Best practices for digital transformation based on a systematic literature review

Ziboud Van Veldhoven and Jan Vanthienen
LIRIS, KU Leuven, Leuven, Belgium

Abstract

Purpose – Digital transformation (DT) projects are complex and often unsuccessful. While researchers have suggested many guidelines and best practices on how to successfully roll out DT projects and how they are spread among a large number of scientific papers. The aim of this paper is to synthesize these guidelines into clear overviews.

Design/methodology/approach – A systematic literature review was conducted on both Scopus and Web of Science to search for papers suggesting DT guidelines or best practices. In total, 150 papers dealing with DT and guidelines were fully analyzed.

Findings – Eight main DT guidelines were found and each one was expanded with several best practices on how to implement these. The results are eight tables giving an overview of the commonly agreed-upon best practices for each DT guideline.

Research limitations/implications – These overviews are useful for both researchers and practitioners, to guide future work and to be inspired respectively. This paper calls for more research on how these guidelines are followed in practice, how these differ per industry and what their impact is on the overall success of DT projects.

Originality/value – The synthesis of DT guidelines organized into an accessible format has not yet been conducted before, and can serve as a seminal pinpoint for future research.

Keywords Digital transformation, Guidelines, Best practices, Recommendations

Paper type Research paper

Introduction

Digital technologies have a massive impact on our society. Companies must constantly innovate to keep up with the current possibilities and trends, a process commonly referred to as digital transformation (DT). This concept has acquired many definitions over the years that differ both in scale and depth. Some commonly used definitions include "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019, p. 1) or as "the continuously increasing interaction between digital technologies, business, and society" (Van Veldhoven & Vanthienen, 2021, p. 11). The powerful ways in which digital technologies change the competitive landscape requires good executive sense and awareness to quickly transform the opportunities into competitive advantages (Bonnet & Westerman, 2021). This has become crucial as the rate of change is increasing and thus the rate of opportunities.

Companies struggle with rolling out DT projects successfully. Not only are these projects strategically difficult due to their size and complexity (Schneider & Kokshagina, 2021), but

also they are paired with technological (Fuchs & Hess, 2018), cultural (Diener & Špaček, 2021) and behavioral challenges (Saarikko, Westergren, & Blomquist, 2020). This results in a high failure rate estimated to be between 66% and 87.5% of all DT projects (Libert, Beck, & Wind, 2016; Wade & Shan, 2020). Therefore, researchers and leading companies are exploring the best practices and guidelines that can aid companies in their transformation. This is difficult because the scale of change is so large resulting in many different business aspects that need to be covered. Yet, detailed DT guidelines for managers are lacking (Hess, Benlian, Matt, & Wiesböck, 2016).

In this paper, we aim to create a practical summary of these guidelines. Not only are the guidelines currently spread among a large number of papers, but there is also a significant lack of how these guidelines can be put into practice. Most guidelines rest on a certain level of abstraction such as "be agile" without clear communication on how a firm can become more agile (Peter, Kraft, & Lindeque, 2020). We conducted a systematic literature review to retrieve the commonly agreed-upon best practices and categorized them into eight main guidelines. These were verified with seven interviews with DT experts before we continued with the further analysis of the literature to retrieve more information on how these guidelines can be followed in practice. The result is an overview of the typical practical guidelines as per main guideline. It is important to note that this work is not meant to be exhaustive but rather as an overview of commonly suggested guidelines. It can aid managers in dealing with DT projects through inspiration, action points or scenario sketching.

In the next section, we go deeper into the meaning of DT and the problems surrounding the guidelines for DT. Then, we explain the systematic literature review methodology in section three. The results are eight tables, one for each main guideline, summarizing the best practices we found in the literature. We discuss the findings in the next section and conclude the paper in the last section.

Background

DT is not a new concept. In fact, the first occurrence of the term was in the year 2000 by Patel and McCarthy to describe e-business (Patel & McCarthy, 2000). However, it took 15 years before the term gained popularity. From 2015, the number of publications published per year with DT as a keyword doubled annually from 50 in 2015 to over 800 in 2022 (Van Veldhoven, Etikala, Goossens, & Vanthienen, 2021). This increased growth highlights the importance of DT, not only in research but also in business. For instance, in a study among 702 executives, 89% have adopted a digital-first strategy (Alt, 2019). Other studies point toward similar estimates such as 85% of companies agree that digital business is a fundamental aspect for success (Kane, Palmer, Phillips, Kiron, & Buckly, 2017).

Part of the recent academic interest can also be attributed to the amalgamation of terminology. Between 2000 and 2015, many different terms were used to describe a similar process in which digital technologies gained a more prominent place in our society. These include digitization, often defined as converting analog processes into digital ones (Loebbecke & Picot, 2015), digitalization or IT/IS-enabled transformation, often defined as the sociotechnical process in which digital technologies are increasingly adopted (Legner *et al.*, 2017), or digital business transformation (Schallmo, Williams, & Boardman, 2017). In other industries, terms such as industry 4.0 are often used. All these terms are different, but they can be understood as precedents of DT. As such, studying DT is complicated and requires a broad query for the literature review.

An additional complexity of this work is the diversity of the guidelines. The guidelines found in the literature often stem from case studies (e.g. Loonam, Eaves, Kumar, & Parry, 2018), surveys (e.g. Brock & von Wangenheim, 2019) or interviews (e.g. Brunetti *et al.*, 2020), and these differ per industry and company. In addition, as DT impacts every aspect of the

business and society (Stolterman & Fors, 2004), there exists a broad spectrum of guidelines. Abstraction must be made of the industry or company-specific guidelines to find general guidelines that span across industries. It is worth noting that the aim of this paper is not to describe best practices to digitalize a certain process or service. Instead, we discuss general top-level best practices for an entire company to embark on DT.

Methodology

To summarize the best practices for DT, the methodology consisted of five steps. First, we performed a systematic literature review on both Scopus and Web of Science (WoS) to retrieve conference and journal papers dealing with DT guidelines. To include both American and British English, wildcards (*) are used to accommodate both spellings of digitali(s/z) ation. Numerous queries were tested on inclusiveness and accuracy, and eventually the following were chosen due to their high accuracy and low false positives.

(1) Scopus: TITLE-ABS-KEY (("digital transformation" OR "digitali*ation") AND ("guideline* OR "recommendation*" OR "best practice*")) AND LANGUAGE ("english") AND DOCTYPE ("ar" OR "cp") AND PUBYEAR (>2009 AND <2022)

(2) WoS: TI=(("digital transformation" OR "digitali*ation") AND ("guideline*" OR "recommendation*" OR "best practice*")) OR AK=(("digital transformation" OR "digitali*ation") AND ("guideline*" OR "recommendation*" OR "best practice*")) OR AB =(("digital transformation" OR "digitali*ation") AND ("guideline*" OR "recommendation*" OR "best practice*")) AND LANGUAGE:(English) AND DOCUMENT TYPES:(Article OR Proceedings Paper) AND Timespan:2009-01-01 to 2022-01-01

The queries retrieved 811 and 445 papers, respectively. After merging the two datasets and filtering the duplicates, a total of 972 papers were obtained. Next, the abstracts were read. Articles that specifically talked about DT projects in companies with suggestions on how to do so were included for further analysis. For the purpose of this study, we excluded papers dealing with public services or educational institutions and papers that could not be accessed. In total, 101 papers were selected. These papers were then fully analyzed to retrieve their guidelines and suggestions on how to roll out DT projects. By analyzing overlap and categorizing the retrieved guidelines based on their main themes, the foundation of this research was formed – eight main DT guidelines.

This foundation was then validated with seven DT domain experts in our preliminary work with an online survey (hidden during the review process). The domain experts are active in a leading role on DT projects for at least four years. For each best practice, Likert scale questions were asked about their relevance. For each guideline, open questions were created to inquire about correctness and completeness. In addition, open questions were asked on how these guidelines can be put into practice. In case the respondent did not immediately know the answer, the survey probed with several practical examples. The validation was largely successful with several slight changes in the main guidelines and steered us in the right direction for the rest of the literature analysis. A summary of the online survey can be found in the appendix.

Next, this foundation was expanded with the other insights from the 101 papers that were fully analyzed in search of best practices on how to follow these eight main guidelines. In addition, the literature set was expanded with other influential DT guidelines papers and with backward and forward referencing to retrieve more information about the main guidelines. The goal was to expand the main guidelines with practical guidelines of how they can be followed in practice. The additional literature search was stopped when no further

information was achieved in the next five papers. In total, we have analyzed 150 papers. In step five, we consolidated the findings in overview tables per main guideline. An overview of the literature search is shown in Table 1.

Digital transformation guidelines

From the initial literature review, we identified eight main guidelines. These include digital strategy, business agility, innovation and ambidexterity, modern organizational structure, digital culture, top management support, adequate IT infrastructure and digital skills. In the following subsections, we go over each guideline and discuss the findings in terms of best practices in more detail.

Digital strategy

One of the most commonly mentioned requirements for successful DT is the need for a digital strategy (Hess *et al.*, 2016). It is often considered as a starting point for any DT efforts (Catlin, Scanlan, & Willmott, 2015; Goerzig & Bauernhansl, 2018). The digital strategy consolidates and aligns the IT and business strategy (Berghaus & Back, 2016) and spans the entire company (Hirte & Roth, 2018). It also plans the company-wide organizational change and outlines the integrated business capabilities and value streams, inspired by novel technologies, that are responsive to the rapidly changing market conditions (Hess *et al.*, 2016; Kane, Palmer, Philips, Kiron, & Buckley, 2015; Ross *et al.*, 2016). Some authors refer to this strategy as the DT strategy, hereby focusing more on the coordination of the transformation efforts (Chanias, Myers, & Hess, 2019; Matt, Hess, & Benlian, 2015; Sebastian *et al.*, 2017), or as the digital business strategy (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Kahre, Hoffmann, & Ahlemann, 2017; Mithas, Tafti, & Mitchell, 2013).

