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Maturity of Building Blocks for Managing Digital Transformation

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Full research paper

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Abstract

In order to support companies in their approach for digital transformation, especially those that are not digitally native, the maturity model for digital transformation DX-MM is presented. The DX-MM was developed according to eight building blocks of digital transformation and assessed based on 20 interviews with representatives of leading manufacturing firms. The findings suggest that the use of maturity models for digital transformation is needed and widespread in companies, but existing models lack a holistic approach as well as applicable transformation steps and measures. The DX-MM attempts to close this gap as it allows organisations to analyse the status quo of digital transformation and supports in identifying specific and tangible steps and measurements for strategy-aligned digital transformation.

Keywords: Digital transformation, maturity model, transformation management, evaluation.

1 Introduction

The integration of new digital technologies exponentially disturbs existing business and operating models and frequently reshapes industries. This transformation improves product and service qualities and provides innovative processes and value creation. Digital transformation has been attracting increasing interest from almost all kinds of businesses. Scholars use a different variety for digital transformation (DX) (Vial 2019). DT is generally defined as a major organizational change driven by, built on, or enabled by digital technology and altering how business is conducted (Mergel et al. 2019). With the development of Industry 4.0 practices, DX includes various combinations of emerging technologies such as AI, cyber-physical systems, digital twins and blockchain (Ghobakhloo 2018).

Scholars provide different frameworks to manage DX. For example, Davis et al. (2010) proposes three steps for DX: developing a vision, planning strategically and implementing the vision. Developing a robust strategy for DX is not simple for most decision makers. The prerequisite for defining the vision for DX is for managers to understand the current state of their company, challenges, and benefits of transformation. However, although DX is becoming a common practice in industries, many do not have a clear and comprehensive roadmap to manage transforming their existing business models and operations (Gökalp and Martinez 2021). It is, therefore, necessary to understand what aspects of the business can be changed, what are the requirements, challenges, and potential impacts. Buck et al. (2021) proposed eight building blocks to manage DX: operations, data, value propositions, customers, transformation management, organizational structure, human resources, and culture. While this framework defines what are the building blocks for managing DX, companies still need to be able to evaluate their current situation in each of these building blocks and develop a clear path to move from their current state to a future state, e.g., to the next digital maturity level. To this end, scholars suggest maturity models. A maturity model provides a framework that assesses and measures the maturity level of an organization in terms of DX (Poeppelbuss et al., 2011).

Our work builds on the existing academic discourse and offers a maturity model that allows organisations to grasp and shape the complex nature of digital transformation in a multidimensional way. The digital transformation maturity model (DX-MM) builds on eight established areas of action in digital transformation and allows a detailed analysis of the status quo and operationalization of interdependent measures for a conscious and targeted increase in the digital maturity of organizations (Buck et al., 2021). Regarding our research, we developed a DX-MM based on Becker et al.'s (2009) procedure model and guidelines. We build on an extensive literature review to define how maturity of these blocks can be operationalized, measured and be divided in different levels. We then evaluate our developed model based on interviews with practitioners and experts. Maturity models are important tools because they allow companies to better position themselves and find solutions for change (Becker et al. 2009). Our research analyses the DX of industrial companies based on eight building blocks, which represent the company's capabilities. With the DX, companies are subject to a process of change. Thus, with this paper we contribute a generally applicable maturity model for digital transformation to systematically evaluate organisations' state of development in relation to DX.

2 Background

DX is occurring in various industries, and the transformation process happens in different ways based on organizational characteristics and requirements. It is complicated and particularly difficult to understand for some companies. Therefore, it is probably the reason why DX does not have an uniform definition. A summary of different definitions of DX can be found in (Markus and Rowe 2023; Vial 2019). Similar to the various definitions of DX, different frameworks have been proposed to manage a successful transformation. For instance, Rueckel et al. (2020) propose a framework with nine factors: innovative organizational culture, internal and external collaboration, strategic embeddedness, digital leadership, digital platform infrastructures, bimodal IT structures, institutionalized innovation processes, individual creativity and innovation capabilities, and ICT literacy. Warner and Wäger (2019) proposes process model for building dynamic capabilities for DX. Besides availability of different frameworks, scholars developed maturity models to describe patterns and develop organizational capabilities for DX. The development of maturity models is constantly growing in number, which can be seen in the increasing number of publications by academics and the wide adoption by practitioners (de Bruin et al. 2005; Paulk et al. 1991; Solli-Sæther and Gottschalk 2010). Various authors define the term maturity as the "state of being complete, perfect, or ready" (Kohlegger et al. 2009; Rosemann and De Bruin 2005; Simpson and Weiner 1989). Accordingly, Klötzer and Pflaum (2017) developed the maturity concept: Maturity refers to the state of a company in which it is perfectly capable of achieving its objectives and thereby mastering the various challenges of DX. The maturity model is used by companies

to assess the current state, derive and prioritize improvement measures, and monitor progress (de Bruin et al. 2005; Iversen et al. 1999).

