Operational Research (2023) 23:45
https://doi.org/10.1007/s12351-023-00784-8

REVIEW

Operational research and business intelligence as drivers for digital transformation

Pavlos Delias[1] · **Fotis C. Kitsios**[2]

Received: 10 May 2023 / Revised: 10 May 2023 / Accepted: 28 May 2023 /
Published online: 26 June 2023

Abstract
Digital transformation has become a crucial phenomenon, impacting society and industries through the implementation of digital technologies. It involves organizations adapting to gain a competitive edge, sense disruptions, and reorganize their business models. Challenges include the need for new strategies and skills, while opportunities arise from increased organizational performance and value creation through data utilization and innovative solutions. Overcoming inertia and resistance are critical in achieving successful digital transformation. Operational research plays a significant role in understanding and addressing these challenges and opportunities in the digital age. This article introduces the Special Issue on 'Operational Research and Business Intelligence as Drivers for Digital Transformation' and briefly discuss its relevance and the works it includes.

Keywords Business intelligence · Operational research · Digital transformation

1 Introduction

In recent years, digital transformation has emerged as an important phenomenon, not only for researchers studying strategic management (Bharadwaj et al. 2013) but also for practitioners (Fitzgerald et al. 2014). Digital transformation encompasses, on a high level, the profound changes that are taking place in society and industries as a direct result of the implementation of digital technologies (Agarwal et al. 2011; Majchrzak et al. 2016). Digital transformation is a process in which digital technologies push organizations to act in order to gain or keep a competitive edge

✉ Pavlos Delias
pdelias@af.ihu.gr

Fotis C. Kitsios
kitsios@uom.gr

[1] International Hellenic University, Kavala, Greece

[2] University of Macedonia, Thessaloniki, Greece

of companies to sense disruptions, take advantage of them (for example, by implementing strategic responses), and reorganize relevant aspects of their business models in response to those disruptions are key questions regarding the effectiveness of these responses (Ramesh and Delen 2021; Vial 2019).

Recent research has contributed to increase our understanding of specific aspects of the digital transformation phenomenon. In line with previous findings on IT-enabled transformation, research has shown that technology itself is only a part of the complex puzzle that must be solved for organizations to remain competitive in a digital world (Kitsios and Grigoroudis 2020; Kitsios et al. 2009). The puzzle must be solved for organizations to have any chance of surviving in the digital world (Heavin and Power 2018; Vial 2019). Digitization is causing a change in the business world, which is already changing quickly. This change is changing the way people work and creating new business models, organizational structures, and new models for entrepreneurship (Kitsios and Kamariotou 2023a). The expansion of emerging markets is causing changes not only in terms of social structure and technological development but also in the geography of economic opportunity (Kamariotou and Kitsios 2022; Kitsios and Kamariotou 2023b). The need for innovative management strategies, including process innovation (Delias and Nguyen 2021) in the digital age has been brought to light by both professionals in the field and academics.

1.1 Digital technologies as sources of disruption

The markets in which companies compete are being shaken up as a result of the proliferation of digital technologies (Mithas et al. 2013). They favor services over products (Barrett et al. 2015), lower barriers to entry, and make it harder for incumbent players to keep their competitive edge because they make it easier to mix and match existing products and services to make new digital offerings (Yoo et al. 2010). According to this point of view, in light of the fact that businesses that compete in a more agile manner in a disruptive world have been redefined as a result of the 4th (Industrial) Revolution and rapidly evolving technologies such as Artificial Intelligence, Cloud, Internet of Things, Robotics, Machine Learning, and Blockchain have been redefined, Chief Digital Officers (CDO) are attempting to determine what new strategies, organizational structures, and managerial skills they will require in order to compete in a constantly evolving competitive landscape. In the context of digital transformation, companies strive to maximize the potential of their data for their own benefit, or in some cases, to monetize their data by selling it to third parties in order to generate revenue (Loebbecke and Picot 2015). Businesses can gain a competitive edge by using analytics to make their processes more efficient (for example, by using data-driven algorithmic decision-making) or by offering services that better meet their customers' needs (Günther et al. 2017; Delias et al. 2018).