The digital strategy typically formulates and outlines the **vision and roadmap** the company is pursuing (Crešnar, Potočan, & Nedelko, 2020; Korachi & Bounabat, 2019; Schuh, Frank, Jussen, Rix, & Harland, 2017; Venkatesh, Singhal, & Mathew, 2018). This vision should in essence be a digitalized view of the company in the future and how it can remain relevant in an ever-changing and digitalizing world (Kretschmer & Khashabi, 2020; Stoyanova, 2020). Fundamental elements in the creation of this vision are to identify specific and measurable digitalization goals (Korachi & Bounabat, 2019; Sjödin, Parida, Kohtamäki, & Wincent, 2020; Stich, Zeller, Hicking, & Kraut, 2020; Wade & Shan, 2020), challenges (Fichter, 2019), scenarios (Bennett & McWhorter, 2021) and corresponding actions (Fichter, 2019; Stoyanova, 2020). The roadmap or action plan describes how to get there, the people involved, the actions required, and the time required (Patel, Kalita, & Asthana, 2018). It can outline multiple paths depending on likely scenarios in the future. According to Ivančić, Vukšić and Spremić (2019), a shared digital vision is essential. By linking this vision to the company's strategy, both internal and external stakeholders will be more aware of the importance of their role in achieving this vision (Fichter, 2019).

Steps	Number of papers
Records identified from databases: Scopus and WoS	811 and 445 papers, respectively
Removing duplicates	−284 papers
Records screened	972 papers
Reports sought for retrieval based on relevance to the study	105 papers
Removing inaccessible papers	−4 papers
Expanded with influential papers	49 papers
Total number of papers analyzed for this review	150 papers

Table 1.
Overview of systematic literature review approach based on the PRISMA methodology

Because DT deals with both the business and IT side, **continuous alignment** between them is needed to be successful (Dolganova & Deeva, 2019; Fischer, Imgrund, Janiesch, & Winkelmann, 2020; Hess *et al.*, 2016; Kane *et al.*, 2015; Li, Liu, Belitski, Ghobadian, & O'Regan, 2016; Saarikko *et al.*, 2020). DT is not about using novel technologies but about integrating and using them to achieve strategic ends (Kane *et al.*, 2015). For this reason, business and IT departments often coordinate their strategies and action plans (Agrawal, Narain, & Ullah, 2020). It is also important to communicate the specific rationale for IT usage and the weaknesses it addresses (Gigova, Valeva, & Nikolova-Alexieva, 2019; Kadir & Broberg, 2020; Korachi & Bounabat, 2019). This fosters collaboration between the two sides and leads to better alignment and firm-wide knowledge on the transformation.

In addition, companies with a formulated DT strategy should be aware that this strategy should be subject to **constant reassessment** (Bach, Spremić, & Vugec, 2018; Krell & Gale, 2005). DT is not a one-time exercise, but a continuous adaptation to changing technological capabilities, markets and customer demands (Matt *et al.*, 2015; Parviainen, Tihinen, Kääriäinen, & Teppola, 2017). The evaluation should assess both the underlying assumptions, the market and the transformational advancement of DT. In case of disparities according to the predefined objectives, timely action is suggested.

Many researchers suggest the importance of **collaboration** with strategic partners in the digital world (Fischer *et al.*, 2020; Hirte & Roth, 2018; Zangiacomi, Sacco, Pessot, De Zan, & Bertetti, 2018). This has become more important due to the wide-scale impact of DT; not only companies but entire sectors and industries are changing (Van Veldhoven & Vanthienen, 2021). One of these decisive changes is the fading of industry borders and competing in ecosystems and multi-sided platforms (Bonnet & Westerman, 2021; Subramaniam, Iyer, & Venkatraman, 2019). Managers are increasingly looking for cross-sector opportunities and threats such as novel business products that are tightly integrated between multiple external partners or ecosystems (Diener & Špaček, 2021; Saarikko *et al.*, 2020; Veile, Kiel, Müller, & Voigt, 2020; Weill & Woerner, 2015). This shift is not just to improve efficiency but serves as a pathway for long-term growth (Subramaniam *et al.*, 2019). For this reason, the digital strategy often investigates strategic collaborations and digital platforms.

It is generally agreed upon that the digital strategy must be **customer-driven** (von Leipzig *et al.*, 2017; Weill & Woerner, 2015). The digital strategy positions, after all, the core business model in such a way that it can generate value from the digital customer environment (Gigova *et al.*, 2019; Stoyanova, 2020). Significant gains can be realized by digitalizing the customer experience and integrating all customer touchpoints such as increased automation, better service quality and an improved customer experience (Berman, 2012; Stoyanova, 2020). Hence, it is crucial that firms design the strategy with the integrative customer perspective in mind (Helbin & Van Looy, 2019). This requires the company to research their customers thoroughly (Agrawal *et al.*, 2020; Klisarova-Belcheva, Yankova, & Ilieva, 2019; Kretschmer & Khashabi, 2020), or to collaborate with their customers to receive feedback (Ivančić *et al.*, 2019).

To ensure that the outcome of the DT process satisfies the preconditions of all stakeholders of a firm, a thorough **stakeholder management** exercise is needed both at the initiation of the DT process and throughout the change journey (Fichter, 2019; Imgrund, Fischer, Janiesch, & Winkelmann, 2018). During the requirements engineering phase, firms should determine and prioritize the informational, functional and technical requirements based on the collaboration of stakeholders and their prerequisites (Fischer *et al.*, 2020). In case of collaborations with external partners, managers usually govern the expectations and objectives of all the parties and balance these in a common proposal (Fechtelpeter, Kuehn, & Dumitrescu, 2018). This is of particular importance as its results should be a major element in the starting point for the DT process. An overview is shown in Table 2.

Business agility
Business agility, the ability to change swiftly, has gained profound awareness in recent years (Fuchs & Hess, 2018; Imgrund *et al.*, 2018; Kane, 2019; Sjödin *et al.*, 2020; Veile *et al.*, 2020). On the one hand, this awareness comes from the failures of some traditional companies stuck in their own ways, such as the camera film seller Kodak that failed to embrace digital pictures as a new business instead of a way to expand their printing business. On the other hand, business environments and customers continue to become more unpredictable and change rapidly due to the massive impact of digital technologies. An agile company is more reactive and thus more resistant to these changes (Bondar, Hsu, Pfouga, & Stjepandić, 2017), as evident during the COVID-19 pandemic, which is why firms are heavily investing in organizational agility for unpredictable areas (Nowakowski *et al.*, 2019; Sommer, 2019). There exist numerous ways in which companies are trying to increase their agility, of which many are intertwined with the other categories we discuss in this paper.

Agile development methods are often recommended, especially in software development (Dremel, Herterich, Wulf, Waizmann, & Brenner, 2017; Leonhardt, Haffke, Kranz, & Benlian, 2017; Sebastian *et al.*, 2017; Sommer, 2019). These are often based on the twelve foundational principles of Beck *et al.* (2001) that include early and frequent delivery, welcoming changing requirements and working efficiently. Popular methodologies include DevOps, which is a set of practices to reduce the time between plans and deployment, and Scrum, a framework to quickly deliver value by ranking the backlog and working in short sprints. These methodologies can be used across the entire company, e.g. the Spotify model, to increase agility and value delivery. These methods can also easily be translated to a working-from-home environment, which was necessary during the COVID-19 pandemic.

Another indirect method of increasing agility is by **empowering employees**. The idea is that by removing the red tape (Kotter, 1995), integrating the employees into the change process, improving the idea exchange to management (Diener & Špaček, 2021) and giving more authority to the employees, the innovation process becomes more flexible and reduces the organizational rigidity. This also enables the employees to act faster and implement the necessary changes without constantly asking for approval (Nair, 2019). Furthermore, this makes the workforce more involved in the change process. This is necessary to develop an optimal view of the day-to-day operations and increase the acceptance of the DT process (Kadir & Broberg, 2020). In the end, the employees are better connected with the DT efforts and become part of it (Diener & Špaček, 2021).

Similarly, **collaborative working principles** are being applied by some companies to facilitate agility and creativity (Bouncken, Kraus, & Roig-Tierno, 2021). For instance, co-working office rooms in which it is easy to sit together with a project team are often installed. Another method is by adopting open office hours which means that for several hours per week, all offices are free to walk into to discuss or collaborate on something. In a

Digital strategy	
Vision and roadmap	The digital strategy outlines the future vision of the company and the roadmap on how to get there
Continuous alignment	The business and IT sides must be continuously aligned
Constant reassessment	The strategy is subject to constant reassessment due to changing markets, customer demands and technologies
Collaboration	Strategic collaborations with partners, ecosystems and platforms
Customer-driven	Design the strategy with a customer-central focus
Stakeholder management	The digital strategy should be agreed upon by all stakeholders, and their feedback must be considered

Table 2.
Best practices for
digital strategy

similar vein, some corporates use free-roaming desks, which gives employees the flexibility to sit with whomever they want (Guest, 2014). During the pandemic, the usage of online collaboration tools such as communication apps, e.g. Slack and Zoom, or project management apps, e.g. Miro and Trello, soared. There are many more principles a business can apply for, but the basic idea is the same: to stimulate collaboration and flexibility.

To quickly adapt the IT capacity to the dynamic market requirements, many firms utilize cloud computing to host their software and services (Bharadwaj et al., 2013). This does not only help to quickly up or downscale the required capacity, but also has benefits regarding costs, portability and reduced hardware and software obsolescence (Ross & Blumenstein, 2013). Cloud services are also helpful to support working-from-home dynamics.

A final recommendation is to outsource areas that are too slow to change (Ebrahimpur & Jacob, 2001). This can also be used to reduce costs for areas where the technological processes required are well structured and not overly complex. However, compared to creating the required competencies internally, outsourcing can be riskier (Hess et al., 2016). Instead of outsourcing to external partners, some companies create spin-offs to take over some business aspects in a more agile way (Veile et al., 2020). An overview is shown in Table 3.

Innovation and ambidexterity
Innovation is becoming a key competitive differentiator in the digital world. Companies that can sense and seize opportunities by quickly experimenting, designing and rolling out new products or services can capture new value streams and stay competitive (Leonhardt et al., 2017; Osterwalder & Pigneur, 2010). Digital innovation, often defined as the combination of digital and physical components to create novel products and services and embedding them in wider sociotechnical environments (Skog, Wimelius, & Sandberg, 2018; Yoo, Henfridsson, & Lyytinen, 2010), is especially important in the last few years. At the same time, the traditional value streams must be safeguarded. This dual goal of balancing innovation and traditional value streams is often referred to as business ambidexterity (Schuchmann & Seufert, 2015). Several ideas have been proposed to improve the innovative capacities of companies.

