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## Developing a Process Model for Digital Transformation – Insights from a multiple cross-industry case study

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### Abstract

*The current volatile business environment has forced companies to undergo a profound digital transformation (DT). In the context of DT, processes, routines and workflows change. As this poses severe challenges to companies, the transforming organizations need a holistic process model that provides guidance during the change. Despite initial research efforts and the frequent challenges in practice, academia still lacks concrete guidelines for companies on how to formulate, implement and evaluate DT strategies. Therefore, the purpose of our study was to design a process model for DT in order to advance our understanding of conducting transformation processes in practice. Based on a multiple cross-industry case study, we developed a concrete process model for supporting DT. The model consists of the five phases of initiating, analyzing, debating, acting and evaluating the change. With the model, we extend the current research and provide guidance for practitioners undertaking DT.*

**Keywords:** Digital Transformation, Process Models, Framework Development, Multiple Case Study.

### 1. Introduction

The current business environment has been undergoing a transformation from an analog to a digital world for several decades (Schwertner, 2017). This technological shift, also referred to as the digital transformation (DT) strategy, is taking hold in most industries and strongly influencing their business model (Li, 2020; Matt et al., 2015). Companies in almost all sectors have taken a number of initiatives to explore new digital technologies and thus harness their benefits (Dragano & Lunau, 2020; Matt et al., 2015; Botzkowski, 2018). Thus, companies are transforming with the increasing use of digital technologies. Hereby, they face the challenge of defining the impact of DT for their own company and of ultimately implementing it (Biallas & Alan, 2020;

Nambisan et al., 2019). DT enables a revolution of traditional structures and is the prerequisite for driving digital business models. These changes contribute to the emergence of companies with innovative business models that work with advanced technologies such as Big Data, artificial intelligence, cloud computing, or additive manufacturing (Martinez-Caro et al., 2020; Rusly et al., 2021). Existing business processes are redesigned and optimized or completely new business models are developed. The aim is to use technology to standardize processes, making them more efficient and employee-friendly (Wolf et al., 2020). At the same time, employees need regular training to keep up with digital developments and changes (Singh & Hess, 2017; Wang et al., 2008). Not only the technical circumstances, but also the role of the individual within the organization has changed (Singh & Hess, 2017). When new technologies are introduced into companies, this is often accompanied by changes in processes. Small and medium-sized enterprises can benefit here by being able to react more quickly and flexibly to changes and make more targeted decisions than corporations and large companies (Rusly et al., 2021). However, companies sometimes associate DT with a one-off radical event and do not design it as a holistic change process with a digital adaptation strategy (Rusly et al., 2021). Formulating a DT strategy is an important approach to supporting companies in implementing DT and coordinating the necessary steps (Bordeleau & Felden, 2019; Roblek et al., 2021; Romero et al., 2019). Where old functions disappear, new ones are introduced. In summary, most organizations are aware of the need for DT, but there is often a lack of action due to uncertainty about the actions to be taken and the lack of a holistic process model to support organizations on their journey to DT.

A comprehensive literature review on existing process models or frameworks for digital transformation was conducted prior to this study. This research revealed several models that were developed for describing the process of DT. However, most of these models referred

to the DT of single business processes in distinct corporate functions. In sum, existing research reveals a lack on holistic models that can eliminate the uncertainty of companies.

Therefore, despite initial research efforts and the frequent challenges in practice, academia still lacks concrete guidelines for companies on how to formulate, implement and evaluate digital transformation strategies (Matt et al., 2015; Roblek et al., 2021; Romero et al., 2019). This problem results in a need for further research in the area of process models for digital transformation projects. These considerations lead us to the following research question: *How can a process model for the digital transformation of organizations be designed and which phases are necessary?*

Thus, the purpose of this paper is to examine how a certain process model can help companies and organizations to implement digital changes in the company in a structured and timely manner. To this end, it is important to make the DT process more transparent and thus reduce its complexity. However, companies often do not have the necessary knowledge about how DT can be designed and implemented in the best possible way. This study intends to close this existing gap highlighted above.