In light of these disruptions, organizations need to devise ways to remain competitive in order to survive in a world where digital technologies offer both game-changing opportunities for companies and existential threats to companies at the same time (Sebastian et al. 2017). Digital transformation is portrayed as a

higher-level phenomenon that causes disruption in the competitive environment and requires a response from the organization's part (Balakrishnan and Das 2020).

1.2 Digital transformation as a source of value creation

Organizational agility can be defined as a company's ability to detect opportunities for innovation and seize those competitive market opportunities by assembling the requisite assets, knowledge, and relationships with speed and surprise (Günther et al. 2017; Huang et al. 2017; Sambamurthy et al. 2003). Digital transformation is also associated with an increase in a number of dimensions of organizational performance. Some of these dimensions include innovativeness (Matt et al. 2015), financial performance (Karimi and Walter 2015), firm growth, reputation (Kane 2014), and competitive advantage. Businesses can make more money when digital technologies make it easier for customers to interact with them and take part in their business.

The use of digital technologies makes it possible to develop new value propositions that are dependent on the delivery of services to an increasing degree (Barrett et al. 2015). Organizations are using digital technologies to transition away from or augment the sales of physical products with the sales of services as an integral part of their value proposition. This allows organizations to satisfy the needs of customers by offering innovative solutions as well as to gather data on the interactions that customers have with products and services (Porter and Heppelmann 2014; Wulf et al. 2017).

Digital technologies are also used by businesses to make changes to the ways they sell and distribute their products. One of two approaches is possible to achieve this goal. First, businesses can reach out to customers and engage them in conversation by establishing new channels that are customer-facing, such as through the use of social media (Hansen and Sia 2015). Second, the emergence of algorithmic decision-making made possible by digital technologies (Günther et al. 2017; Newell and Marabelli 2015) provides an unrivaled opportunity for organizations to effectively allow software to coordinate activities across organizations. Delias and Matsatsinis (2009) early identified the potentials of having a digital twin-like simulation for strategic management decisions. This is a problem for organizations, though, because it can be difficult for software to work well across organizations to coordinate activities. One of the most important parts of a company's ability to successfully participate in a digital platform or ecosystem is how well it integrates digital technologies from different parties. The majority of studies on digital transformation acknowledge that it is necessary for companies to collaborate with other organizations in order to create innovative digital products (e.g., Hansen and Sia 2015; Nehme et al. 2015).

1.3 Challenges for digital transformation

In the context of DT, when an organization's structure and culture change, it is common for employees to take on tasks that were traditionally outside of their functions.

To be more specific, the research emphasizes the concept that digital transformation encourages situations in which employees who are not part of the IT function take the lead on projects that are heavily dependent on technology (Yeow et al. 2018). On the other hand, members of the IT function are expected to be involved in putting these projects into action and to know about business. As new forms of automation and decision-making processes are made possible by digital technologies, questions regarding the need to develop the skills of existing workers (Hess et al. 2016) and the skills required for future workers who will form the digital workforce (Colbert et al. 2016) are also becoming increasingly relevant. This is because digital technologies enable new forms of automation and decision-making processes (Watson 2017). The need for organizations to rely on human capital is not eliminated by digital transformation; rather, employees are required to rely more heavily on their analytical skills to solve increasingly complex business problems. Accompanying employees through this transition poses significant challenges that go beyond the purview of human resources (Karimi and Walter 2015; Singh and Hess 2017).

Inertia is one of the most significant obstacles that digital transformation must overcome. It is important to consider inertia in situations in which existing resources and capabilities can serve as barriers to disruption (Svahn et al. 2017). This highlights the significance of path dependence as a limiting factor for innovation enabled by digital technologies (Srivastava et al. 2016). When disruptive technologies are first brought into an organization, employees may fight them. This is another barrier to digital transformation.