One idea is to **foster innovation outside the core business.** Some authors recommend creating a new division inside the company that specializes in innovation (Christensen, Raynor, & McDonald, 2015; Dremel et al., 2017). For instance, Alphabet created division X to investigate cutting-edge innovations such as quantum computing. Another strategy is to invest in or co-operate with innovative start-ups (Matzler, Friedrich von den Eichen, Anschober, & Kohler, 2018). Similarly, firms can enhance internal innovative capabilities by engaging in partnerships with external knowledge-rich associations or in the form of open innovation or living labs (Fischer et al., 2020; Galimova, Gileva, Mukhanova, & Krasnuk, 2019; Matzner et al., 2018). It is important that the explorative pilot projects that

Business agility	
Agile development methods	Agile development methods, e.g. Scrum or DevOps, can bring more agility to projects by working on short iterations with frequent feedback sessions
Empowering employees	Empower employees so they can act on their ideas without red tape
Collaborative working principles	Collaborative working principles improve collaboration and thus agility
Cloud computing	Cloud computing for quickly scaling the IT services to the market's demands
Outsource slow areas	Areas that are slow to change internally can be outsourced to smaller and nimble companies, or to spin-offs

Table 3.
Best practices for business agility

come forth are aligned with the overall digital strategy (Barata, da Cunha, & Coyle, 2018). This way, long-term innovation can be secured without interfering with the core business.

When the goal is to foster innovation inside the core business, some companies organize **product innovation days**. These can be in the form of hackathons, innovation competitions, or offsite days for brainstorming (Berghaus & Back, 2017). Other companies install dedicated innovation ideas mailboxes in which employees can submit ideas (Ivančić *et al.*, 2019). These efforts facilitate new idea generation and identify gaps in the organization that could be further innovated. Because an overload of new ideas can be received, efforts can be made to adequately manage these ideas.

Firms can also partner up with **research institutions**, innovation incubators or public institutions. These partnerships can create innovation clusters that foster creativity and catalyze innovation by following an open system perspective (Fechtelpeter *et al.*, 2018; Veile *et al.*, 2020; Zangiacomi *et al.*, 2018). This allows companies to access the latest methods, software and technology for both developments of new and future DT projects (Fechtelpeter *et al.*, 2018; Ivančić *et al.*, 2019).

Finally, it has been recommended to **invest in a mix of technologies** (e.g. Stoyanova, 2020). The portfolio of projects should be a balance between exploring emerging technologies and exploiting existing high-performing technologies (Helbin & Van Looy, 2019; Ishlahuddin, Handayani, Hammi, & Azzahro, 2020). For this dual-purpose, firms are endorsed to continuously monitor the external technological environment to identify emerging technologies that can be valuable to the company (Ishlahuddin *et al.*, 2020; Kadir & Broberg, 2020). With this approach, companies are at the forefront of innovation and reduce the risk of falling behind. An overview is shown in Table 4.

Modern organizational structure
Tying in closely with the other recommendations in this paper is the need for a modern organizational structure (Dremel *et al.*, 2017; Morgan & Page, 2008). This is a critical element to achieve the other recommendations such as business agility, innovation, aligning the IT and business side and following the DT strategy (Fischer *et al.*, 2020). A modern organizational structure is characterized by a focus on openness, collaboration and agility.

A common element is a flat or horizontal structure (Berghaus & Back, 2017; Veile *et al.*, 2020). In this system, the number of managers is limited which results in a more decentralized and agile decision-making environment (Dolganova & Deeva, 2019; Earley, 2014). For example, the online clothing retailer Zappos is experimenting with Holacracy: a business structure in which there are no titles and managers (Guest, 2014). This reduces the time lost by meetings, approval and appointments.

In addition, more than 70% of digitally mature companies rely on **cross-functional teams** to organize work (Kane, Palmer, Phillips, & Kiron, 2017). These are interdisciplinary

Innovation and ambidexterity	
Foster innovation outside the core	Secure innovation without interrupting the core business by creating new divisions, partnering with start-ups or partners
Product innovation days	Organize product innovation days, hackathons, competitions or brainstorming sessions to generate ideas
Partner with research institutions	Partner with research institutions to share knowledge and innovation
Invest in a mix of technologies	Invest in a mix of technology projects to explore emerging technologies and possibilities

Table 4.
Best practices for
innovation and
ambidexterity

teams consisting of experts from various departments such as software developers, marketers, salespeople and business analysts, who work together usually on a product or project (Veile *et al.*, 2020). They are characterized by their dedicated, solution-oriented mindset (Dolganova & Deeva, 2019). Together, they have the necessary skills to manage the entire lifecycle of the product. These teams, also referred to as speedboats, are often more agile than a traditional company, also referred to as tankers (Matzler *et al.*, 2018). These teams ideally complement the existing business structures (Dremel *et al.*, 2017). Several business structures with cross-functional teams as the foundation exist, such as the Spotify model. The use of these teams is often linked to increased organizational agility and creativity (Imgrund *et al.*, 2018; Veile *et al.*, 2020).

Some companies create **DT subsidiaries or divisions** to lead their DT efforts (Ivančić *et al.*, 2019; Westerman, Calméjane, Bonnet, Ferraris, & McAfee, 2011). These divisions benefit from being tightly integrated with all other divisions and include staff members from various other departments for gaining feedback and assessing needs (Ivančić *et al.*, 2019; Westerman *et al.*, 2011). This is different from the innovation labs from the previous section; here the division is focused on delivering the DT of the business itself while the innovation labs are focused on experimenting with new and novel technologies to foster innovation. Having a dedicated division for DT can be beneficial for digitalizing the company.

Similar to the strategy, the business structure should **continuously be realigned** with new technologies and the IT infrastructure (Fischer *et al.*, 2020). This is important to maximize the gains from digital technologies and automation (Fischer *et al.*, 2020). Indeed, applying digital technologies without proper alignment is a frequent cause of failure (Brock & von Wangenheim, 2019; Issa, Hatiboglu, Bildstein, & Bauernhansl, 2018). Ideally, the entire supply chain is seamlessly aligned with the firm's IT infrastructure (Moi & Cabiddu, 2020). It is also recommended to integrate digital business projects into the existing organizational structure, rather than creating a separate structure. An overview is shown in Table 5.

Digital culture
Companies embarking on DT should assess and reconsider their corporate culture from the start (Çetin Gürkan & Çiftci, 2020; Fichter, 2019; Hartl & Hess, 2017). The business ethos is indeed considered as the enabler or disabler for any kind of changes (Hartl & Hess, 2017), thus companies often spend a considerable effort on transforming the business culture into a digital culture. This is typically characterized by a high level of creativity, equality, flexibility, openness, willingness to learn and digital savviness (Kaufman & Horton, 2014; Veile *et al.*, 2020). It stimulates innovation, the use of digital technologies, and is the key to achieving the necessary agility (Fischer *et al.*, 2020; Imgrund *et al.*, 2018). This is crucial because one of the main causes of poor DT performance is the lack of the right culture that embraces digitalization (Hartl & Hess, 2017; Silverio-Fernández, Renukappa, & Suresh, 2021; Wade & Shan, 2020). There are several ways in which a company can promote a digital culture.

Business structure	
Horizontal structure	Reduce the vertical flow of information and authority
Cross-functional teams	Organize work in cross-functional teams with the required authority to manage projects and products in an agile way
DT subsidiaries or divisions	To lead the DT, a dedicated subsidiary or division can be created within the company with the necessary skills, authority and top management support
Continuously realigned	The business structure must be continuously realigned with the new technologies and the IT infrastructure

Table 5.
Best practices for a modern organizational structure

One way to develop the culture is by **promoting change** as an inherent part of everyday life in the company (Diener & Špaček, 2021; Kane, 2019). Communication plays a vital role in increasing awareness among employees that change is needed and urgent (Fichter, 2019). Once the employees are aware of the need for change, they must be allowed to experiment and innovate, while leaders and HR departments ensure that the business is acceptive for potential failures of the projects (Nair, 2019). In other words, an open culture that encourages employees' creativity and risk-taking projects is recommended (Brink, Packmohr, & Vogelsang, 2020; Fischer *et al.*, 2020; Matzler *et al.*, 2018). Some companies offer monetary or intrinsic rewards for innovation efforts (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2013).

Another method to improve the digital culture is moving away from rigid regulations to **value-based regulations** (Berman, 2012). Traditional companies often have rigid regulations in which the exact procedures are formally described, whereas digital natives often have value-based regulations whereby employees are encouraged to work toward the company's goals and values (Matzner *et al.*, 2018). Value-based regulations promote employees to create change that maximizes value (Martinez, 2019).

Throughout the process of reconsidering the corporate culture, the organization should foster **open communication** among departments and hierarchical levels (Veile *et al.*, 2020). Hence, eliminating potential barriers that limit the employees from cooperating is a good starting point such as an open office in favor of assigned desks (Guest, 2014). In addition, the interdependence of projects must be verified to avoid certain departments implementing changes at the expense of other departments (Ishlahuddin *et al.*, 2020). This is crucial for departments to reach aligned outcomes and create value throughout the entire DT process. Not only the communication should be open, but the domain-specific knowledge should also be consultable company-wide (Dremel *et al.*, 2017).

Additionally, researchers suggest that a **digital mindset** is beneficial for the company (Warner & Wäger, 2019). It is fundamental that employees can apply novel technologies themselves (Diener & Špaček, 2021). This mindset can also embrace novel technologies such as data analytics and evidence-based decision-making (Dremel *et al.*, 2017; Vial, 2019). In essence, digital should be a core part of your organization (Kane, Palmer, Phillips, Kiron *et al.*, 2017).