To answer the research question, we conducted an analysis of extensive qualitative data obtained through a multiple-case study design comprising eight cases (Yin, 2014). For a comprehensive analysis of the cases, we coded the interviews inductively (Mayring, 2021). We compared our findings to the conceptual framework from Hansen et al. (2011), which have proposed a theoretical model for managing DT comprising four phases: *initiate*, *analyze*, *debate* as well as *act*. In our findings, we develop a process model for DT comprising five distinct phases. In the *initiate* phase, organizations need to be prepared for the change and concrete targets need to be set and communicated. Regarding the *analyze* phase, the current situation of the company's processes to be transformed need to be recorded, understood and evaluated. The subsequent *debate* phase should define and visualize target processes as well as create use cases for the DT project. Further, in the *act* phase, the DT is implemented and the target processes, tools or technologies are established. Lastly, we defined an *evaluate* phase in order to analyze the success of a DT project according to predefined key performance indicators. This phase was not reflected by Hansen et al. (2011) and therefore marks a significant finding of our study.

We provide the following contributions to academia and the knowledge about guiding DT. First, our findings reveal five phases that represent the main stages in conducting digitalization projects. This contributes to our scientific knowledge on DT as an

existing theoretical model for transformational projects was developed further based on insights from practice.

Second, we discuss our findings by highlighting challenges that occur during these phases. Further, as our interview partners stem from different industries, we are able to emphasize industry specific recommendations for DT projects.

The remainder of this article is structured as follows: Section 2 presents the theoretical background and explains the pertinent terms for this research, including the DC theory. Chapter 3 provides insights into the methodology of this paper. In Section 4 we present our results of the identified process model for DT. Finally, Section 5 offers a discussion of the findings. Finally, Section 6 provides a conclusion with limitations and avenues for further research.

## 2. Theoretical Background

### 2.1. Digital Transformation

In an era of Industry 4.0, which is seen as a new chapter in the management and control of the industrial value chain, the term DT has arisen (Ghobakhloo and Iranmanesh, 2021). As a unified definition lacks, DT can be described as an organizational process that brings disruptive changes to an organization that is enabled and driven by digital technologies (Barann et al., 2019). Uhl & Gollenia (2014) consider DT to be a specialized type of business transformation in which information technology (IT) plays a dominant role in transforming the strategy, structure, culture, and processes of companies. In a similar vein, Hanelt et al. (2021) define DT as an organizational change that is triggered and shaped by the widespread use of digital technologies. Vial (2019) extends the view on DT by emphasizing its process character and the aim of digitalization efforts of triggering organizational changes by means of information, communication or technologies. According to the author's view on DT, the transformational concept sees improvement as an expected outcome of DT (Vial, 2019). As a DT is an immensely resource-intensive and complex process that can be characterized by inevitability, irreversibility, rapidity and uncertainty (Ghobakhloo & Iranmanesh, 2021). Therefore, sufficient process models to manage this complex change are required.

### 2.2. Process Models

At the beginning of every project, there exists a clear idea and a project goal. This specified aim can be realized through a sequential or parallel sequence of activities called a process. Accordingly, a process is a

structure whose elements are tasks linked by logical sequential relationships that determine the course of action in the project. There is a defined starting event, the input, and a result, the output, which serves to create value for an organization (Kirchmer & Franz, 2020). All organizational units that receive outputs in form of products or services from the process are involved. Thus, a process model is a graphical model that depicts one or more processes and determines the course of realization (Adams et al., 2021; Georgakopoulos et al., 1995). A process model thus defines the organizational framework and supports systematic and methodical project execution. The process model structures the processes systematically and completely and supports the gathering and sharing of information during the distinct sequences (Adams et al., 2021). The representation of the activities, also known as the process model, from analysis and planning to implementation and further development, divides the entire process into sections that follow one another in a hierarchy. Processes that are planned and specified gradually at an early stage are called stringent processes (Boehm & Turner, 2004). By contrast, agile processes are predominantly characterized by flexible and iterative procedures in project execution (Boehm & Turner, 2004). The aim is to reduce the often-complex processes to a simplified and comprehensible manner, thereby facilitating communication and bringing the understanding of processes among those involved up to the same level. This forms a good basis for more far-reaching changes. In practice, the term process model is often used to represent an ideal image of the company's processes. All so-called process models have in common that they structure the processes and activities of a company in order to work in a goal-oriented manner (Adams et al., 2021; Curtis et al., 1992).