According to the practitioner literature, "innovation fatigue" (Fitzgerald et al. 2014) is one of the causes of resistance, which raises important questions regarding the ways in which and pace at which technologies are introduced into an organization. Singh and Hess (2017) can be used to make sure that digital technologies are used in ways that are consistent with the organization's culture and that employees are used to, which makes it easier for them to be accepted. Resistance is caused by inertia that is rooted in everyday work and can't be fixed by just changing how employees act. Rather, processes must be altered to allow for flexibility in the face of change. Svahn et al. (2017) say that resistance can also be caused by people not knowing what digital technologies can benefit them.

2 Digital transformation in operational research

This collection of papers disseminates recent scientific advances in the field of Operational Research and Management Science. It investigates the challenges and opportunities of developing and using operational research in a wide range of business areas. This collection of papers compiles a high-quality selection of recent research articles on the subject. Also, it aims to answer strategic questions of scholars and practitioners about the importance and effects of digital transformation in both the private and public sectors. Furthermore, it aims to shed light on practically relevant operational research concerns in the digital age, as methodologies and concepts are inevitably hazy and their practical implications are limited.

2.1 This special issue

The current special issue followed the organization of the Balkan Conference on Operational Research, which run under the main theme of "Operational Research in the Era of Digital Transformation and Business Analytics". The call for papers attracted the attention of both participants of the conference as well as of scholars of the greater community. Following rigorous reviewing procedures we selected 8 submissions that are briefly presented here.

Gayiallis et al. (2023) present the development of an information system that optimizes vehicle routes and schedules for efficient delivery of goods in urban areas, considering delivery time windows, customer requirements, street network characteristics, and traffic congestion issues. The system utilizes operational research algorithms enabled by information technologies to support logistics operations effectively. To further enhance logistics operations, Asgharizadeh et al. (2023) present a multi-level supply chain model for the Fast-Moving Consumer Goods (FMCG) industry. Their model aims to reduce the transmission of COVID-19 while maintaining the freshness of items, optimizing the objectives of minimizing the total costs of supply chain network design and maximizing the freshness of items.

Symeonidis et al. (2023) present a framework that analyzes user posts related to a product on social networking platforms. It categorizes posts based on intention, sentiment, and type of opinion, and can help businesses make decisions based on public opinions expressed on social media. Building upon the analysis of public opinions, Dimitriou and Sartzetaki (2023) develop a performance assessment model for managing transport enterprises. Their framework considers the different stakeholders and shareholders as well as social actors that play a role in transport enterprise performance optimization, ultimately aiming to optimize enterprise performance.

Mitropoulos and Mitropoulos (2023) propose a framework using stochastic DEA model and meta-frontier to assess the efficiency of national ecosystems for entrepreneurship across 30 countries. The authors aim to analyze the entrepreneurial gap between innovation-driven and efficiency-driven countries and provide specific improvement suggestions. To complement the assessment of national ecosystems for entrepreneurship, Sartal et al. (2023) explore the relationship between lean management practices and Industry 4.0 technologies in manufacturing shop floors. Their study utilizes a fuzzy-set qualitative comparative analysis to examine possible interactions and highlights the influence of vertical and horizontal data integration in improving industrial performance.

Babiloni et al. (2023) propose a new methodology to estimate the fill rate in the Order-Point, Order-Up-to-Level inventory system by correcting the bias introduced by neglecting the undershoots. The proposed methods are developed under a data-driven perspective and are used to illustrate the practical implications of this hypothesis on the performance and design of the (s, S) system. To further explore practical implications, Vavatsikos et al. (2023) propose a decision-making framework for GIS-based land-use suitability analysis. Their framework combines the PROMETHEE II outranking multicriteria method with inverse distance weighting (IDW) spatial interpolation model, analytic hierarchy process (AHP) as a criterion weights elicitation method, and Monte Carlo Simulation, providing a detailed discussion for

a variety of net preference flows estimation options using both total and per criterion net preference flows.