Previous digital maturity models provide basis for assessing digital maturity and readiness of organizations for DX. Colli et al. (2018) proposed a model based on five dimensions: governance, technology, connectivity, value creation and competence. Lin et al. (2020) proposed three building blocks: process, technology, and organization. Gökalp and Martinez (2021) proposed a digital transformation capability maturity model based on four dimensions: strategic governance, information and technology, digital process transformation, and workforce management. Viloria-Núñez et al. (2022) conducted a literature review of digital maturity models for SMEs. They identified dimensions such as process, culture, strategy, IT infrastructure, transformation management, people, and customers as a common dimension used in most of maturity models. Berghaus and Back (2016) developed a digital maturity model (DMM), which comprises nine dimensions based on the previous DMM by Back and Berghaus (2016). The increasing research as well as existing maturity models show a clear need for holistic approaches to the design of DX that can be applied in corporate practice. While previous maturity models take a very macro perspective on organizations or focus on capabilities needed for DX, the DX-MM incorporates a customer and value creation perspective, digital infrastructure, capabilities, and employees, as well as change management and organizational change through the eight building blocks of DX (Buck et al., 2021). We base our work on the eight building blocks of DX from Buck et al. (2021), as it puts a holistic perspective on the DX of organizations and allows to operationalize different levels of DX within each building block. Moreover, the artifact can support companies' transformation processes on the technical, organizational, and strategic levels. The artifact is applicable for the analysis of the status quo of DX and allows explicit measurements, identified in each of the eight building blocks, for goal-directed and resource-efficient DX. Thus, DX-MM supports the digital transformation process on organizational and strategic levels, including organizational redesign, decision support systems, roadmap development methods, and balanced scorecards.

3 Research Method

We built a DX-MM based on the design science method by Hevner et al. (2004). Figure 1 present our research method. First, we started with identification and formulation of the problem and objectives. We looked at business needs emerging because of the radical changes in the environment (e.g., businesses, industries, technology adaption and operations) triggered by DX. The industries struggle with the fundamental shift that threatens their established structures. Therefore, they need guidance to assist organizations by providing current capability and maturity determination and the creation of a comprehensive roadmap for the improvement in a structured way (Gökalp and Martinez 2021). We used the integrative framework for DX by Buck et al. (2021) that represents the artifact and builds the structural basis of the research. Furthermore, we conducted a systematic literature review (SLR) for each building block to gain thorough knowledge about the problem space. We designed and developed our DX-MM based on the findings from the SLR. Insights from SLR enabled us to explore opportunities presented by DX and define maturity levels.

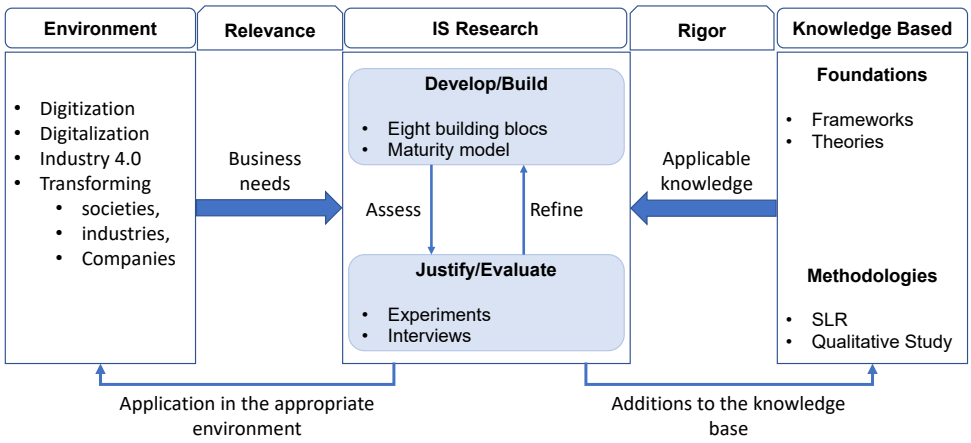

Figure 1 : Research Method (Adopted from (Hevner et al. 2004, p. 80))

Once we developed our DX-MM, we conducted interviews to evaluate our model. The artifact is the basis for the maturity model, and industry leaders should be able to assess their companies in all eight fields

with the defined maturity levels. Thereby, the classification of the maturity levels of the eight building blocks report on companies' current situations and provide adjusted digital roadmaps for companies to overcome the transformation phase.