### 2.3. Conceptual Framework

Given our research purpose and methodology, we need to consider a conceptual framework for DT process models. In this study, we consider the conceptualization of the participatory process model for realizing DT (Hansen et al., 2011). This framework suggests four steps with respective purposes when intending to transform digitally (here and in the following Hansen et al., 2011). Therefore, in a first step, DT has to be *initiated*. This phase serves the identification of views and interests on the desired changes in the company. Second, agreements and disagreements within the organizations have to be *analyzed*. In a third phase, the consequences of the transformation have to be *debated*. Here, transformation leaders evaluate new insights based on data collection that offer opportunities for the

organization. Lastly, the transformation is *acted out*, carrying out a developed reposition strategy.

**Table 1. Conceptual framework in accordance with Hansen et al. (2011)**

Step and Purpose	Description
Step 1: Initiate	Identification of the views and interests on the desired changes
Step 2: Analyze	Analysis of agreements and disagreement within the company
Step 3: Debate	Debate of insights and opportunities of transformation
Step 4: Act	Implementation and reassessment of newly developed strategy

New strategic initiatives are implemented, reassessed and changed when needed. Table 1 depicts our conceptual framework. Considering this framework, we examine the impact of DT on the respective phases.

### 3. Research Design

We conducted a multiple case study as part of our research to uncover practical insights. While existing literature offers some indications of process models for DT as mentioned by Hansen et al. (2011), deriving generalizable results from these models remains challenging due to their inherent ambiguity. This challenge is particularly pronounced in areas with limited prior research. In such contexts, an exploratory study design along with qualitative research methods proves to be highly suitable, as advocated by Mayring (2021). Furthermore, the benefits of qualitative research methods in exploring research topics are emphasized by Kembro & Näslund (2014). These methods allow for a comprehensive analysis of the contextual factors that extend beyond the primary company under investigation. Additionally, qualitative approaches excel in addressing "how" questions and provide valuable insights into real-life situations, as underscored by Yin (2014). The selection of cases and conducting expert interviews plays a central role in gathering data for qualitative research (Yin, 2014). Experts are individuals who possess extensive specialized knowledge, practical wisdom, and actionable insights related to the research topic, giving them an advantage over the researcher. We selected potential cases and experts for interviews, including those with expertise in managing DT and general transformation projects. When designing the study, we deliberately avoided focusing on a specific industry to ensure a comprehensive exploration of the research topic from diverse perspectives (Yin, 2014). For our study conducted in 2022, we examined eight cases. Table 2 provides details about the case companies, the positions of the experts, and their relevant professional experience in the respective industry.

**Table 2. Overview of cases**

Case	Industry	Expert	Company Size [Employees]	Revenue 2022 [€]	Intention for undergoing DT
1	Chemical Industry	Managing Director Germany	< 100	4.5 million	Implement digital technologies for more advanced and robust processes
2	Producing Industry	Head of Development Product Range	103,300	20.37 billion	Implement digital technologies to produce more efficiently
3	Transport	Chief Executive Officer (CEO)	160	38 million	Implement digital technologies for better processes and create new digital services
4	Construction	Project Management Office	11,000	5 billion	Use technology to improve business processes, add digital capabilities to existing products and become more sustainable
5	Producing Industry	Director Manufacturing Operations and Engineering (USA)	421,000	88.2 billion	Implement digital technologies to produce more efficiently and add digital capabilities to existing products and create new digital products/services that complement existing ones
6	Producing Industry	Head of Central Services, including IT	7,000	634 million	Implement digital technologies for better processes and become more sustainable in general
7	Energy Industry	Global Employer Branding Project Lead	5,300	14.4 billion	Use technology to improve business processes and to position the company as an attractive employer
8	Producing Industry	Product Manager Technical Sales	330	60 million	Implement digital technologies for better processes and a new way of thinking

To gather relevant data, we employed a semi-structured interview approach using an interview guideline (Bell et al., 2022). The interview guideline encompassed various sections. It commenced with an introduction, covering the study's purpose, interview structure, and general information about the expert. Subsequently, the guideline focused on discussing the organization's recent transformation projects, including the methods and procedures employed during the transformation process. The interview guideline concluded by providing an opportunity for additional questions and remarks, outlining details about transcription, and summarizing the next steps of the study. This approach facilitated the ability to ask follow-up questions and allowed experts to contribute valuable insights that emerged throughout the study. Additionally, the interviews were recorded with the experts' consent, transcribed, and analyzed using the qualitative data analysis software MAXQDA, following an inductive coding approach (Mayring, 2021). In order to analyze the acquired data, a thorough structural analysis is essential in case study research. Consistent with our multiple-case study design, we conducted a cross-case synthesis to examine the data (Yin, 2014). Furthermore, we employed the principles of qualitative content analysis to analyze our qualitative data (Mayring, 2021). Content analysis involves a systematic examination of texts, where the material is processed incrementally using category systems. Here, MAXQDA enabled us to assign relevant categories to marked text segments and develop a comprehensive category system consisting of main and sub-categories.