The collection of papers highlights the role of operational research and business intelligence as drivers for digital transformation in various domains. From optimizing logistics operations and supply chain management to leveraging social media data for decision-making and exploring the integration of Industry 4.0 technologies, these studies demonstrate the power of data-driven approaches and information technologies in enhancing operational efficiency and enabling informed strategic choices. The findings underscore the importance of embracing digital transformation in achieving competitive advantages and fostering innovation across industries. A lot of focus is put on empirical evidence and the use of operational research methodology frameworks to measure and evaluate the effects of digital transformation. Integrating these frameworks with technical approaches to the development of digital transformation in businesses and organizations is a promising and rich area of research for the coming years.

Funding Open access funding provided by HEAL-Link Greece.

References

Agarwal R, Johnson SL, Lucas HC (2011) Leadership in the face of technological discontinuities: the transformation of EarthColor. Commun Assoc Inf Syst 29(1):628–644

Asgharizadeh E, Daneshvar A, Homayounfar M, Salahi F, Khouzani MA (2023) Modeling the supply chain network in the FMCG industry during COVID-19 pandemic. Oper Res Int J 23:14

Babiloni E, Guijarro E, Trapero JR (2023) Stock control analytics: a data-driven approach to compute the fill rate considering undershoots. Oper Res Int J 23:18

Balakrishnan R, Das S (2020) How do firms reorganize to implement digital transformation? Strateg Change 29(5):531–541

Barrett M, Davidson E, Prabhu J, Vargo SL (2015) Service innovation in the digital age. MIS Q 39(1):135–154

Bharadwaj A, El Sawy OA, Pavlou PA, Venkatraman NV (2013) Digital business strategy: toward a next generation of insights. MIS Q 37:471–482

Colbert A, Yee N, George G (2016) The digital workforce and the workplace of the future. Acad Manag J 59(3):731–739

Delias P, Lagopoulos A, Tsoumakas G, Grigori D (2018) Using multi-target feature evaluation to discover factors that affect business process behavior. Comput Ind 99:253–261

Delias P, Matsatsinis N (2009) A genetic approach for strategic resource allocation planning. CMS 6:269–280