3.1 Systematic Literature Review

Our DX-MM is based on the existing work of Buck et al. (2021). Our SLR strategy followed the guidelines for performing a SLR in software engineering (Kitchenham et al. 2009). We employed previous studies (e.g., Becker et al. 2017; Berghaus and Back 2016; Buck et al. 2021) to define the keywords. The keywords include a list of synonyms, abbreviations and alternatives for DX and individual building blocks. We conducted our search on Web of Science (WoS) based on title, abstract, and keywords on the papers published between 2009 and 2021. The selection of the relevant literature was governed by the inclusion and exclusion criteria regarding English publication, related to DX, considers one of the eight building blocks, papers published in Q1 journals with an impact factor of 4 or more. We excluded articles that were not within the field of IS or management, which resulted in 60,265 articles. For the remaining articles, we executed a two-stage selection approach that included title and abstract check. First, we excluded all articles that did not contain in the title or abstract the term DX, digitalization, or digitization and a minimum of one of the keywords from the building blocks. In the second step, the papers were read, evaluated, and critically assessed; if the research was outside the scope, then it was discarded. After the removal of duplicates, we received 152 papers.

3.2 Qualitative Interviews

First, we developed an interview protocol to conduct semi-structured interviews. The protocol is intended to provide a controlled approach to the research topic (Kitchenham et al. 2009). The protocol comprises four parts: a short introduction of the researcher and demographic questions. Then, the research objectives and the problem are explained. This is followed by the presentation of the maturity model, which was sent to the interviewee in advance. In this part, each interviewee is asked to discuss personal thoughts about, opinions of and experiences with the model or any other maturity model. In the final part, the evaluation criteria are presented for the actual discussion and evaluation of the model. The evaluation criteria have been developed based on (March and Smith 1995). We initially invited 140 people via LinkedIn; ultimately, 20 interviewees agreed to participate in the study. We used theoretical sampling to select our participants based on their role in the industry, their experience in DX projects and their potential knowledge to explore perception of DX-MM – therefore, our subjects differed in the companies in which they worked and how involved they were in DX projects. Table 1 provides a demographic information of our participants.

Gender	**Female**	**2**
	Male	18
Industry	Automotive	6
	Cement	1
	Consultancy	3
	Consumer good	1
	Energy Supply	2
	Medical Engineering	1
	Metal	1
	Paper	1
	Pharmaceutical	2
	Plastic	1
	Potash	1
Role	IT enterprise architect	1
	Head of HR processes and systems	1
	DX manager/director, VP	9
	Consultant	3
	Product manager	2
	Innovation manager	2
	Digital strategy manager	1
	Agile project manager	1
Total number		**20**

Table 1. Demographic information of our interviewees

4 Digital transformation maturity model (DX-MM)

Based on the results of the literature review, we developed five maturity levels. Then we explain how these levels can apply to the eight building blocks of our maturity model. Figure 2 represent an overview of maturity levels.

4.1 Maturity Levels

Level 0: Unambitious – In this level, the motivation for DX is small. The company therefore avoids DX (Solberg et al. 2020) or there is no road map for DX. The existing structures are maintained and no restructuring occurs.

Level 1: Commencing – In this level, the company begins to revise its technological and operational infrastructure to align with the business (Sia et al. 2021) and identifies a way to adapt to the new reality and the digital business model (Björkdahl 2020).

Level 2: Engaged – In this level, companies create an ambidextrous technology foundation, initiated the transformation processes, and several measures are undertaken place (Björkdahl 2020).

Level 3: Advanced – In this level, the company's business operations, capability internal culture and organizational structure are influenced by DX (Berghaus and Back 2016), allowing for proactive engagement with new technology and processes while providing opportunities for mastery (Solberg et al. 2020).

Level 4: Optimized – In this level, the DX has reached the pinnacle of maturity and is known as a digital innovator in its respective industry (Björkdahl 2020). Key Performance Indicator for DX have been established and are regularly reviewed.