Finally, digital culture is characterized by a high level of **personal development** (Kane *et al.*, 2017). With personal development, we mean that employees continuously learn and improve their skills. This can be done through dedicated training hours or offering time-off hours for personal growth. Another method is the use of training groups where the digital-savvy employees collaborate with the other employees. Indeed, it is important to have internal IT competencies (Dolganova & Deeva, 2019). An overview is shown in Table 6.

Top management support
The support and determination of senior management is a key success factor for DT (Fischer *et al.*, 2020; Harrington & Tjan, 2008; Kane *et al.*, 2017). It is known that DT is severely hindered without this support, for instance by resistance (Brock & von Wangenheim, 2019; Fitzgerald *et al.*, 2013; Matt *et al.*, 2015). Hence, a successful DT process requires executives that support the DT projects.

Some companies create a **chief digital officer (CDO)** position to lead the DT initiatives (Haffke, Kalgovas, & Benlian, 2016; Singh & Hess, 2017). The CDO is located between the business and the ICT, and develops, communicates and orchestrates the holistic digital strategy across the company, hereby embracing the full spectrum of technological opportunities (Singh & Hess, 2017). They have knowledge of the industry-specific effect of digitalization and determine how this impacts the firm (Haffke *et al.*, 2016; Ishlahuddin *et al.*, 2020). Other companies give this responsibility to the chief executive officer (CEO) or chief

information officer (CIO) (Hess *et al.*, 2016). In any case, it is required that this person has sufficient authority and support to fulfill their tasks (Singh & Hess, 2017).

The top management should also be responsible for **communicating the digital vision** of the company (Fitzgerald *et al.*, 2013; Mugge, Abbu, Michaelis, Kwiatkowski, & Gudergan, 2020). The vision includes both the DT strategy and the DT objectives. It should be communicated across the entire company and all stakeholders. It is also important that top management assigns clear responsibilities for carrying out the digital strategy (Matt *et al.*, 2015; Morgan & Page, 2008).

Not only should senior managers communicate the digital vision, but they should also **act as role models** for their employees (Diener & Špaček, 2021). This is important for hesitant employees who often show some resistance toward change on accepting the new approaches (Bach *et al.*, 2018). One way to do this is by increasing awareness about the benefits of digitalization projects (Fischer *et al.*, 2020; Silverio-Fernández *et al.*, 2021). Some authors call for pro-active leadership, in which the leader supports, motivates and inspires teams, while actively incorporating their followers' ideas (Ebert & Duarte, 2018; Kontić & Vidicki, 2018).

Finally, it has been suggested that executives should create a **sense of urgency** to initiate DT (Kotter, 1995; Westerman, Bonnet, & McAfee, 2012). This perception is vital to overcome the inertia that exists in many companies that are stuck in their traditional ways of working (Besson & Rowe, 2012; Saarikko *et al.*, 2020). By highlighting that DT is not only necessary but also requires immediate action, hesitant employees can be persuaded to put effort into the digitalization. An overview is shown in Table 7.

Adequate IT infrastructure
DT relies on an adequate IT infrastructure. The IT infrastructure can be understood as the backbone of any digitalization effort. Accordingly, many DT projects fail because their backbone is insufficiently capable (Diener & Špaček, 2021). Several authors emphasize that firms must optimize the flexibility, standardization and operation stability of their IT systems (Brink *et al.*, 2020; Fischer *et al.*, 2020; Schuh *et al.*, 2019). This includes documenting the

Digital culture	
Promoting change	The digital culture should promote change, experimenting and creativity
Value-based regulations	Encourage employees to work toward the goals and the values of the company instead of following the traditional procedures
Open communication	To promote collaboration, there should be open communication so employees can freely discuss projects with their peers and supervisors
Digital mindset	A digital mindset among employees encourages digital technologies
Personal development	Digital culture is characterized by continuous personal development so employees keep learning and increasing their IT competencies

Table 6.
Best practices for a digital culture

Top management support	
CDO	The responsibility of the DT is given to a dedicated CDO
Communicating the digital vision	Top management must clearly communicate the digital vision and responsibilities to all employees
Act as a role model	Top management should act as role models in the DT
Sense of urgency	Top management must create a sense of urgency. It must be clear to all stakeholders that DT is necessary and requires immediate attention

Table 7.
Best practices for top management support

system configurations in an understandable and interpretable manner and evaluating the risks of potential malfunctions. There are several elements commonly mentioned in the scientific literature in respect to the IT infrastructure.

First, the **operational backbone** on which the business operations run is of crucial importance (Ross *et al.*, 2016; Sebastian *et al.*, 2017). It should ensure the efficiency and reliability of the core operations and back-office services in an integrated, adaptable and reconfigurable way (Agrawal *et al.*, 2020; Colli *et al.*, 2019). For some companies, this comes in the form of an enterprise resource planning (ERP) system (Ivančić *et al.*, 2019). This is the foundation for future business process optimizations (Colli *et al.*, 2019; Paschek, Luminosu, & Draghici, 2017).

Secondly, a **digital services platform** is highly beneficial. It is a set of digital components that connects the processes in the operational backbone with services, data analytics, websites and ecosystems (Bonnet & Westerman, 2021; Ross *et al.*, 2016). It enables the fast development, implementation and rollout of digital innovations (Ross *et al.*, 2016; Westerman *et al.*, 2012). Some recent examples can be found at Kaiser Permanante's who created a digital services platform supporting 21 technology components for operational services (Ross *et al.*, 2016), or at the LEGO group who created an engagement platform that hosts microservices for personalizing customer experience (Ross *et al.*, 2016).

Another important IT element deals with **the usage of data**. In recent years, data have become a valuable and essential resource when properly managed (Sathananthan, Hoetker, Gamrad, Katterbach, & Myrzik, 2017). Thoughtful design regarding data generation and multiple purpose usage must be conducted (Saarikko *et al.*, 2020). Several studies urged firms to create a unified database in which all customer and corporate data are centralized (Brock & von Wangenheim, 2019; Schuh *et al.*, 2017). The data must be available in real-time to all relevant employees and shared according to value streams (Bouncken *et al.*, 2021). Regarding the data itself, firms often prioritize data quality and usefulness over data hoarding (Colli *et al.*, 2019; Saarikko *et al.*, 2020). Analytics and data mining can then be used to generate insights (Berman, 2012), make evidence-based decisions (Weill & Woerner, 2015) and make predictions.

Because digital technologies are one of the most important drivers of DT (Hess *et al.*, 2016), the IT infrastructure ought to **support novel technologies**. These typically include social media, mobile applications, data analytics, cloud computing and the internet of things (SMACIT). Dolganova and Deeva (2019) state that the efficiency of implementing new technology largely depends on the flexibility of the IT infrastructure, integration potential and scalability of the solutions. This also implies that the IT departments should also be motivated and acceptive toward novel technologies.

Simultaneously, **cybersecurity** is of crucial importance (Vial, 2019). First, the safety and privacy of the data should be safeguarded. Therefore, an adequate IT governance system is required to be in place (Korachi & Bounabat, 2019). It is recommended that external regulations on IT governance are also adopted through compliance mechanisms, security tools and a clear communication mechanism (Ishlahuddin *et al.*, 2020). Moreover, companies must ensure that the data are hosted ethically and securely (Imgrund *et al.*, 2018; Veile *et al.*, 2020). A second element is about the protection against cyber-attacks. According to KMPG, 72% of CEOs are not prepared for cyberattacks (KPMG & Veihmeyer, 2016). Yet, this is crucial as entire companies can be shut down when major cyberattacks happen. For instance, the entire production line of Picanol, a major industrial player, was closed for over a week due to cyberattacks. Hence, companies can invest in cybersecurity to keep their business running.

Regarding existing **legacy systems**, a combination of keeping and updating those systems is recommended. While legacy systems can pose a significant challenge (e.g. Makarchenko, Nerkararian, & Scmeleva, 2016), they also work and are trusted. Some authors suggest that DT must be supported by a similar IT transformation and not simply add to the existing legacy infrastructure (Makarchenko *et al.*, 2016). Others recommend

integrating the legacy systems with novel services (e.g. Mielli & Bulanda, 2019). Careful consideration must be made between upgrading existing systems or adding to existing systems. An overview is shown in Table 8.

Digital skills
Due to the high leverage of digital technologies in DT, digital skills are an important asset for companies embarking on DT (Adam, Hofbauer, & Mandl, 2019; Fischer *et al.*, 2020; Hirte & Roth, 2018; Imgrund *et al.*, 2018). Under this umbrella term, we include digital strategy, digital technologies, data science and cybersecurity skills (Brock & von Wangenheim, 2019). Managers must evaluate whether new skills are required, and if so, plan how to obtain these (Fischer *et al.*, 2020). Educating existing employees is not always easy, as many employees are hesitant toward digitalization (Brink *et al.*, 2020). Thus, many companies rely on hiring new employees with digital skills.

Recruiting employees with appropriate digital competencies and digital curiosity is a rapid way to increase human IT capital (Diener & Špaček, 2021; Mielli & Bulanda, 2019; Ross & Blumenstein, 2013). There exists a reciprocal effect, however, in the sense that digital-savvy applicants are more likely to join digitally mature companies, such as having a clearly formulated digital vision (Nair, 2019). In addition, it is increasingly difficult to find an available workforce with specific digital skills. Hence, sufficient effort must be made to create a culture that attracts digital talent (Kane, Palmer, Phillips, Kiron *et al.*, 2017).

Another method is investing in **continuous education** in digital skills through training and development programs (Brink *et al.*, 2020; Diener & Špaček, 2021; Fischer *et al.*, 2020; Kane *et al.*, 2017; Nair, 2019). This is important because keeping pace with the latest technologies is challenging for many employees yet necessary to thrive in the digital economy (Ivančić *et al.*, 2019; Mugge *et al.*, 2020). These programs should enhance their awareness of why DT is important for the company's future and their willingness to cooperate (Krüger & Teuteberg, 2016). The main task, however, is to develop new competencies and increase the digital skills of all enterprise employees (Bickauske, Simanaviciene, Jakubavicius, Vilys, & Mykhalchyshyna, 2020; Kamal, 2020; Lööw, Abrahamsson, & Johansson, 2019). For the more technical profiles, dedicated training courses can be used to enhance their specific expertise (Strutynska, Dmytrotsa, Kozbur, Melnyk, & Olha, 2020). These efforts attract and retain digital workers, prepare employees for career advancement, increase the acceptance of digital culture and facilitate knowledge sharing (Buhulaiga, Telukdarie, & Ramsangar, 2019; Stoyanova, 2020). Another way to educate employees is by close collaboration with experts to share their knowledge (Diener & Špaček, 2021). These educational programs will ideally create an innovation fostering atmosphere in which employees take more initiative to use and upgrade their digital abilities (Nair, 2019). An overview is shown in Table 9.