When undertaking a qualitative study, it is important to take into account various quality criteria (Yin, 2014; Flyvbjerg, 2006). In this study, we focused on the criteria of construct validity, external validity, and reliability (Yin, 2014). To ensure construct validity, it was crucial to establish a shared understanding of the

different aspects of DT. This challenge was addressed by discussing DT implementation during the interviews. Additionally, a multiple case study design (Yin, 2014) was utilized in this research, incorporating companies from diverse industries. The adoption of a multiple case study design necessitates a focus on replication rather than sampling logic (Yin, 2014), and careful selection of individual cases was undertaken to obtain generalizable results. The generalizability of the findings contributes to the criterion of external validity (Yin, 2014). To ensure reliability, all interviews were conducted using an interview guide, providing a consistent structure throughout the study (Yin, 2014).

#### 4. Findings

In this section, we present our findings related to our conceptual framework. These will be discussed extensively in Chapter 5.

*Initiate.* The first proposed phase is reflected by various experts. Expert 2, Expert 5 as well as Expert 6 describe this phase as “development phase”, defining the purpose of this phase to prepare the organization for an ongoing transformation. According to Expert 8, in this first step a concrete problem or starting point for transformation has to be defined, which has been identified either by internal employees or by external parties. Then, existing structures need to be broken down to prepare the organization for the change. Experts 4 and 7 add that therefore concrete targets need to be set and communicated in the entire organization. The need to create transparency in the organization in the preliminary stages of a transformation is also emphasized by Expert 1. According to the experts, an important part of this phase is also to inform employees about planned changes and to gauge their readiness for transformation. Therefore, workshops appear as a useful

method (Expert 3). In addition, initial planning of task packages that are needed during the first steps of the transformation takes place here (Expert 2). One important task to consider, for example, is establishing interconnectivity between production facilities. If this is established, potentials such as the tracking of products in the shop floor can be realized. Further, such applications can also allow drawing conclusions about the behavior of the product during the production process. This is stated by Expert 5: *“For this, both the product and the production facilities need to generate the basic properties data points in the first place and store them.”*

According to the interviewees, there is another important aspect to be considered in this phase. As such, a pertinent strategy for the planned digital transformation needs to be developed (Expert, 2, 5, 6). Therefore, a proactive scanning of the current market environment can be very helpful for orientation. For the development of an adequate digitization strategy, consulting firms can also be involved (Expert 6). However, the benefits of the transformation are not immediately visible in many cases, which is why Expert 5 advises against giving up too hastily. *“It is important to know that the positive contribution to results from digitization projects does not necessarily have to be visible immediately. The organization needs self-learning projects. The strategy can then be adjusted on the basis of the acquired experience on the one hand and the reflection on the market requirements on an annual basis.”* (Expert 5).

*Analyze.* The second phase comprises the analysis of the current situation. To do this, transformation-specific knowledge must be built up so that it can later be applied in the organization (Experts 2, 3, 5, 6). This includes recording the current processes in the organization (Experts 3, 6). These must be thoroughly understood in terms of their design, processes and personnel involvement in order to achieve an adequate transformation. The selection of the processes to be transformed depends on the strategy defined in the first phase. According to Expert 5, the analysis of the existing state also includes an assessment of the maturity of organizational capabilities. This involves setting priorities are set in relation to the problem and precise objectives are defined. In this context, Expert 6 describes the necessity of a *“fit-gap-analysis”* in order to evaluate to detect discrepancies between the planned DT strategy and the current situation of processes.