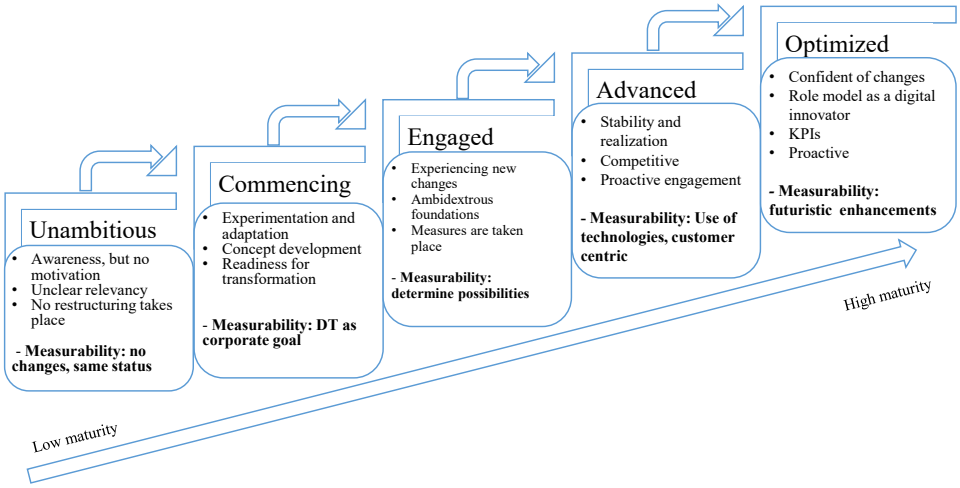

Figure 2: Overview of maturity levels

4.2 Maturity Model

4.2.1 Operations

Operations deal with production processes, coordination, planning, and controlling - all the tasks and resources needed to produce goods and services (Buck et al. 2021). In the unambitious level, companies do not have technological approaches, processes are not automated, and there is no direct plan to change. While the company leaders may be aware of the need for transformation, they also know that their business processes are not flexible. At this stage, leaders identify the needs and initiate the digitalization process.

In the commencing level, company leaders align the technological and operational infrastructures with the business (Sia et al. 2021). The company lay the foundations of DX by applying different methods such as lean principles and operational agility, and acquisition of basic infrastructure required to transform the operations (Warner and Wäger 2019). They develop approaches and analyze the feasibility of a DX with available resources. In the engaged level, company leaders start the adaption of changes such as installation of flow-related lean production practices and improve operational performance extended by new standards, occurs through the digital automation and introduction of

service-oriented technologies, such as cloud services, IoT, sensors for remote monitoring and control or big data analytics.

In the advanced level, companies reach a certain maturity and grow. This is accompanied by the creation of an ambidextrous technological foundation through which the core operating business is modernized and a new platform for digital services is established. Now the company is ready to establish the acquired ideas and implementations to use them on the market (Olsen and Tomlin 2020; Solberg et al. 2020; Veile et al. 2020). In the optimized phase companies need to enhance and build exploitation capabilities, such as cyber-physical systems for the operational backbone (Sia et al. 2021). More complex solutions, such as hyper-automation, smart robots, IoT, blockchain, and AI for smartification of different operating processes are used (Olsen and Tomlin 2020). Additionally, data-driven workflows and workstations can be formed to achieve the optimal efficiency.

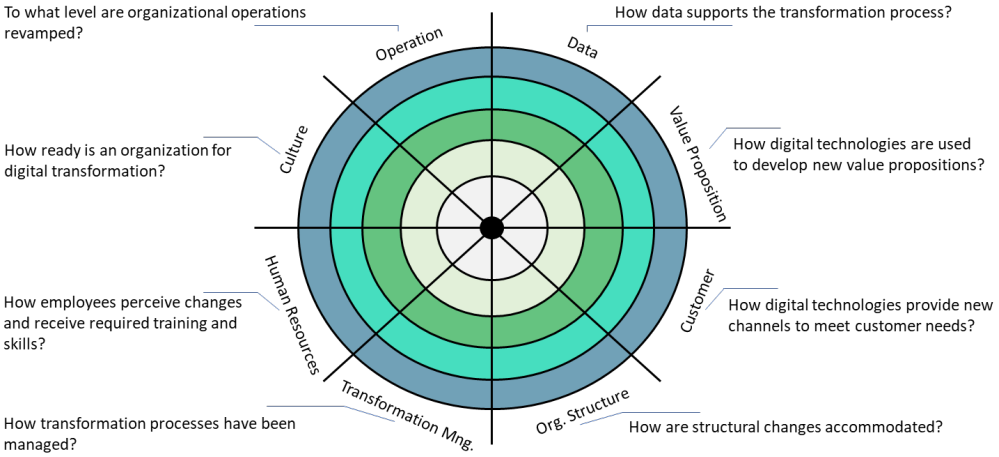

Figure 3: Digital Transformation Maturity Model (DX-MM)