Adequate IT infrastructure	
Operational backbone	The core business should be hosted efficiently on the operational backbone
Digital services platform	A digital services platform must be created to connect the operational backbone with services, data analytics, websites and ecosystems
Usage of data	Data must be used for evidence-based decision-making, generating insights
Support novel technologies	The IT infrastructure should be able to support the use and integration of novel technologies such as social media, mobile applications, data analytics, cloud computing and the internet of things
Cybersecurity	Safeguard the privacy of data and protect themselves against cyberattacks
Legacy systems	Firms must carefully consider adding to or replacing legacy systems

Table 8.
Best practices for an adequate IT infrastructure

Discussion

This study conducted a systematic literature review of the DT literature to retrieve the commonly mentioned best practices and guidelines. From the 150 papers, eight main guidelines were identified including digital strategy, business agility, innovation and ambidexterity, modern organizational structure, digital culture, top management support, adequate IT infrastructure and digital skills. For each of these main guidelines, we summarized several best practices of how these can be followed in practice. The results of this paper provide an overview of the general best practices for large companies embarking on DT. These can be used as checklists for firms or managers, or as a source of inspiration. It is important, however, to realize how these guidelines should be interpreted. They are not meant as mandatory rules nor are they applicable for every company. In addition, it should be noted that these guidelines are heavily intertwined. For instance, a company cannot become more agile by only following the agile guidelines proposed in this work but must also pay attention to corporate culture and business structure. These results also indicate that there is no golden rule to follow but DT requires a multitude of strategic actions that must be personalized to the firm's objectives, capabilities and outlook.

The expert interviews uncovered some interesting findings as well. First, the main guidelines were validated with the expert interviews, and all deemed particularly important for DT. However, they require a degree of nuance and adaptability. A second important finding is the discrepancy between the high-level suggestions in the literature and the more down-to-earth approach suggested by the experts. For example, one expert notes that a digital strategy should be carefully implemented step-by-step compared to the more optimistic implementation ideas found in the academic literature. Another example is shared by another expert who claims that overenthusiasm in digital technologies can be harmful as well. Rather than a digital-first mindset, a digital-where-suitable mindset should be the goal. The contrast between the confident literature and skepticism found in practice is an interesting research avenue for further research.

Given this overview of guidelines, a common question is where to start. To answer this question, a framework was constructed that describes the general steps a company can follow when embarking on DT. The framework was constructed based on the combination of the insights from the literature analysis and on a comparison of a series of DT process models (Besson & Rowe, 2012; Earl, 2000; Faro, Abedin, & Kozanoglu, 2019; Fichman, Dos Santos, Zheng, & Eric, 2014; Gong & Ribiere, 2020; Hanelt, Bohnsack, Marz, & Antunes Marante, 2020; Ismail, Khater, & Zaki, 2017; Kaufman & Horton, 2014; Kontić & Vidicki, 2018; Kotter, 1995; Krell & Gale, 2005; Morgan & Page, 2008; Parviainen *et al.*, 2017; Schallmo & Williams, 2018; Siachou, Vrontis, & Trichina, 2020; Skog *et al.*, 2018; Venkatraman, 1994; Vial, 2019; von Leipzig *et al.*, 2017; Westerman *et al.*, 2011). Many process models recommend starting with an assessment of the current market, company's capabilities and opportunities which is referred to as the reality scan (e.g. Schallmo & Williams, 2018; Skog *et al.*, 2018; von Leipzig *et al.*, 2017). This reality check is followed by creating a *digital strategy* that outlines the goal or future core business, roadmap and action plan based on the insights from the reality scan (Buhulaiga *et al.*, 2019; Colli *et al.*, 2018). This requires however that there is *top management support*. The digital strategy outlines

| Digital skills	
Recruiting digital talent	Firms can quickly increase their human IT capital by hiring employees with digital capabilities
Continuous education	Many firms invest in continuous education in digital skills to keep their workforce competent

both the innovation ambitions and the sustainability of the core business. *Innovation* efforts must then be done to create pilot projects of new projects and areas to innovate in to establish proof of concept (Barata *et al.*, 2018; Fechtelpeter *et al.*, 2018; Veile *et al.*, 2020). These projects require the necessary *digital skills* to exist in the company. Over time, the goal is that the core business evolves into the *future core business* by combining with the innovation efforts and that the company follows the new paradigm of digital agility. At the same time, however, the core business must be kept operational and sustainable. To span this timeframe, the *ambidexterity* best practices can be followed to make sure both innovation and the core businesses are protected. Next, when the innovation projects start gaining shape, changes can be made in the *organizational structure* to support these projects into an active role. This requires an *adequate IT infrastructure* as well. To keep the momentum going, companies are advised to invest in *business agility* supported by a *digital culture*. It should be noted that the DT process is not a one-time exercise but must be continuously conducted. Hence, the processes of planning the *future core business* and conducting *reality scans* follow each other in rapid succession. The framework is shown in Figure 1.

This research contributes to the existing literature by summarizing and outlining often suggested guidelines and best practices for DT. This overview is necessary as the popularity of the research field is overwhelming its findings. In addition, the overview is crucial to steer future research forward. Each of the main guidelines requires more research to investigate when, for who and how they should be implemented. While we have given several best practices for each guideline, more research can be conducted to give a broader overview of how these best practices can be put into practice. Distinctions can be made between particular industries or types of firms. In essence, what is needed is a complete overview of main guidelines, best practices and how to implement them in practice for each type of firm. Future research should investigate successful DT cases and describe how they implemented the best practices with this overview as their main anchor point to keep the findings cohesive. Other research could investigate the impact of following certain best practices.

The limitations of this study mostly relate to the acquired dataset. Different queries with more keywords could retrieve more papers and potentially give different results, albeit we
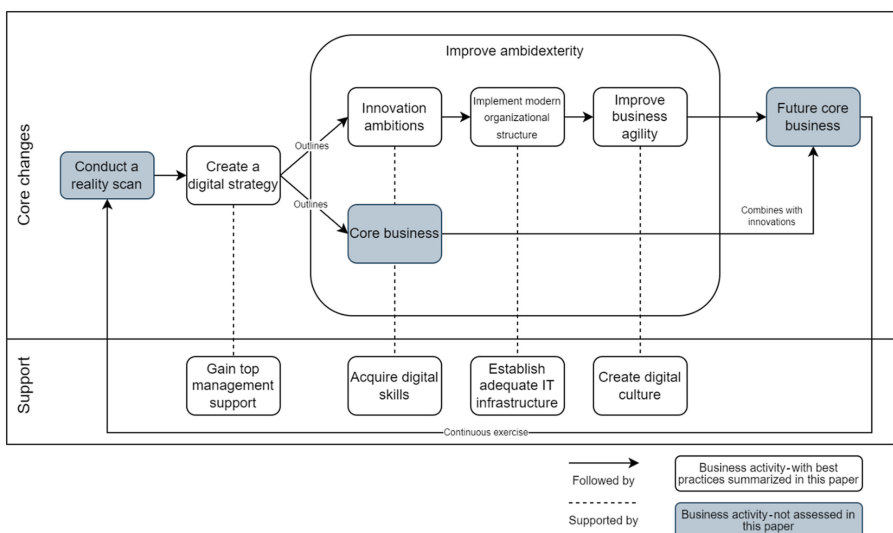
Figure 1.
A process model to embark on DT based on DT best practices

believe the main guidelines would not change much. While we excluded educational and public agencies, including them could give different results for those sectors. This could be a fruitful area for future research. Lastly, due to the high overlap of guidelines, different categorizations could be obtained by different authors.

Conclusion

In this paper, we contribute to the research by providing a summary of commonly suggested guidelines and best practices for DT. Eight main DT guidelines were found and each one was expanded with best practices on how to implement these guidelines into practice. These overviews highlight the complex and interwoven process of DT and guide researchers in their further work. We call for more research into each of these guidelines and best practices, especially on how the best practices can be implemented in a company. Finally, practitioners can be informed and inspired by the overviews.

References

Adam, M., Hofbauer, M., & Mandl, B. (2019). Integration of IT into a lean basic training: Target group-specific insights and recommendations. *Procedia Manufacturing*, *31*, 52–59. doi: 10.1016/j. promfg.2019.03.009.

Agrawal, P., Narain, R., & Ullah, I. (2020). Analysis of barriers in implementation of digital transformation of supply chain using interpretive structural modelling approach. *Journal of Modelling in Management*, *15*, 297–317. doi: 10.1108/JM2-03-2019-0066.

Alt, R. (2019). Electronic markets on digital transformation methodologies. *Electronic Markets*, 307–313. doi: 10.1007/s12525-019-00370-x.

Bach, M. P., Spremić, M., & Vugec, D. S. (2018). Integrating digital transformation strategies into firms: Values, routes and best practice examples. In *Management and Technological Challenges in the Digital Age* (pp. 107–128). CRC Press.

Barata, J., da Cunha, P. R., & Coyle, S. (2018). Guidelines for using pilot projects in the fourth industrial revolution. *ACIS 2018 - 29th Australasian Conference on Information Systems*. doi: 10.5130/ acis2018.ag.

Beck, K., Grenning, J., Martin, R., Beedle, M., Highsmith, J., & Mellor, S. (2001). *Manifesto for agile software development* (pp. 12–14), Agile Alliance.

Bennett, E. E., & McWhorter, R. R. (2021). Virtual HRD's role in crisis and the post covid-19 professional lifeworld: Accelerating skills for digital transformation. *Advances in Developing Human Resources*, *23*, 5–25. doi: 10.1177/1523422320973288.