*Debate.* According to the experts, this phase serves the definition of target processes that are to be achieved with the transformation journey (Expert 6). As also stated by Hansen et al., (2011) this stage includes

debating concrete insights and opportunities of the transformation project (Experts 2, 5, 8). Expert 6's company has set up a separate department for process management to define the target processes. Here, the principles of the Business Process Model and Notation (BPMN) are used, and planned states are modeled using swim lanes. As the Expert states: *“We have founded a separate process management department in addition to the IT department and the process management department uses such software and the target processes are modeled via swim lanes. Where you then see where in which department, at which jump practically which activity should be executed or where then other department comes to it.”* Visual preparation is important both internally and for external stakeholders, so that everyone involved in the transformation is informed (Expert 7). Expert 7 specifically mentioned dashboards for visual preparation, which may be either internally produced or provided by the consultancy firm involved in the transformation. Expert 8 also stated that the visualization could take the form of a report.

The experts further emphasize the integration of consulting firms at this stage, as essential resources are often scarce. This is why Expert 7 states: *“So you always bring them on board, because you usually don't have the resources internally. Quite often, you simply lack the expertise, both in the technological sense, IT, etc., but also the expertise of the employees. Mostly, the consultancies for such a project then take over and create the project composition.”* According to the expert, the involvement of consulting firms also ensures neutrality and objectivity: *“Of course, you're always a little bit influenced internally in terms of decisions or in terms of maybe preferences.”* However, the expert also expresses concerns about the involvement of consultancies. According to him, there is the risk that consultancies will take less account of internal company circumstances and instead always follow fixed steps. The actual implementation is based on use cases and user acceptance tests that were previously written and conducted in this phase. As Expert 6 states: *“Use cases are then actually written in advance and all of them are run through. From the business department's point of view, the use cases naturally include all relevant business processes in their entirety. And the results of the user acceptance test ultimately provide a good overview of how good the system is in terms of maturity. Or whether essential business processes are not yet stable.”* As soon as a comprehensive transformation strategy exists, the current processes for transformation are determined and a concrete target is defined, the fourth phase of *acting* out the change can begin.

*Act.* The experts describe this phase as “roll out phase” or “deployment phase”. It includes the actual

implementation of the transformation and the go-live of the new technologies or software products. Here, the defined target processes are established and the organization is adapted to the change. As Expert 6 describes, during the implementation tests are carried out in order to check and review the progress. In this phase, a great deal of support is provided by the consultancies. According to Expert 6, it can take weeks to months for the implementation of the new systems to permeate the organization.

Another important task in this phase is the education and training of employees regarding the operation of the new systems, software tools and technologies (Experts 1, 2, 4, 5 and 8). A central new task of the employees in the course of DT is the accumulation and analysis of data. Expert 5 summarizes: *“For my area, this then includes the networking of production facilities to generate data for deriving improvement projects for the product but also for the production operation. Evaluation is essential. The evaluation and visualization of large amounts of data is virtually the core task of employees on the store floor. Then, of course, the engineers and, of course, the managers.”* To do this, employees need competencies on the subject of connectivity. *“And the staff must be trained in the areas of measuring and data acquisition, and storage, i.e. in the sense of a database, and the infrastructure or server infrastructure must of course also be in place. And last but not least, the company must be able to handle the evaluation of the data.”* (Expert 5). In addition, Expert 2 notes that it is important to define key users for the respective tools: *“And these key users are already more familiar with the tool and are networked with each other in order to address improvements or coordination measures. So networking is important.”* While common educations can be easily delivered via online tools and documents, the expert recommends an on-site trainer for key user training. In addition to training existing employees, it is also advisable to bring competencies into the company by hiring external specialists (Experts 4 and 5). In this phase, the experts mention three particular important aspects: Building transformation-specific expertise, an adequate application of new technologies, and creating a transformative and open corporate culture.