4.2.2 Data

Data plays a key role in the digital economy to add value through advanced analytics and data enabled technologies such as AI. The unambitious level describes a stage in which the company does not have central control of data and does not allow easy access to data (Björkdahl 2020). Measures such as data security and data privacy have not been addressed. This is the point when company leaders recognize that without the ordinary administration of data, the DX cannot be initiated.

In the commencing level, company leaders are motivated for data integration and to acquire new data continuously. They create data storage and analysis capabilities that allow all functions to access the data and provide the ability to analyze generated and gathered data (Björkdahl 2020). The use of data management enables internal and external access to data and builds a base for the upcoming innovations (Correani et al. 2020). In the engaged level, the data related technologies are implemented, data science groups are stablished, and new infrastructure such as advanced network connections, sensors, microprocessors and actuators are used to collect and analyse machine generated and other relevant data (Veile et al. 2020). Consequently, the handling of data is stabilized and a secure approach to the implementation of measures is enabled.

In the advanced level, companies continuously improve and check the security of all systems (Veile et al. 2020). In this level, real-time data analysis enables employees proactively to analyse, e.g., to determine the contextual status of machines (Correani et al. 2020) and to adapt the generated insights into the business process. In this level, data volume grows, and an ethical system is implemented that stimulates the kind of trust that fosters customer loyalty and involve users when developing digital ethics practices (Sestino et al. 2020). In the optimized level, which includes current, real-time and accurate 360-degree applications potential needs are identified to determine future trends and demands (Ghobakhloo 2018). Technologies such as advanced analytics and business intelligence allow company leaders to identify what is possible and helpful to develop new solutions to maintain pace with the competition (Björkdahl 2020).

4.2.3 Value Proposition

Value proposition refers to the to advantages and benefits organizations provide to their customers or target audiences through their products or services (Ritter and Pedersen 2020). In the unambitious level, the company does not implement any additional flexible machines or services to generate additional value. There are no other measures to generate additional service through DX. However, the leaders realize that if no value is created, there is no motivation for the DX process.

In the commencing level, leaders analyze key trends and begin to pursue digitalization and servitization to offer new value (Ritter and Pedersen 2020). With new approaches such as digital servitization, leaders start developing new business opportunities, digital offerings, and smart solutions. In the engaged phase, leaders develop new competencies and technologies through which they provide digital offerings (Ross et al. 2019). Digital capabilities, such as crowd, digital startups, and cloud analytics providers enable extensions of innovative applications to provide more value and advanced digital offerings. Software- and platform-enabled services offer enhanced value as well as new value creation (Correani et al. 2020).

In the advanced level, company leaders present smart products and customer-centric offerings so that customers directly receive the value proposition. By implementing digital applications, companies manage to offer extended access, improved functionality, and better communication and collaboration. In this level, organizations also benefit from the collaboration with the variety of third party digital solution providers (Schreieck et al. 2021). In the optimized phase, company leaders begin to develop and market optimized solutions with digital native ecosystem partners, which allows new offerings to be supported cooperatively and competitively to meet customer needs and develop new innovations through a successful ecosystem (Correani et al. 2020). In this level, leaders increase sales of smart services and use emerging digital technologies to increase the competitive advantage over other providers.

4.2.4 Customer

Customers are stakeholders who obtain, have obtained, or could obtain the value propositions offered by the company. At the unambitious level, the customer access does not run via digital channels and thus limits the possibilities regarding accessibility (Björkdahl 2020). There is no clear understanding on how and why digital technologies play an important role in creating value for the customer.

In the commencing maturity level, the company considers implementation of digital technologies to address the customers' needs. They start implementing digital channels to identify customers' communication needs, improve customer engagement and create a customer centric approach (Lee et al. 2019). In the engaged level, leaders analyze key trends, improve customer experience, involve customers in value co-creation processes, increase customer knowledge and provide better customer support and monitoring (Ghobakhloo 2018; Warner and Wäger 2019). Customer data is becoming an enterprise-wide resource for new innovations. Further motivation lies in the sales transformation, which entails the digitalization of internal and customer-oriented processes.