Berghaus, S., & Back, A. (2016). Stages in digital business transformation: Results of an empirical maturity study. In *Mediterranean Conference on Information Systems (MCIS)* (pp. 1–17).

Berghaus, S., & Back, A. (2017). Disentangling the fuzzy front end of digital transformation: Activities and approaches. In *Thirty Eight International Conference on Information Systems* (p. 17).

Berman, S. J. (2012). Digital transformation: Opportunities to create new business models. *Strategic Leadership*, *40*, 16–24. doi: 10.1108/10878571211209314.

Besson, P., & Rowe, F. (2012). Strategizing information systems-enabled organizational transformation: A transdisciplinary review and new directions. *The Journal of Strategic Information Systems*, *21*, 103–124.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, *37*, 471–482.

Bickauske, D., Simanaviciene, Z., Jakubavicius, A., Vilys, M., & Mykhalchyshyna, L. (2020). Analysis and perspectives of the level of enterprises digitalization (Lithuanian manufacturing sector case). *Independent Journal of Management and Production*, *11*, 2291. doi: 10.14807/ijmp.v11i9.1404.

Bondar, S., Hsu, J. C., Pfouga, A., & Stjepandić, J. (2017). Agile digital transformation of System-of-Systems architecture models using Zachman framework. *Journal of Industrial Information Integration*, *7*, 33–43. doi: 10.1016/j.jii.2017.03.001.

Bonnet, D., & Westerman, G. (2021). The new elements of digital transformation. *MIT Sloan Management Review*, *62*, 8.

Bouncken, R. B., Kraus, S., & Roig-Tierno, N. (2021). Knowledge- and innovation-based business models for future growth: Digitalized business models and portfolio considerations. *Review of Managerial Science*, *15*, 1–14. doi: 10.1007/s11846-019-00366-z.

Brink, H., Packmohr, S., & Vogelsang, K. (2020). Fields of action to advance the digital transformation of NPOs – development of a framework. *Lecture Notes in Business Information Processing LNBIP*, *398*, 82–97. doi: 10.1007/978-3-030-61140-8_6.

Brock, J. K.-U., & von Wangenheim, F. (2019). Demystifying AI: What digital transformation leaders can teach you about realistic artificial intelligence. *California Management Review*, *61*(4), 110–134.

Brunetti, F., Matt, D. T., Bonfanti, A., De Longhi, A., Pedrini, G., & Orzes, G. (2020). Digital transformation challenges: Strategies emerging from a multi-stakeholder approach. *TQM Journal*, *32*, 697–724. doi: 10.1108/TQM-12-2019-0309.

Buhulaiga, E. A., Telukdarie, A., & Ramsangar, S. J. (2019). Delivering on Industry 4.0 in a multinational petrochemical company: Design and execution. In *2019 Int. Conf. Fourth Ind. Revolution, ICFIR 2019* (pp. 1–6). doi: 10.1109/ICFIR.2019.8894790.

Catlin, T., Scanlan, J., & Willmott, P. (2015). Raising your digital quotient. *McKinsey Quarterly*, (June 2015), 1–13. doi: 10.1088/0004-637X/752/2/97.

Çetin Gürkan, G., & Çiftci, G. (2020). Developing a supportive culture in digital transformation. In *Digit. Bus. Strateg. blockchain Ecosyst. Contrib. to Manag. Sci.* (pp. 83–102). doi: 10.1007/978-3-030-29739-8_5.

Chanias, S., Myers, M. D., & Hess, T. (2019). Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *Journal of Strategic Information Systems*, *28*, 17–33. doi: 10.1016/j.jsis.2018.11.003.

Christensen, C. M., Raynor, M. E., & McDonald, R. (2015). What is disruptive innovation. *Harvard Business Review*, (December 2015), 1–16.

Colli, M., Madsen, O., Berger, U., Møller, C., Wæhrens, B. V., & Bockholt, M. (2018). Contextualizing the outcome of a maturity assessment for Industry 4.0. *IFAC-PapersOnLine*, *51*, 1347–1352. doi: 10.1016/j.ifacol.2018.08.343.

Colli, M., Berger, U., Bockholt, M., Madsen, O., Møller, C., & Wæhrens, B. V. (2019). A maturity assessment approach for conceiving context-specific roadmaps in the Industry 4.0 era. *Annual Reviews in Control*, *48*, 165–177. doi: 10.1016/j.arcontrol.2019.06.001.

Črešnar, R., Potočan, V., & Nedelko, Z. (2020). Speeding up the implementation of industry 4.0 with management tools: empirical investigations in manufacturing organizations. *Sensors*, *20*(12), 3469.

Diener, F., & Špaček, M. (2021). Digital transformation in banking: A managerial perspective on barriers to change. *Sustainability*, *13*, 2032. doi: 10.3390/su13042032.

Dolganova, O. I., & Deeva, E. A. (2019). Company readiness for digital transformations: Problems and diagnosis. *Business Informatics*, *13*, 59–72. doi: 10.17323/1998-0663.2019.2.59.72.

Dremel, C., Herterich, M. M., Wulf, J., Waizmann, J. C., & Brenner, W. (2017). How AUDI AG established big data analytics in its digital transformation. *MIS Quarterly Executive*, *16*, 81–100.

Earl, M. J. (2000). Evolving the E-business. *Business Strategy Review*, *11*, 33–38.

Earley, S. (2014). The digital transformation: Staying competitive. *IT Professional*, *16*, 58–60. doi: 10.1109/MITP.2014.24.

Ebert, C., & Duarte, C. H. C. (2018). Digital transformation. *IEEE Software*, *35*, 16–21. doi: 10.1109/MS. 2018.2801537.

Ebrahimpur, G., & Jacob, M. (2001). Restructuring for agility at volvo car technical service (VCTS). *European Journal of Innovation Management*, *4*, 64–72. doi: 10.1108/14601060110390558.

Faro, B., Abedin, B., & Kozanoglu, D. C. (2019). Continuous transformation of public-sector organisations in the digital era. In *Twenty-fifth Am. Conf. Inf. Syst.* (pp. 1–7).

Fechtelpeter, C., Kuehn, A., & Dumitrescu, R. (2018). Supporting the planning phase of SME-tailored technology transfer projects. In *Towar. Sustain. Technol. Innov. - Proc. 27th Annu. Conf. Int. Assoc. Manag. Technol, IAMOT* (pp. 0–20).

Fichman, R. G., Dos Santos, B. L., Zheng, Z., & Eric (2014). Digital innovation as a fundamental and powerful concept in the information systems curriculum. *MIS Quarterly*, *38*, 329–343. doi: 10. 25300/MISQ/2014/38.2.01.

Fichter, A. (2019). Change management towards digitalization and innovation. In *ICETA 2019 - 17th IEEE Int. Conf. Emerg. eLearning Technol. Appl. Proc.* (pp. 185–190). doi: 10.1109/ICETA48886. 2019.9040141.

Fischer, M., Imgrund, F., Janiesch, C., & Winkelmann, A. (2020). Strategy archetypes for digital transformation: Defining meta objectives using business process management. *Information Management*, *103262*. doi: 10.1016/j.im.2019.103262.

Fitzgerald, M, Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing digital technology: A new strategic imperative. *MIT Sloan Management Review*, *55*(2), 1–12. doi: 10.1057/palgrave.ejis.3000650.

Fuchs, C., & Hess, T. (2018). Becoming agile in the digital transformation: The process of a large-scale agile transformation. In *International Conference on Information Systems 2018, ICIS 2018* (p. 17).

Galimova, M., Gileva, T., Mukhanova, N., & Krasnuk, L. (2019). Selecting the path of the digital transformation of business-models for industrial enterprises. *IOP Conference Series: Materials Science and Engineering*, *497*. doi: 10.1088/1757-899X/497/1/012071.

Gigova, T., Valeva, K., & Nikolova-Alexieva, V. (2019). Digital transformation – opportunity for industrial growth. In *International Conference on Creative Business for Smart and Sustainable Growth (CREBUS)* (pp. 2019–2022), IEEE.

Goerzig, D., & Bauernhansl, T. (2018). Enterprise architectures for the digital transformation in small and medium-sized enterprises. *Procedia CIRP*, 540–545. doi: 10.1016/j.procir.2017.12.257.

Gong, C., & Ribiere, V. (2020). Technovation Developing a unified definition of digital transformation. *Technovation*, *17*. doi: 10.1016/j.technovation.2020.102217.

Guest, M. (2014). *Building your digital DNA: Lessons from digital leaders Contents the digital organisation* (*51*). London: Deloitte.

Haffke, I., Kalgovas, B., & Benlian, A. (2016). The role of the CIO and the CDO in an organization's digital transformation. *ICIS 2016 Proceedings*, *1*, 1–20.

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2020). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*. doi: 10.1111/joms.12639.

Harrington, R. J., & Tjan, A. K. (2008). Transforming one customer strategy at a time. *Harvard Business Review*, *86*(3), 62–73.

Hartl, E., Hess, T., (2017). The role of cultural values for digital transformation: Insights from a delphi study. In *AMCIS 2017 - Am. Conf. Inf. Syst. A Tradit. Innov.* 2017-August.

Helbin, T., & Van Looy, A. (2019). Business process ambidexterity and its impact on business-it alignment. A systematic literature review. In *Proc. - Int. Conf. Res. Challenges Inf. Sci.*, 2019-May. doi: 10.1109/RCIS.2019.8877073.

Hess, T., Benlian, A., Matt, C., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, *15*, 123–139.

Hirte, R., & Roth, P. (2018). Advanced innovation management: Best practice of German and American corporations in the mobility sector. In *PICMET 2018 - Portl. Int. Conf. Manag. Eng. Technol. Manag. Technol. Entrep. Engine Econ. Growth, Proc*. doi: 10.23919/PICMET.2018.8481904.

Imgrund, F., Fischer, M., Janiesch, C., & Winkelmann, A. (2018). Approaching digitalization with business process management. *Lecture Notes in Computer Science*, 59, 301–308.

Ishlahuddin, A., Handayani, P. W., Hammi, K., Azzahro, F., (2020). Analysing IT governance maturity level using COBIT 2019 framework: A case study of small size higher education institute (XYZ-edu). In *2020 3rd Int. Conf. Comput. Informatics Eng. IC2IE 2020* (pp. 236–241). doi: 10.1109/IC2IE50715.2020.9274599.

