind*., 100, 212-223. https://doi.org/10.1016/j.micpro.2020.103201

Abid H., Javaid, M. & Vaishya, R. (2020), Effects of COVID-19 Pandemic in Daily Life. *Current Medicine Research and Practice*, 10(2), 78–79. https://doi.org/ 10.1016/j.cmrp.2020.03.011

Agostino D., Arnaboldi, M., & Lema, M. (2020), New development: COVID-19 as an accelerator of digital transformation in public service delivery. *Public Money and Management*, 0(0), 1–4. https://doi.org/10.1080/09540962.2020.1764206

Adriole, S. (2017). Five myths about digital transformation. *MIT Sloan Management Review*, 58(3), 20-22.

Brunetti, F., Matt, D., Bonfati, A., Longhi, A., Pedrini, G., and Orzes, G. (2020). Digital transformation challenges: strategies emerging from a multi-stakeholder approach. *TQM Journal*, 32(4), 697-724. https://doi.org/10.1108/TQM-12-2019-0309

Bai, C., Quayson, M., & Sarkis, J. (2021), COVID-19 pandemic digitisation lessons for sustainable development of micro-and small- enterprises. *Sustainable Production and Consumption*, 27, 1989- 2001. https://doi.org/10.1016/j.spc.2021.04.035

Bag, S., Wood, L., Mangla, S. & Luthrad, S. (2020), Procurement 4.0 and its implications on business process performance in a circular economy. Resources, *Conservation and Recycling*, 152, 104502. https://doi.org/10.1016/j.resconrec.2019.104502

Cukusic, M. (2021). Contributing to the current research agenda in digital transformation in the context of smart cities. *International Journal of Information Management*, 58, article 102330. https://doi.org/10.1016/j.ijinfomgt.2021.102330

Cardoso, D. (2021). Application of predictive maintenance concepts using artificial intelligence tools. *Applied Sciences*, 11, 1-18. https://doi.org/10.3390/app11010018

Collings, D., Nyberg, A., Wright, P., & McMackin, J. (2021), Leading through paradox in a COVID-19 World: Human Resources Comes of Age. *Human Resource Management Journal*. 1–15. https://doi.org/10.1111/1748-8583.12343

Carnevale, J. & Hatak, I. (2020), Employee Adjustment and well-being in the era of COVID-19: Implications for Human Resource Management. *Journal of Business Research,* 116, 183-187. https://doi.org/10.1016/j.jbusres.2020.05.037

Caligiuri, P., Cieri, H., Minbaeva, D., Verbeke, A., & Zimmermann, A. (2020), International HRM Insights for Navigating the COVID-19 Pandemic: Implications for Future Research and Practice. *Journal of International Business* Studies, 51, 697-713. https://doi.org/10.1057/s41267-020-00335-9

McGuire, D. Germain, M., & Reynolds, K. (2021), Reshaping HRD in Light of the COVID-19 Pandemic: An Ethics of Care Approach. *Advances in Developing Human Resources, 23*(1), 26-40. https://doi.org/10.1177/1523422320973426

Donthu, N., Gustafsson, A. (2020), Effects of COVID-19 on Business and Research. *Journal of Business Research,* 117, 284-289. https://doi.org/10.1016/j.jbusres.2020.06.008

Del Giudice, M., Scuotto, V., Garcia-Perez, A., and Petruzzeli, A. (2019). Shifting wealth II in Chinese economy. The effect of the horizontal technology spillover for SMEs for international growth.

Technological Forecast. Soc. Change, 145, 307-316. https://doi.org/10.1016/j.techfore.2018.03.013

Doshi, A., Platt, Y., Dressen, J., Mathews, B., and Siy, J. (2020). Keep calm and log on: telemedicine for COVID-19 pandemic response 2020–05 *Journal Hosp. Med.*,15, 301-304. https://doi.org/10.12788/jhm.3419

Aizenberg, E., & Hoven, J.V.D. (2020), Designing for human rights in AI. *Big Data & Society, 7*(2), p.1-14. https://doi.org/10.1177/2053951720949566

Faraj, S., Renno, W., and Bhardwaj, A. (2021). Unto the breach: what the COVID-19 pandemic exposes about digitalisation. *Inf. Organ.*, 31, 1, 1-7. https://doi.org/10.1016/j.infoandorg.2021.100337

Gao, G. & Sai, L. (2020), Towards a "Virtual" world: Social Isolation and Struggles during the COVID-19 Pandemic as Single Women Living Alone. *Gender, Work, and Organization, 17*(5), 754-762. https://doi.org/10.1111/gwao.12468

Gamaroodi, M., Favirar, F., Haghighi, M., Shoorehdeli, M., and Jolfaei, A. (2020). Detection of anomalies in industrial iot systems by data mining: Study of CHRIST osmotron water purification system. *IEEE Internet of Things Journal*, 8, 10280-10287.