In the advanced maturity level, company leaders attempt to identify how DX can be simplified and how to implement the innovations identified in the engaged level. Thus, in this level, the development of a chatbot supplements or even replaces humans in service interactions, which makes it easier to manage the relationship with the customer, allows more efficient use of customer time and provides better understanding regarding product performance. Different customer experience levels are achieved through personalized interactions (Warner and Wäger 2019). In the optimized level, leaders invest in new technology is implemented that interacts with the customer through sensors that collect data on customer activities (Correani et al. 2020). The improvement of customer care service occurs through conversational autonomous interfaces based on AI that operates through a few channels, through digital assistance and through voice-activated services, which allow the company to be a digital innovator.

4.2.5 Organizational Structure

DX requires company leaders to adapt the organizational hierarchy, reporting structure and divisions of tasks within the organization (Sia et al. 2021). In the unambitious level, organizations are stuck in the traditional structure and the same processes are applied to the reporting relationships and business processes. The IT department fulfills a support function instead of promoting digitalization (Björkdahl 2020). There is no flexibility due to the preservation of the old organizational structures. In this level, leaders realise the need to adopt IT to their business transform develop a need for basic structures , that the transformation can be implemented.

In the commencing level, leaders start merging new technologies to improve adaptability and flexibility of their structure. The aim is to decrease the authority of centralized decision makings and provide more autonomy to the employees in different organizational levels. This adaption forms a new operations division that adds business value through technology. The engaged maturity level contains adaption of the routines to achieve flexibility in the long-term and become ambidextrous (Sia et al. 2021). Company leaders introduce ambidexterity by creating multifunctional IT and business foundations in which core operating businesses are modernized and a digital service platform is established.

In the advanced maturity level, the organizational structure promotes cross functional teams that allow quick adoption to changing market conditions, technology advancements and customer needs (Sia et al. 2021). It leverages digital tools and platforms to facilitate communication and collaboration, distribute decision-making authority through the organisation and empowers employees at all levels to make informed decisions and take ownership of their work. In the optimized level, organizations embrace agility and flexibility in their structure. By applying the exploit-explore approach, existing resources are refined, and the structure provides the scope for speed, flexibility, and experimentation in the development of innovative solutions (Sia et al. 2021). The organization adopts a mindset of continuous improvement, and has a clear digital governance structure in place, with defined roles and responsibilities for overseeing digital initiatives. Organizations align their digital strategy with overall business objectives and ensures that digital initiatives are prioritized and resourced accordingly (Björkdahl 2020).

4.2.6 Transformation management

Transformation management deals with the change process, strategy formulation and implementation (Gfrerer et al. 2021). Furthermore, a transformation requires restructuring to maintain the goals in the long term. Companies in the unambitious level have a lack of support from senior management regarding the motivation for transformation (Björkdahl 2020). Another unsuccessful belief is that DX can be managed by one function, which leads to barriers between different departments and functions.

In the commencing level, organizations invest in defining digital strategies, merging technology and operation divisions, and forming a basis for transformation management to coordinate and drive the transformation forward. After the structure of the transformation is determined, leaders of companies in the engaged level must determine procedures for formulating, implementing, evaluating and adapting DX strategies to create a roadmap and a checklist. The importance of DX is known within the company and is a top priority. Organizations use digital tools to communicate and engage employees in the transformation processes in an interactive way (Gfrerer et al. 2021). In this level clear positions for the management of the transformation are determined; employees' perceptions and their readiness have been analysed and communicated.

At the advanced maturity level, leaders provide a clear vision for DX, communicate its importance, and lead by example in embracing change. They establish change governance structures to oversee and support the change management process. Leaders create a culture of continuous learning and adaptation and provide training and resources to build skills and capabilities, and create a supportive environment for change (Firk et al. 2021). In the optimized level, a guideline for the creation and appropriation of value through digital technologies is defined for the achievement of long-term goals (Correani et al. 2020). In this level, transformation management involves proactive change management, identifying and involving key stakeholders, including employees, customers, and partners, to gain their support, address concerns, and ensure their active participation in the change process. They ensure transparent and consistent communication about the transformation journey (Correani et al. 2020).