Ismail, M. H., Khater, M., & Zaki, M. (2017). Digital business transformation and strategy: What do we know so far? doi: 10.13140/RG.2.2.36492.62086.

Issa, A., Hatiboglu, B., Bildstein, A., & Bauernhansl, T. (2018). Industrie 4.0 roadmap: Framework for digital transformation based on the concepts of capability maturity and alignment. *Procedia CIRP*, 72, 973–978. doi: 10.1016/j.procir.2018.03.151.

Ivančić, L., Vukšić, V., & Spremić, M. (2019). Mastering the digital transformation process: Business practices and lessons learned. *Technology Innovation Management Review*, 9, 36–50. doi: 10.22215/timreview/1217.

Kadir, B. A., & Broberg, O. (2020). Human well-being and system performance in the transition to industry 4.0. *International Journal of Industrial Ergonomics*, 76. doi: 10.1016/j.ergon.2020.102936.

Kahre, C., Hoffmann, D., & Ahlemann, F. (2017). Beyond business-IT alignment - digital business strategies as a paradigmatic shift: A review and research agenda. In *Proc. 50th Hawaii Int. Conf. Syst. Sci.* (pp. 4706–4715). doi: 10.24251/hicss.2017.574.

Kamal, M. M. (2020). The triple-edged sword of COVID-19: Understanding the use of digital technologies and the impact of productive, disruptive, and destructive nature of the pandemic. *Information Systems Management*, 37(4), 310–317. doi: 10.1080/10580530.2020.1820634.

Kane, G. (2019). The technology fallacy: People are the real key to digital transformation. *Research-Technology Management*, 62, 44–49. doi: 10.1080/08956308.2019.1661079.

Kane, G., Palmer, D., Philips, A. N., Kiron, D., & Buckley, N. (2015). *Strategy, not technology, drives digital transformation* (27). MIT Sloan Management Review and Deloitte, Deloitte University Press.

Kane, G., Palmer, D., Phillips, A. N., & Kiron, D. (2017). Winning the war for talent. *MIT Sloan Management Review*, 58, 17–19.

Kane, G., Palmer, D., Phillips, A. N., Kiron, D., & Buckly, N. (2017). Achieving digital maturity. *MIT Sloan Management Review*, 59, 1–29.

Kaufman, I., & Horton, C. (2014). Digital transformation: Leveraging digital technology with core values to achieve sustainable business goals. *European Finance Review*, (December 20), 63–67.

Klisarova-Belcheva, S., Yankova, T., & Ilieva, G. (2019). Bi or no Bi? Presence and future of BI in small and medium-sized enterprises from South Central Bulgaria. In *ACM Int. Conf. Proceeding Ser*. doi: 10.1145/3351556.3351575.

Kontić, L., & Vidicki, Đ. (2018). Strategy for digital organization: Testing a measurement tool for digital transformation. *Strategic Management*, 23, 29–35. doi: 10.5937/StraMan1801029K.

Korachi, Z., & Bounabat, B. (2019). Integrated methodological framework for digital transformation strategy building (IMFDS). *International Journal of Advanced Computer Science and Applications*, 10, 242–250. doi: 10.14569/ijacsa.2019.0101234.

Kotter, J. P. (1995). Leading change: Why transformation efforts fail. *Harvard Business Review*, 12. doi: 10.1016/0029-1021(73)90084-4.

KPMG, K. and Veihmeyer, J. (2016). *Now or never: 2016 global CEO outlook*. Schweiz: KPMG International.

Krell, T., & Gale, J. (2005). E-Business migration: A process model. *Journal of Organizational Change Management*, 18, 117–131. doi: 10.1108/09534810510589552.

Kretschmer, T., & Khashabi, P. (2020). Digital transformation and organization design: An integrated approach. *California Management Review*, 62, 86–104. doi: 10.1177/0008125620940296.

Krüger, N., & Teuteberg, F. (2016). IT consultants as change agents in digital transformation initiatives. *Multikonferenz Wirtschaftsinformatik*, 2, 1019–1030, MKWI 2016.

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., . . . & Ahlemann, F. (2017). Digitalization: Opportunity and challenge for the business and information systems engineering community. *Business and Information Systems Engineering*, 59, 301–308. doi: 10.1007/s12599-017-0484-2.

Leonhardt, D., Haffke, I., Kranz, J., & Benlian, A. (2017). Reinventing the IT function: The role of IT agility and IT ambidexterity in supporting digital business transformation. In *European Conference on Information Systems Proceedings* (pp. 968–984).

Li, W., Liu, K., Belitski, M., Ghobadian, A., & O'Regan, N. (2016). e-Leadership through strategic alignment: An empirical study of small- and medium-sized enterprises in the digital age. *Journal of information technology*, 31, 185–206. doi: 10.1057/jit.2016.10.

Libert, B., Beck, M., & Wind, Y. (2016). 7 questions to ask before your next digital transformation. *Harvard Business Review Digit. Artic*, 60(12), 11–13.

Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *Journal of Strategic Information Systems*, 24, 149–157. doi: 10.1016/j.jsis.2015.08.002.

Lööw, J., Abrahamsson, L., & Johansson, J. (2019). Mining 4.0 - the impact of new technology from a workplace perspective. *Mining Engineering*, 71, 47–48. doi: 10.1007/s42461-019-00104-9.

Loonam, J., Eaves, S., Kumar, V., & Parry, G. (2018). Towards digital transformation: Lessons learned from traditional organizations. *Strategic Change 27*, 101–109. doi: 10.1002/jsc.2185.

Makarchenko, M., Nerkararian, S., & Scmeleva, I. (2016). How traditional banks should work in smart city. In *International Conference on Digital Transformation and Global Society* (pp. 123–134), Cham, Springer. doi: 10.1007/978-3-319-49700-6.

Martinez, F. (2019). Process excellence the key for digitalisation. *Business Process Management Journal*, 25, 1716–1733. doi: 10.1108/BPMJ-08-2018-0237.

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business and Information Systems Engineering*, 57, 339–343. doi: 10.1007/s12599-015-0401-5.

Matzler, K., Friedrich von den Eichen, S., Anschober, M., & Kohler, T. (2018). The crusade of digital disruption. *Journal of Business Strategy*, 39, 13–20.

Matzner, M., Büttgen, M., Demirkan, H., Spohrer, J., Alter, S., Fritzsche, A., . . . & Neely, A. (2018). Digital transformation in service management. *Journal of Service Science and Management*, 2, 3–21. doi: 10.15358/2511-8676-2018-2-3.

Mielli, F., & Bulanda, N. (2019). Digital transformation: Why projects fail, potential best practices and successful initiatives. In *Conf. Proc. - IEEE-IAS/PCA Cem. Ind. Tech. Conf.* (pp. 9–14), 2019-April. doi: 10.1109/CITCON.2019.8729105.

Mithas, S., Tafti, A., & Mitchell, W. (2013). How a firm's competitive environment and digital strategic posture influence digital business strategy. *MIS Quarterly*, 37, 511–536. doi: 10.1257/jel.50.4.1051.

Moi, L., & Cabiddu, F. (2020). Leading digital transformation through an agile marketing capability: The case of spotahome. *Journal of Management and Governance*, Springer. doi: 10.1007/s10997-020-09534-w.

Morgan, R. E., & Page, K. (2008). Managing business transformation to deliver strategic agility. *Strategic Change*, 17, 155–168.

Mugge, P., Abbu, H., Michaelis, T. L., Kwiatkowski, A., & Gudergan, G. (2020). Patterns of digitization: A practical guide to digital transformation. *Research-Technology Management*, 63, 27–35.

Nair, K. (2019). Overcoming today's digital talent gap in organizations worldwide. *Development and Learning in Organizations*, *33*, 16–18. doi: 10.1108/DLO-02-2019-0044.

Nowakowski, E., Farwick, M., Trojer, T., Häusler, M., Kessler, J., & Breu, R. (2019). An enterprise architecture planning process for industry 4.0 transformations. 572–579. doi: 10.5220/0007680005720579.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. Wiley. doi: 10.1523/JNEUROSCI.0307-10.2010.

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: How to benefit from digitalization in practice. *Journal in Information Systems, Project Management*, *5*, 63–77. doi: 10.12821/ijispm050104.

Paschek, D., Luminosu, C. T., & Draghici, A. (2017). Automated business process management-in times of digital transformation using machine learning or artificial intelligence. *MATEC Web of Conferences*, *121*, 1–8. doi: 10.1051/matecconf/201712104007.

Patel, K., & McCarthy, M. P. (2000). *Digital transformation: The essentials of E-business leadership*. McGraw-Hill Professional.

Patel, A., Kalita, P. C., & Asthana, S. (2018). Design for future: Strategic planning and design innovation framework for digital organizations. In *Proc. Nord. Des. Era Digit. Nord. 2018*.

Peter, M. K., Kraft, C., & Lindeque, J. (2020). Strategic action fields of digital transformation: An exploration of the strategic action fields of Swiss SMEs and large enterprises. *Journal of Strategy and Management*, *13*, 160–180. doi: 10.1108/JSMA-05-2019-0070.

Ross, P., & Blumenstein, M. (2013). Cloud computing: The nexus of strategy and technology. *Journal of Business Strategy*, *34*, 39–47. doi: 10.1108/JBS-10-2012-0061.

Ross, J. W., Sebastian, I. M., Beath, C., Mocker, M., Moloney, K. G., Fonstad, N. O., (2016). Designing and executing digital strategies. In *2016 International Conference on Information Systems ICIS 2016* (pp. 1–17).

Saarikko, T., Westergren, U. H., & Blomquist, T. (2020). Digital transformation: Five recommendations for the digitally conscious firm. *Business Horizons*. doi: 10.1016/j.bushor.2020.07.005.

Sathananthan, S., Hoetker, P., Gamrad, D., Katterbach, D., & Myrzik, J. (2017). Realizing digital transformation through a digital business model design process. In *Jt. 13th CTTE 10th C. Conf. Internet Things - Bus. Model. Users, Networks 2018-Janua* (pp. 1–8). doi: 10.1109/CTTE.2017.8260996.