*Evaluate.* The experts mentioned a fifth important phase when conducting DT projects that was not reflected in Hansen’s et al. (2011) model. The stage includes the evaluation of the transformation journey and the expert call it “feedback phase” or “review phase” (Experts 2, 3, 5, and 6). Here, on the one hand, the continuous adaption of the organization to the change, and, on the other hand, its further development is emphasized. Further, predefined key performance indicators (KPIs)

with regard to sales, runtimes or quality requirements help in the evaluation (Expert 2). Expert 5 adds that evaluation at the end of the DT project is important, but also monitoring across all previous phases is essential. *“Through the regular reviews of the progress and the additional evaluation of the data of strategic projects according to the roadmap, all this should happen meanwhile. In addition, we have the milestones that are reached before it goes into a next step in the roadmap, so there are actually enough control options to get an overview of how things are going.”*

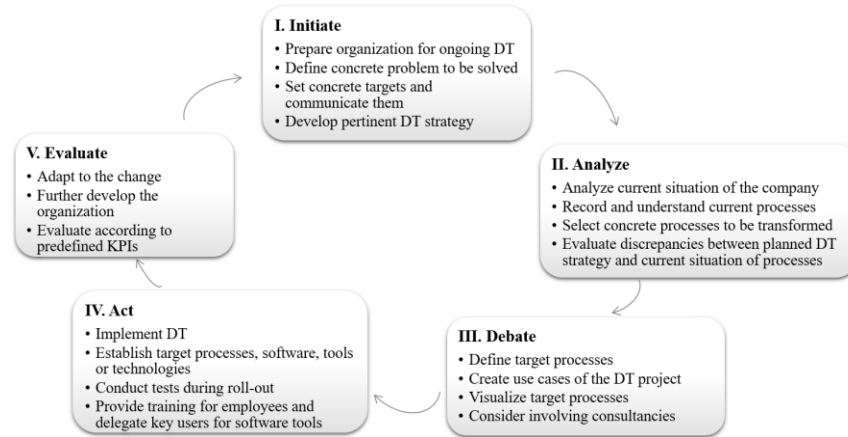
Lastly, the expert state that a circular design of any DT project is necessary (Experts 1, 2, 3, 4, and 5). As Expert 1 states: *“Digitization is taking place as a kind of cycle.”* The experts justify the circularity by the fact that although the project itself is completed, *“...but of course the tools will be developed further for the next project. And then there are already updates.”* (Expert 2). Further, *“new technologies are emerging all the time.”* (Expert 3). Experts 3 and 5 add: *The process is continuously improved and optimized through constant repetition.”* *“It’s a kind of cycle process and you can’t say that it will be completed at some point.”*

Based on these insights from practice, we propose the following process model. The model is presented in Figure 1. It includes the four phases as suggested by Hansen et al. (2011), enriched by the *evaluation* phase. Further, the respective key actions as described in this chapter are mentioned.

## 5. Discussion

Our findings reveal in total 5 phases addressing relevant stages for a process model for DT. In the initiate phase, organizations need to be prepared for the change and concrete targets need to be set and communicated. Regarding the analyze phase, the current situation of the company’s processes to be transformed need to be recorded, understood and evaluated. The subsequent debate phase should define and visualize target processes as well as create use cases for the DT project. Further, in the act phase, the DT is implemented and the target processes, tools or technologies are established. Lastly, we defined an evaluate phase in order to analyze the success of a DT project according to predefined key performance indicators.

However, despite of proposing the relevant DT key phases of their respective companies, the experts name several challenges to be faced concerning the transformation. A severe challenge was posed by the Covid-19 pandemic. Due to the related restrictions, the responsible DT leaders could not work on-site what complicated the collaboration.



**Figure 1. Proposed process model for DT**

Further risks are posed by the fact that a DT is conducted in a live-environment besides the current daily tasks in the company (Expert 3). The expert states here that while tests can be carried out, the actual transformation must be introduced during ongoing operations. In this context, there is the challenge of creating interfaces between the individual applications and systems alongside ongoing normal operations.

Experts 4, 6, and 7 name another challenge. Although each expert states the relevance of applying a DT process model, they note that during implementation, they often have to deviate from the plan: *“Whereby I say that this is so often a process where you only realize on the way what is or can be the right thing to do in the end.”* This can result in having to deviate at some points and to even try things out. Expert 6 therefore recommends an agile mindset during a DT, as firmly prescribed patterns are not goal-oriented. Expert 4 states: *“In a digital transformation, you start down the path without knowing where B is.”* This can also refer to the time level. For example, two experts report that they are already at least two years behind the original DT schedule. They cite the further challenge of communication as the reason for this. Experts 2 and 4 consider this to be far too low. *“Digital transformation is certainly talked about, mostly in the hallway and then mostly scolded.”* Experts 4 and 7 even do not necessarily see a roadmap with fixed milestones as an advantage, since many steps only develop along the path of change and this is not possible with a fixed, prescribed procedure. Expert 4 commented as follows: *“In the course of digitization, many business models or many processes only emerge through research or collaboration, through trial and error. As a result, little is known and a fixed pattern is often not helpful.”*