4.2.7 Human resources (HR)

The employees are important resources for a company, as only through their engagement can a transformation be achieved. The unambitious maturity level describes the situation in which the way of working does not change and there are no further HR practices regarding DX. Company leaders notice the importance of involving employees in the transformation process; however, profiles, skills and knowledge must be transferred for the transformation to occur.

In the commencing maturity level, assessing and adapting HR practices are the first steps, especially in implementation digital strategies (Vereycken et al. 2021). HR managers develop employee involvement practices, especially in suitable job design and skill development (Vereycken et al. 2021). The existing knowledge of the company's leaders and employees expands with visits to leading technology companies to learn about industry best practices in designing modern systems (Sia et al. 2021). They try to implement planned theoretical ideas and venture forward. In the engaged maturity level leaders

considers both direct and indirect implications of technological innovations for HR practices (Vereycken et al. 2021). Companies offer ongoing educational initiatives and focus on updating employee skills, which leads to the maintenance of current job profiles. Internal workshops support the dissemination of knowledge through the company and provide access to user knowledge. By adopting flexible team structures, employees share and accumulate knowledge.

Advanced level is after the core areas of HR have been transformed. In this level, leaders build future scenarios that describe trends and future use cases (Abrell et al. 2016). HR leaders examine the alignment between specific technologies and their HR practices to be more innovative (Vereycken et al. 2021). Digital tools, such as collaborative IT tools, lead to temporary and smart working solutions to enable new configurations of people, teams and firms (Marion and Fixson 2021). In the optimized level, intelligent capabilities and smart tools facilitate efficient and effective methods for continuous knowledge sharing among management and employees. They also enable team structuring and collaborations such as a transition from agile to DevOps (Hemon et al. 2020). Additionally, teams may establish a process-expert network with experts from key functional areas to discuss and share knowledge.

4.2.8 Culture

Culture has a major role in DX. In the unambitious level a company maintains its existing culture and the assumption is that the leaders are not open to changes. According to the mindset of the company's leaders, change is perceived as radical and is not supported. Company leaders realize that without the openness and adaptability of their culture, the DX cannot be initiated.

In the commencing level, approaches for the change are initiated. Top management gradually motivates and implements the changes in corporate culture using top-down processes (Veile et al. 2020). As the change is driven by a leader, the management promotes the importance of DX and ensures that all employees are working on this common goal (Björkdahl 2020). Leaders support implementation for the promotion of a consistent, coherent culture and the comprehensive presence of values and norms that promote the implementation and use of digital technologies to generate long-term success (Veile et al. 2020). The use of digital communication technologies allows formal hierarchies to diminish, which also opens new and easy ways for employees to interact digitally with supervisors and colleagues across formal boundaries. In the engaged level, the culture of the organization is in place to accept changes, undertake risks and demonstrate a certain readiness and see the added value in DX (Karimi and Walter 2015). To ensure that the innovative approach is successfully implemented, leaders support creativity and idea generation.

In the advanced level, an innovative culture has been developed and strengthened by different activities such as design thinking workshops (Gfrerer et al. 2021; Warner and Wäger 2019). There is a digital mindset of the leaders and the employees during the technological change enabling an agile workplace culture which allows more flexibility and increases productivity (Ghobakhloo 2018). In the optimized level, the company and the employees have accepted innovation as one of the core values and foster their commitment to it (Karimi and Walter 2015). Employees have a customer-centric viewpoint that fosters a customer-first mindset that drives the development and delivery of digital solutions and experiences that meet and exceed customer expectations.

5 Model Evaluation

We evaluated our model based on their fidelity with the real world phenomena, completeness, level of details, robustness and ease of use as proposed by March and Smith (1995).

5.1 Completeness

Most participants found the model to be comprehensive and complete. Participants mentioned comments such as *"Model makes sense"* or *"Good approach"* to describe the comprehensiveness of the proposed model. They also found that the naming and the explanations of the individual blocks were clear and beneficial for understanding. However, three participants mentioned that definitions for the maturity levels were missing in the model, which made the understanding of dependencies between the levels more difficult. Moreover, for more than one-quarter of participants, there was a lack of measurability between the levels that would have simplified the classification within the transformation process, although these users evaluated the model as complete. Four interviewees have added further categories such as technology, external partners, product, finance, R&D or product development processes, business model agility, digital products and IT services or IT systems as complementary blocks to the model; however, they also confirmed that it may decreases clarity and ease of use.