Gandrita, D. M., Gandrita, A. & Rosado, D.P. (2022). Overcoming Remote Leadership Challenges: Lessons Learned from Covid-19. Journal of Business and Management studies, 4(4), 170-183. https://doi.org/10.32996/jbms.2022.4.4.27

Ghobakhloo, M., Fathi, M. (2020), Corporate survival in Industry 4.0 era: the enabling role of lean-digitised manufacturing. *Journal of Manufacturing Technology Management, 31*(1), 1–30. https://doi.org/10.1108/JMTM-11-2018-0417

Horváth, D., Szabó, R. (2019). Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? *Technological Forecasting and Social Change,* 146, 119-13. https://doi.org/10.1016/j.techfore.2019.05.021

Hsu, L., Wang, C. (2012), Clarifying the Effect of Intellectual Capital on Performance: The Mediating Role of Dynamic Capability. *British Journal of Management, 23*(2),179–205. https://doi.org/10.1111/j.1467-8551.2010.00718.x

Iza Gigauri, I. (2020), Effects of COVID on Human Resource Management from the Perspective of Digitalization and Work-Life Balance. *International Journal of Innovative Technologies in Economy, 4*(31). https://doi.org/10.31435/rsglobal_ijite/30092020/7148

Kumar, A., Luthra, S., Kumar, S., and Kazançoğlud, Y. (2020), COVID-19 impact on sustainable production and operations management. *Sustainable Operations and Computers*, 1, 1–7. https://doi.org/10.1016/j.susoc.2020.06.001

Kateb, S., Ruehle, C., Kroon, D., Burg, E., and Huber, M., (2022). Innovating under pressure: Adopting digital technologies in social care organisations during the COVID-19 crisis. *Technovation*, article 102536. https://doi.org/10.1016/j.technovation.2022.102536

Kraus, S., Susanne, D., Ferreira, J., Veiga, J., Kailer, N., and Weinmann, A. (2022). Digital transformation in business and management research: An overview of the current status quo. *International Journal of Information Management*, 63, article nº 102466. https://doi.org/10.1016/j.ijinfomgt.2021.102466

Liu, D., Chen, S., & Chou, T. (2011), *Reso*urce fit in digital transformation: Lessons learned from the CBC Bank global e-banking *project. Management Decision*, 49(10), 1728–1742. https://doi.org/10.1108/00251741111183852

Martinez-Caro, E., Cegarra, J., and Ruiz, F. (2020). Innovating under pressure: Adopting digital technologies in social care organisations during the COVID-19 crisis. *Technovation,* article 102536. https://doi.org/10.1016/j.technovation.2022.102536

Manfreda, A., Ljubi, K., and Groznik, A. (2021). Autonomous vehicles in the smart city era: An empirical study of adoption factors important for millennials. *International Journal of Information Management*, 58, Article 102050. https://doi.org/ 10.1016/j.ijinfomgt.2019.102050

Mahmood, S., Hasan, K., Carras, M., and Labrique, A. (2020). Global preparedness against COVID-19: we must leverage the power of digital health. *JMIR Public Health and Surveillance, 6*(2), 1-7. https://doi.org/10.2196/18980

Matzler, K., von den Eichen, F., Anschober, M. and Kohler, T. (2018), The crusade of digital disruption. *Journal of Business Strategy, 39*(6), pp. 13-20. https://doi.org/10.1108/JBS-12-2017-0187

Mosterman, P., Zander, J. (2016). Cyber-physical systems challenges: a needs analysis for collaborating embedded software systems. *Software Syst. Model*, 15, 5-16. https://doi.org/10.1007/s10270-015-0469-x

Mateescu, M., Muscalu, M. & Baleanu, D. (2020), Human Resources Dynamics in the Context of the Pandemic. *Economic Sciences Series, 20*(1), 415-421.