The training of employees often falls short and they are not adequately involved in the transformation process. If there is no communication about DT,

employees will not accept it. This should be urgently pursued in the fourth phase of the transformation. However, the experts do not agree on the timing. While the majority of the interviewees are in favor of involving employees at an early stage, Expert 3 takes a critical view. For him, the processes should first be preconceived and completely developed before the end users are informed about the functionality of the tools. However, the experts agree on the fact that the existing problems can be summarized by the keyword of inadequate change management. These considerations illustrate the complex process that a company has to go through when undertaking DT. Almost all interviewees argue that it is very important to prepare this process reliably and to communicate it. Expert 6 stated that *“...in addition to the IT department, a separate process management department has been set up.”*

Another challenge of DT is the difficulty of evaluating it and mapping it in financial statements (Experts 2 and 6).

A further important aspect during a DT process is the role of top managers and executives. They play an active role in the transformation and must show constant attention to employees and take them along with them in the change (experts 2, 4, 5, 3 and 7). Proactively modeling DT and acting as a committed role model is very important, as Expert 4 states: *“So if the department head is already averse, it will be relatively difficult to get the employees to pick up from him as well.”* Expert 5 adds: *„What gets Attention gets done.“* However, Expert 2 notes that the higher a manager is in the hierarchy, the further away he or she is from the actual application. Therefore, as previously explained, it is important to assign key users for the tools to ensure control and support here.

Additionally, Expert 7 notes that the culture of the company and that of the resident country is crucial in shaping DT. While American corporations make top-down decisions, the decision-making and management

processes of Scandinavian companies are much more participatory.

The experts additionally identify various drivers or triggers of DT. One major driver is the Corona pandemic, which has almost forced the digitization of workflows in order to continue to collaborate effectively (Experts 2 and 3). The academic literature describes this phenomenon as a "tsunami change" that has swept over companies (Warrick & Cady, 2022). The experts see management as another impetus for DT. "*You can say per se the bigger the scope, the more budget, the more resources are tied up in such a project, the higher it goes in the hierarchy.*" (Expert 7). At corporate level, the head office plays the decisive role. Digitization projects in particular start at headquarters and are ultimately rolled out across the Group (experts 2 and 5). The individual sites and business units then become pilot users. In some cases, pilot projects are started in departments then later extended to other departments (Expert 4). Expert 4 further notes that it is usually the parent company that decides on a DT and develops the associated strategy. The subsidiaries are not involved in this process, but are only asked to implement the correspondingly developed processes afterwards.

A further aspect is that there are strong industry-specific differences (Dragano & Lunau, 2020; Matt et al., 2015; Botzkowski, 2018). The construction industry lags far behind other industries in terms of digitalization and sustainability. Nevertheless, the call for digitized products and sustainable materials is growing louder in this industry. According to Expert 4, "*the construction industry is, in my opinion, the last industry that has put off digitization for a long time and is now ... facing a huge challenge to implement and realize this as quickly as possible.*" Building Information Modelling (BIM) describes a method in the construction industry that enables networked planning with the help of software (Gao et al., 2019; Wong & Fan, 2013). Relevant construction data is digitally captured, modelled and combined to increase planning accuracy and transparency between the parties involved in a construction project. The spread of digital technologies thus contributes to greater sustainability and supports the DT of the construction sector.

The chemical industry is increasingly relying on digitalization to achieve its goals as well. Digital technologies have become an important part of the value chain from development to the customer. The challenges and uncertainties associated with this have led the chemical industry to rapidly drive DT in all areas and to see it as one of the most important issues in the chemical industry. As Expert 1 states: "*That was actually the first step, to optimize processes and create transparency.*"

In the freight forwarding and transport sector, DT has become indispensable and, above all, a decisive factor in competition (Gurbaxani & Dunkle, 2019). Processes are so closely coordinated and interlinked that the economy depends on them running smoothly. The transition from traditional analogue and paper-based processes to digital solutions is well underway. (Expert 3). In addition to technical innovations, agile solutions and seamless transparency between the customer and the freight forwarder are particularly in demand. "*We started by digitalizing dispatching, i.e. moving the processes in the forwarding environment from paper to an IT environment, and then enabling dispatching in the multi-user area. And then we made another major adjustment to have basically everything in the process digitized.*" (Expert 3).