Delias P, Nguyen GT (2021) Prototyping a business process improvement plan. An Evid-Based Approach Inf Syst 101:101812
Dimitriou D, Sartzetaki M (2023) Performance assessment modeling for managing transport enterprises based on modified fuzzy TOPSIS analysis. Oper Res Int J 22:6037–6053
Fitzgerald M, Kruschwitz N, Bonnet D, Welch M (2014) Embracing digital technology: a new strategic imperative. MIT Sloan Manag Rev 55(2):1–12
Gayiallis S, Kechagias EP, Konstantakopoulos GD (2023) A city logistics system for freight transportation: integrating information technology and operational research. Oper Res Int J 22:5953–5982
Günther WA, Mehrizi MHR, Huysman M, Feldberg F (2017) Debating big data: a literature review on realizing value from big data. J Strateg Inf Syst 26(3):191–209
Hansen R, Sia SK (2015) Hummel's digital transformation toward omnichannel retailing: key lessons learned. MIS Q Exec 14(2):51–66
Heavin C, Power DJ (2018) Challenges for digital transformation–towards a conceptual decision support guide for managers. J Decis Syst 27:38–45
Hess T, Matt C, Benlian A, Wiesböck F (2016) Options for formulating a digital transformation strategy. MIS Q Exec 15(2):123–139
Huang JC, Henfridsson O, Liu MJ, Newell S (2017) Growing on steroids: rapidly scaling the user base of digital ventures through digital innovation. MIS Q 41(1):301–314
Kamariotou M, Kitsios F (2022) Strategy implications of IS planning: executives' perceptions on firm performance. Inf Manag 59(3):103625
Kane GC (2014) How Facebook and Twitter are reimagining the future of customer service. MIT Sloan Manag Rev 55(4):1–6
Karimi J, Walter Z (2015) The role of dynamic capabilities in responding to digital disruption: a factor-based study of the newspaper industry. J Manag Inf Syst 32(1):39–81
Kitsios FC, Grigoroudis E (2020) Evaluating service innovation and business performance in tourism: a multicriteria decision analysis approach. Manag Decis 58(11):2429–2453
Kitsios F, Kamariotou M (2023a) Digital innovation and entrepreneurship transformation through open data hackathons: design strategies for successful start-up settings. Int J Inf Manag 69:102472
Kitsios F, Kamariotou M (2023b) Information systems strategy and innovation: analyzing perceptions using multiple criteria decision analysis. IEEE Trans Eng Manag 70(5):1977–1985
Kitsios F, Doumpos M, Grigoroudis E, Zopounidis C (2009) Evaluation of new service development strategies using multicriteria analysis: predicting the success of innovative hospitality services. Oper Res Int J 9(1):17–33
Loebbecke C, Picot A (2015) Reflections on societal and business model transformation arising from digitization and big data analytics: a research agenda. J Strateg Inf Syst 24(3):149–157
Majchrzak A, Markus ML, Wareham J (2016) Designing for digital transformation. MIS Q 40(2):267–278
Matt C, Hess T, Benlian A (2015) Digital transformation strategies. Bus Inf Syst Eng 57(5):339–343
Mithas S, Tafti A, Mitchell W (2013) How a firm's competitive environment and digital strategic posture influence digital business strategy. MIS Q 37:511–536
Mitropoulos P, Mitropoulos A (2023) Evaluating efficiency and technology gaps of the national systems of entrepreneurship using stochastic DEA and club convergence. Oper Res Int J 23:1
Nehme JJ, Srivastava SC, Bouzas H, Carcasset L (2015) How Schlumberger achieved networked information leadership by transitioning to a product-platform software architecture. MIS Q Exec 14(3):105–124
Newell S, Marabelli M (2015) Strategic opportunities (and challenges) of algorithmic decision-making: a call for action on the long-term societal effects of 'datification.' J Strateg Inf Syst 24(1):3–14
Porter ME, Heppelmann JE (2014) How smart, connected products are transforming competition. Harv Bus Rev 92(11):64–88
Ramesh N, Delen D (2021) Digital transformation: how to beat the 90% failure rate? IEEE Eng Manag Rev 49(3):22–25
Sambamurthy V, Bharadwaj A, Grover V (2003) Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. MIS Q 27:237–263
Sartal A, Llach J, León-Mateos F (2023) Do technologies really affect that much? Exploring the potential of several industry 4.0 technologies in today's lean manufacturing shop floors. Oper Res Int J 22:6075–6106
Sebastian I, Ross J, Beath C, Mocker M, Moloney K, Fonstad N (2017) How big old companies navigate digital transformation. MIS Q Exec 16(3):197–213

Singh A, Hess T (2017) How chief digital officers promote the digital transformation of their companies. MIS Q Exec 16(1):1–17

Srivastava SC, Teo TS, Devaraj S (2016) You can't bribe a computer: dealing with the societal challenge of corruption through ICT. MIS Q 40(2):511–526

Svahn F, Mathiassen L, Lindgren R, Kane GC (2017) Mastering the digital innovation challenge. MIT Sloan Manag Rev 58(3):14–16

Symeonidis S, Peikos G, Arampatzis A (2023) Unsupervised consumer intention and sentiment mining from microblogging data as a business intelligence tool. Oper Res Int J 22:6007–6036

Vavatsikos AP, Sotiropoulou KF, Tzingizis V (2023) GIS-assisted suitability analysis combining PROMETHEE II, analytic hierarchy process and inverse distance weighting. Oper Res Int J 22:5983–6006

Vial G (2019) Understanding digital transformation: a review and a research agenda. J Strateg Inf Syst 28:118–144

Watson HJ (2017) Preparing for the cognitive generation of decision support. MIS Q Exec 16(3):153–169

Wulf J, Mettler T, Brenner W (2017) Using a digital services capability model to assess readiness for the digital consumer. MIS Q Exec 16(3):171–195

Yeow A, Soh C, Hansen R (2018) Aligning with new digital strategy: a dynamic capabilities approach. J Strateg Inf Syst 27(1):43–58

Yoo Y, Henfridsson O, Lyytinen K (2010) Research commentary—the new organizing logic of digital innovation: an agenda for information systems research. Inf Syst Res 21(4):724–735