Olan, F., Arakpogun, E., Suklan, J., Nakpodia, F., Damij, N., and Jayawickrama, U. (2022). Artificial intelligence and knowledge sharing: Contributing factors to organisational performance. Journal of Business Research, 145, 605-615. https://doi.org/10.1016/j.jbusres.2022.03.008

O'Leary, D. (2020), Evolving Information Systems and Technology Research Issues for COVID-19 and Other Pandemics. *Journal of Organizational Computing and Electronic Commerce*, 30(1), 1–8. https://doi.org/10.1080/10919392.2020.1755790

Oztemel, E., Gursev, S. (2020), Literature review of Industry 4.0 and related technologies. *Journal of Intelligent Manufacturing, 31*(1), 127–182. *https://doi.org/10.1007/s10845-018-1433-8*

Bastos, B. P. (2022). Contribution of hotels' revenue management for supply chain sustainability. Journal of Revenue and Pricing Management, 0123456789, 1–12. https://doi.org/10.1057/s41272-022-00380-z

Papa, A., Santoro, G., Tirabeni, L., and Monge, F. (2018). Social media as tool for facilitating knowledge creation and innovation in small and medium enterprises. .*Baltic Journal of Management, 13*(3), 329-344. *https://doi.org/10.1108/bjm-04-2017-0125*

Pianese, T., & Errichiello, L. (2016). Organizational Control in the Context of Remote Work Arrangements: A Conceptual Framework. *Performance Measurement and Management Control: Contemporary Issues* 3, 273-305. https://doi.org/10.1108/S1479-351220160000031009

Barbieri, P., Boffelli, A., Elia, S., Fratocchi, l., Kalchschmidt, M., Samson, D. (2020), What can we learn about reshoring after COVID-19? *Operations Management Research, 13*(3–4), 131–136. https://doi.org/10.1007/s12063-020-00160-1

Qadir, F., Kakamad, F., Abdullah, I., Mohammed, S., Salih, R., Ali, R., and Salh, A. (2022). The relationship between CT severity infections and oxygen saturation in patients infected with COVID-19, a cohort study Ann. *Med. Surg*.,76, Article 10343. https://doi.org/10.1016/j.amsu.2022.103439

Burbach, R. (2012), Strategic Alignment: The Sine Qua Non of e-HRM Implementation? In: Tansley C and Williams H (ed). *Proceedings of the 4th International e-HRM Conference: Innovation, Creativity, and e-HRM. Nothingham UK*, 28, 103-127.

Rudrapati, R. (2022). Using industrial 4.0 technologies to combat the COVID-19 pandemic. *Annals of Medicine and Surgery*, 78, article 103811. https://doi.org/10.1016/j.amsu.2022.103811

Rudolph, C., Allan, B., Clark, M., Hertel, G., Hirschi, A., & Kunze, F. (2021). Pandemics: Implications for research and practice in industrial and organisational psychology. *Cambridge press*, *14*(1-2), 1-35. https://doi.org/10.1017/iop.2020.48

Richter, A. (2020), Locked-down digital work. *International Journal of Information Management*, 55, 102157. https://doi.org/10.1016/j.ijinfomgt.2020.102157

Shockley, K., Shoss, M., Sonnentag, S., & Zacher, S. (2021), Pandemics: Implications for Research and Practice in Industrial and Organisational Psychology. *Industrial and Organisational Psychology: Perspectives on Science and Practice, 14*(1), 1-35. https://doi.org/10.1017/iop.2020.48

Saks, A. (2021). Caring human resources management and employee engagement. *Human Resource Management Review*, 100835. https://doi.org/10.1016/j.hrmr.2021.100835

Soto-Acosta, P. (2020), COVID-19 Pandemic: Shifting Digital Transformation to a High-Speed Gear. *Information Systems Management, 37*(4), 260–266. https://doi.org/10.1080/10580530.2020.1814461

Strohmeier, S. (2020), Digital Human Resource Management: A Conceptual Clarification. German. *Journal of Human Resource Management, 34*(3) p345–365. https://doi.org/10.1177/2397002220921131