Schallmo, D., & Williams, C. (2018). Digital transformation now! Guiding the successful digitalization of your business model. *IEEE Software*. doi: 10.1109/MS.2018.2801537.

Schallmo, D., Williams, C. A., & Boardman, L. (2017). Digital transformation of business models — best practice, enablers, and roadmap. *International Journal of Innovation Management*, *21*, 17. doi: 10.1142/s136391961740014x.

Schneider, S., & Kokshagina, O. (2021). Digital transformation: What we have learned (thus far) and what is next. *Creativity and Innovation Management*, *30*(2), 1–28. doi: 10.1111/caim.12414.

Schuchmann, D., & Seufert, S. (2015). Corporate learning in times of digital transformation: A conceptual framework and service portfolio for the learning function in banking organisations. *International Journal of Advanced Corporate Learning*, *8*, 31–39. doi: 10.3991/ijac.v8i1.4440.

Schuh, G., Bleider, M., Hoffmann, J., Hartard, E., Heisenberger, P., & Zeller, V. (2019). Systematic analysis of IT complexity challenges hindering the implementation of Industrie 4.0 roadmaps. In *ACM Int. Conf. Proceeding Ser.* (pp. 104–108). doi: 10.1145/3312714.3312716.

Schuh, G., Frank, J., Jussen, P., Rix, C., & Harland, T. (2017). Manufacturing industry. In *Impact English Civ. War Econ. London, 1642-50* (pp. 201–218). doi: 10.4324/9781315300412-3.

Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2017). How big old companies navigate digital transformation. *MIS Quarterly Executive*, *16*, 197–213. doi: 10.1017/S0021859600058731.

Siachou, E., Vrontis, D., & Trichina, E. (2020). Can traditional organizations be digitally transformed by themselves? The moderating role of absorptive capacity and strategic interdependence. *Journal of Business Research*. doi: 10.1016/j.jbusres.2020.11.011.

Silverio-Fernández, M. A., Renukappa, S., & Suresh, S. (2021). Strategic framework for implementing smart devices in the construction industry. *Construction Innovation*, *21*, 218–243. doi: 10.1108/CI-11-2019-0132.

Singh, A., & Hess, T. (2017). How chief digital officers promote the digital transformation of their companies. *MIS Quarterly Executive*, *16*, 1–17.

Sjödin, D., Parida, V., Kohtamäki, M., & Wincent, J. (2020). An agile co-creation process for digital servitization: A micro-service innovation approach. *Journal of Business Research*, *112*, 478–491. doi: 10.1016/j.jbusres.2020.01.009.

Skog, D. A., Wimelius, H., & Sandberg, J. (2018). Digital disruption. *Business and Information Systems Engineering*, *60*, 431–437. doi: 10.1007/s12599-018-0550-4.

Sommer, A. F. (2019). Agile transformation at LEGO group. *Research and Management*, *62*, 20–29. doi: 10.1080/08956308.2019.1638486.

Stich, V., Zeller, V., Hicking, J., & Kraut, A. (2020). Measures for a successful digital transformation of SMEs. *Procedia CIRP*, *93*, 286–291. doi: 10.1016/j.procir.2020.03.023.

Stolterman, E., & Fors, A. C. (2004). *Information technology and the good life, information systems research*. Boston, MA: Springer. doi: 10.1007/1-4020-8095-6_45.

Stoyanova, M. (2020). Good practices and recommendations for success in construction digitalization. *TEM Journal*, *9*, 42–47. doi: 10.18421/TEM91-07.

Strutynska, I., Dmytrotsa, L., Kozbur, H., Melnyk, L., & Olha, H. (2020). Developing practical recommendations for increasing the level of digital business transformation index. *CEUR Workshop Proceedings*, *2732*, 351–362.

Subramaniam, M., Iyer, B., & Venkatraman, V. (2019). Competing in digital ecosystems. *Business Horizons*, *62*, 83–94. doi: 10.1016/j.bushor.2018.08.013.

Van Veldhoven, Z., & Vanthienen, J. (2021). Digital transformation as an interaction-driven perspective between business, society, and technology. *Electronic Markets*, *16*. doi: 10.1007/s12525-021-00464-5.

Van Veldhoven, Z., Etikala, V., Goossens, A., & Vanthienen, J. (2021). A scoping review of the digital transformation literature using scientometric analysis. In *24th International Conference on Business Information Systems (BIS 2021)* (p. 12). doi: 10.52825/bis.v1i.49.

Veile, J. W., Kiel, D., Müller, J. M., & Voigt, K. I. (2020). Lessons learned from Industry 4.0 implementation in the German manufacturing industry. *Journal of Manufacturing Technology Management*, *31*, 977–997. doi: 10.1108/JMTM-08-2018-0270.

Venkatesh, R., Singhal, T. K., & Mathew, L. (2018). Emergence of digital services innovation as a path to business transformation: Case of communication services providers in GCC region. *International Journal of Innovative Technology and Exploring Engineering*, *8*, 56–63.

Venkatraman, N. (1994). It-enabled business transformation - from automation to business scope redefinition. *Sloan Management Review*, *35*, 73–87. doi: 10.1002/qua.560360829.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems*, *28*, 1–27. doi: 10.1016/j.jsis.2019.01.003.

von Leipzig, T., Gamp, M., Manz, D., Schöttle, K., Ohlhausen, P., Oosthuizen, G., . . . & von Leipzig, K. (2017). Initialising customer-orientated digital transformation in enterprises. *Procedia Manufacturing*, *8*, 517–524. doi: 10.1016/j.promfg.2017.02.066.

Wade, M., & Shan, J. (2020). Covid-19 has accelerated digital transformation, but may have made it harder not easier. *MIS Quarterly Executive*, *19*, 213–220. doi: 10.17705/2msqe.00034.

Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long-Range Planning*, *52*, 326–349. doi: 10.1016/j.lrp.2018.12.001.

Weill, P., & Woerner, S. L. (2015). Thriving in an increasingly digital ecosystem. *MIT Sloan Management Review*, 56, 27–34. doi: 10.1287/isre.1100.0318.

Westerman, G., Calméjane, C., Bonnet, D., Ferraris, P., & McAfee, A. (2011). *Digital transformation: A road-map for billion-dollar organizations*. Capgemini Consulting & MIT Sloan Management.

Westerman, G., Bonnet, D., & McAfee, A. (2012). The digital capabilities your company needs. *MIT Sloan Management Review*, 1–5.

Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research*, 21, 724–735. doi: 10.1287/isre.ll00.0322.

Zangiacomi, A., Sacco, M., Pessot, E., De Zan, A., & Bertetti, M. (2018). A perspective for the implementation of a path towards the factory of the future: The Italian case. In *2018 IEEE Int. Conf. Eng. Technol. Innov. ICE/ITMC 2018 - Proc*. doi: 10.1109/ICE.2018.8436386.

Appendix
Online survey

(1) What is your current job function and responsibilities concerning DT?

(2) Digital strategy

- The digital strategy needs to align the IT and business goals (1–5 scale)

- The digital strategy needs to outline the digital business model and value chain (1–5 scale)

- The digital strategy must be customer-driven (1–5 scale)

- The digital strategy must investigate strategic partnerships (1–5 scale)

- Are there any other important aspects of the digital strategy not named above? (open question)

- How can these aspects of the digital strategy be rolled out in practice? (open question)

(3) Business agility

- Companies should increase its business agility by outsourcing (1–5 scale)

- Companies should increase its business agility by giving employees more decision-power (1–5 scale)

- Companies should increase its business agility by implementing agile development methods (1–5 scale)

- Companies should increase its business agility by leveraging cloud technologies (1–5 scale)

- Are there any other important aspects of business agility not named above? (open question)

- How can these aspects of the business agility be rolled out in practice? (open question)

(4) Innovation

- Companies can become more innovative by investing in startups (1–5 scale)

- Companies can become more innovative by creating a new division for innovation (1–5 scale)

- Companies can become more innovative by establishing dedicated hours/days for innovation (1–5 scale)

- Are there any other important aspects of innovation not named above? (open question)

- How can these aspects of innovation be rolled out in practice? (open question)

(5)   Organizational structure

- Companies should modernize their organizational structure by establishing cross-functional teams (1–5 scale)

- Companies should modernize their organizational structure by flattening the hierarchy (1–5 scale)

- Companies should modernize their organizational structure by stimulating collaboration (1–5 scale)

- Companies should modernize their organizational structure by establishing a digital division to lead DT (1–5 scale)

- Are there any other important aspects of a modern organizational structure not named above? (open question)

- How can these aspects of a modern organizational structure be rolled out in practice? (open question)

(6)   Digital culture

- Companies should build a digital culture where change is part of daily-life (1–5 scale)

- Companies should build a digital culture where a digital-first mindset is the default (1–5 scale)

- Companies should build a digital culture where collaboration is the default (1–5 scale)

- Companies should build a digital culture where training and education is a permanent effort (1–5 scale)

- Are there any other important aspects of a digital culture not named above? (open question)

- How can these aspects of a digital culture be rolled out in practice? (open question)

(7)   Top management

- Top management should appoint a CDO to lead the DT (1–5 scale)

- Top management should create a digital vision and communicate it to all stakeholders (1–5 scale)

- Top management should create a feeling of urgency and necessity of DT (1–5 scale)

- Top management should lead with a supportive, advising, and proactive mindset (1–5 scale)

- Are there any other important aspects of top management support not named above? (open question)

- How can these aspects of top management support be rolled out in practice? (open question)

(8)   IT infrastructure

- Companies need an operational backbone for speedy, efficient, and reliable business processes (1–5 scale)

- Companies need a central database for all company data (1–5 scale)

- Companies need to support modern technologies such as data mining, IoT, and cloud computing (1–5 scale)

- Are there any other important aspects of IT infrastructure not named above? (open question)

- How can these aspects of IT infrastructure be rolled out in practice? (open question)

(9) Wrap-up

- Are there any other best practices not mentioned in this survey for DT?

- Any other comments?

Corresponding author
Ziboud Van Veldhoven can be contacted at: ziboud.vanveldhoven@kuleuven.be