In the energy industry, DT is strongly driven by the competitive market environment. Utilities need to reposition themselves internally to meet customer needs. The electricity market has to deal with radical changes and develop appropriate solutions for its end customers through new technologies and regulations.

In manufacturing, the topic of DT is one of the most advanced compared to other industries. The term Industry 4.0 is used to describe state-of-the-art information and communication technologies that enable highly networked, dynamic and efficient production.

In sum, our findings reflect the key claims of relevant authors in the DT research area. As such, a plethora of authors notes that DT is driven by the use and consideration of digital technologies and IT (e.g., Barann et al., 2019; Culot et al., 2020; Hanelt et al., 2021; Matt et al., 2015). This is reflected in the act phase of our model and thus displays a key building block in the framework. Furthermore, Vial (2019) as well as Morakanyane et al. (2017) even directly ascribe process character to DT in their definition and specifications, prompting calls for a comprehensive model for its realization. Regarding further definitions of DT, aspects as the modification or adaptation of business models through the setting of adequate targets (Kotarba, 2018), internal processes and value creation (Mergel et al., 2019; Zaoui & Souissi, 2020), are reflected in our model as well. Thus, a comparison of our model with the relevant descriptions of DT shows that its essential elements are contained in the characterizations. What is not referred to in the literature, however, is any mention of the need to evaluate the transformation. Therefore, our developed framework goes somewhat beyond the existing research, highlighting its novelty value.

## 6. Conclusion

The purpose of our study was to design a process model for DT in order to advance our understanding of conducting transformation processes in practice. Through a multiple and cross-industry case study design and qualitative data analysis (Mayring, 2021; Yin, 2014), we gained valuable insights into how companies can design their transformation process. Drawing on the DC theory and a conceptual framework according to Hansen et al. (2011), we examined the central key phases of DT and translated these into a circular process model. Our findings show that the key phases of Hansen et al. (2011) are still valid, but need to be enriched by an additional element concerning the evaluation of the DT.

With its findings, our study provides a contribution for academia in that we empirically and inductively develop a framework for DT as well as compare this with an established process model in order to develop it further. Regarding the *initiate* phase, organizations need to be prepared for the change and concrete targets need to be set and communicated. In the *analyze* phase, the current situation of the company's processes to be transformed need to be recorded, understood and evaluated. The subsequent *debate* phase should define and visualize target processes as well as create use cases for the DT project. Further, in the *act* phase, the DT is implemented and the target processes, tools or technologies are established. Lastly, supplementing Hansen et al. (2011), we defined an *evaluate* phase in order to analyze the success of a DT project according to predefined key performance indicators.

In terms of implications for practitioners, our findings suggest that companies can use process models that include the five relevant stages to consider when undergoing digital transformation. The findings can help practitioners make the case for DT to adapt to the disruptive business environment.

Our study has shed light on the importance of process models in supporting DT. However, it is important to acknowledge the limitations of our research. First, our research relied on qualitative data from a limited number of cases, and further empirical studies with larger sample sizes may provide more comprehensive insights. Second, the rapidly evolving nature of DTs means that our findings represent just a snapshot in DT research.

Nevertheless, our findings and limitations suggest several avenues for future research. First, it would be valuable to examine the influence of process models in more industries and countries to test the generalizability of our findings, including a higher number of cases. Second, quantitative studies could complement our qualitative analysis and provide a more quantitative assessment of our research area. Third, longitudinal

studies could capture the dynamic nature of DTs and the necessity of predefined process models. Forth, existing definitions on DT could be enriched by the need to evaluate the transformational efforts in order to receive feedback on the success of the technology implementation. Finally, companies face even more challenges than mere DT. As such, the literature argues that digital technologies are necessary for realizing both the transformation towards greater sustainability and the integration of the circular economy. (Dzenghiz & Niesten, 2020; Feroz et al., 2021; Hallstedt et al., 2020). Regarding the trend of servitization, the same applies (Boehmer et al., 2020; Hallstedt et al., 2020). In this context, research could explore how the developed process model can support the realization these transformation projects.

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## 8. References

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