Sohrabi, A., Alsafi, Z., O'Neil, N., Khan, M., Kerwan, A., AL-Jabir, A., and Losifidis, C. (2020). World Health Organization declares global emergency: a review of the 2019 novel Coronavirus (COVID-19). *Int. J. Surg*.,76, 71-76. https://doi.org/10.1016/j.ijsu.2020.02.034

Scuotto, V., Caputo, F., Villasalero, M., and Giudice, M. (2017). A multiple buyer–supplier relationship in the context of SMEs' digital supply chain management. *Prod. Plann. Control, 28*(16), 1378-1388. https://doi.org/10.1080/09537287.2017.1375149

Tangi, L., Janssen, M., & Benedetti, M. (2021). Digital government transformation: A structural equation modelling analysis of driving and impeding factors. *International Journal of Information Management,* 60, Article 102356. https://doi.org/10.1016/j.ijinfomgt.2021.102356

Thoben, K., Wiesner, S., and Wuest, T. (2017). "Industrie 4.0" and smart manufacturing-a review of research issues and application examples. *Int. J. Autom. Technol.*, 11, 4-16. https://doi.org/10.20965/ijat.2017.p0004

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems, 28,* (2), 118-144. https://doi.org/10.1016/j.jsis.2019.01.003

Veile, J., Kiel, D., Müller, J., & Voigt, K. (2019), Lessons learned from Industry 4.0 implementation in the German manufacturing industry. *Journal of Manufacturing Technology Management*, *31*(5), 977–997. https://doi.org/10.1108/JMTM-08-2018-0270

Watkins, K., Marsick, V. (2020), Informal and Incidental Learning in the Time of COVID-19. *Advances in Developing Human Resources*, 23(1), 88–96. https://doi.org/10.1177/1523422320973656

Wang, X., Givenchi, M., and Wang, L. (2017). Manufacturing system on the cloud: a case study on cloud-based process planning. *Procedia CIRP*, 63, 39-45.

White, M. (2012), Digital workplaces: Vision and reality. *Business Information Review, 29*(4), 205–214. https://doi.org/10.1177/0266382112470412

Wiesmann, B., Snoei, J.R., Hilletofth, P. and Eriksson, D. (2017), Drivers and barriers to reshoring: a literature review on offshoring in reverse. *European Business Review, 29*(1), pp. 15-42. https://doi.org/10.1108/EBR-03-2016-0050

Wrycza, S., Maslanlowski, J. (2020). Social media users' opinions on remote work during the COVID-19 pandemic. Thematic and sentiment analysis. *Information Systems Management, 37*(4), p. 288-297. https://doi.org/10.1080/10580530.2020.1820631

Wen, J., Aston, J., Liu, X., & Ying, T. (2020), Effects of misleading media coverage on public health crisis: a case of the 2019 novel coronavirus outbreak in China. *Anatolia, 31*(2), 331–336. https://doi.org/10.1080/13032917.2020.1730621

Zhou, C., Su, F.,Tao Pei, Zhang, A., Du, Y., Luo Zhidong Cao, B., Wang, J., Yuan, W., Zhu, Y., Song, C., Chen, J., Xu, J., Li, F., Ma, T., Jiang, L., Yan, Jiawei Y. & Xiao, H. (2021), *COVID-19 Challenges to GIS with Big Dat*a. Geography and Sustainability, 1, 77-87. https://doi.org/10.1016/j.geosus.2020.03.005

Zuopeng, W., Zhang & Li, W. (2021), Information technology solutions, challenges, and suggestions for tackling the COVID-19 pandemic. I*nternational Journal of Information Management,* 57, 102287. https://doi.org/10.1016/j.ijinfomgt.2020.102287

Zhang, D., Lim, J., and Zhou, L. (2020). From networking to mitigation: The role of social media and analytics in combating the COVID-19 pandemic. *Information Systems Management*, 37, 318-326. https://doi.org/10.1080/10580530.2020.1820635

Zhang, C., Marin, S., and Yu, M. (2021). Exploring public sentiment on enforced remote work during COVID-19. *Journal of Applied Psychology, 106(*6), 797. https://doi.org/10.1037/apl0000933

Zekic, M., Mitrovic, S., and Has, A. (2021). Machine learning based system for managing energy efficiency of public sector as an approach towards smart cities. *International Journal of Information Management,* 58, Article 102074. https://doi.org/10.1016/j.ijinfomgt.2020.102074