5.2 Fidelity to real-world

More than half of the participants rated the maturity model as realistic and applicable. The eight blocks and their content were considered realistic. They found that the selection of maturity items was applicable in the real world, however, the interviewee from the automotive industry, indicated that more than eight building blocks may exist. Interviewees also mentioned the blocks are independent and their relationships should be clarified. We also agree that our blocks are not mutually exclusive, and they depend on each other. Three participants mentioned that the assignment of maturity items may not have been close to reality, since defined items in low levels could also fit into higher levels. The step-by-step structure of the levels was not fluid and transparent to many participants; thus, projects may exist at low or high levels, which was not considered in our DX-MM. Furthermore, some maturity items may occur in multiple levels and not just one level, as we defined it.

5.3 Level of detail

Participants were partially agreeing with the level of details in the model. They mentioned that *"it makes sense to have the five levels."* The content and scope seemed to be sufficient for almost half of the participants. The explanation of maturity levels was sufficient and clear for participants 01, 02, 05, 11 and 13. They also mentioned that the scope of the five levels covered the most important DX steps. For some, the division was not clear enough; these participants suggested that brief definitions for each block and level would allow the classification to run better. The intermediate steps were not illustrated in the figure and therefore were considered missing. Additional details, such as splitting the model into B2B and B2C companies, were recommended. For Participants 07 and 17, a detailed breakdown would be more conceivable.

5.4 Robustness

While some participants found the model stable and robust, some other participants could not make a statement about the robustness of the model. Participants rated the model as robust because of its flexibility and therefore its adaptability to changes. Interviewees 02, 05 and 13 believed excessive detail does not lead to flexibility and therefore the model cannot be robust. According to Participant 15, robustness would be generated by including a quantifiable and reproducible catalog of questions.

5.5 Ease of use

The DX-MM was seen by interviewees as useful for strategic discussions with the management board. Most of the interviewees considered the model easy to use due to its simple structure. The simplified definition of levels makes the model applicable. Moreover, according to participant 07, the model would be useful for a gap analysis with the CDO and the CIO; packages could be made from it and updates could be provided with it to determine the transformation state. Participant 03 stated that it seemed to be difficult to implement the DX-MM, as it would not be easy to perform the classification depending on the business unit.

6 Discussions and Conclusion

To determine the current state of the DX process in industries, we developed a DX-MM based on Buck et al. (2021) eight building blocks of DX. Our DX-MM proposes theoretical and practical implications.

The contribution of this study to the literature is twofold. First, while our study corroborates with previous maturity models (Colli et al. 2018; Gökalp and Martinez 2021; Lin et al. 2020; Viloria-Núñez et al. 2022), we extend previous models by providing more comprehensive dimensions to assess DX maturity of organizations. Our model describes maturity levels on a more parsimonious and comprehensive abstraction level. For instance, we decompose concepts such as governance, technology, connectivity into blocks that are more faithful and authentic to real-world phenomena. Second, we contribute to the current literature by highlighting the importance of different aspects of DX. For instance, similar to Björkdahl (2020), our results also indicate that strategic implementation and coordination is only possible with a motivated transformation management, and the lack of structure and unity makes a DX unsuccessful. Furthermore, we also argue that an agile workplace culture and involving employees in innovations increases the process of DX and productivity (Ghobakhloo 2018; Warner and Wäger 2019). Our proposed model provides practical implications. It can be used as an initial checklist by organizations and their management board to assess their current situation and allows the strategic team to develop a transformation plan and strategies. The initial classification with the maturity model enables company leaders to classify what is required and use it as a benchmark to set transformation goals. The maturity model enables an assessment of the capabilities and offers a

rough roadmap for a well-defined strategy or at least to develop one. Thus, company leaders can examine different areas and use the model for midstream reviews. The maturity model in this study provides a map for the typical stages of each building block. However, when applied, company leaders must evaluate whether the respective maturity items are relevant and feasible for the respective company's industry and standards.

Our study has some limitations. First, because of the practical reasons, we only reviewed a limited number of papers reviewed from WoS database to build a knowledge basis to develop our model. Future studies may use other methods or extended literature as a knowledge base for developing a more detailed model. Second, we used predefined evaluation criteria to conduct our semi-restructured interviews. More open approaches can be used to collect qualitative data and other measurement items can be used to evaluate the model. Third, we mainly interviewed males for evaluation. Future studies should take the aspect of gender inequality into account. Finally, we evaluate applicability of our model based on our interviewees. Future studies can use other methods such as a case study or workshops to examine applicability of our model.

7 References

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