Development of a Digital Transformation Maturity Model for IT Companies

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***Abstract*—The more the technological and digital shift moves forward, the more are companies struggling to keep in touch with the latest innovations and state-of-the-art technologies. Although companies differ regarding their transformation approach in detail, there is a rising demand for digital transformation maturity models to determine the status of a company's digital transformation to cope with digitalization. In order to provide companies with the opportunity to uncover the areas that are lacking behind in the digitalization process or self-assess their current transformation status, we pursue the goal to develop a digital transformation maturity model fitting to IT companies. The artifact was developed in collaboration with an IT company from the energy sector. This case serves as a first and exemplary application scenario. Based on literature on digital transformation maturity models and eight expert interviews, we iteratively designed and evaluated a maturity model tailored to IT companies. As a result, we synthesized five dimensions: culture, ecosystem, operations, governance, and strategy. Each dimension consists of further criteria specifying the respective dimension. Our artifact shows a high fit with the needs of the company under investigation and can serve as a blueprint for other IT companies.**

***Index Terms*—Digital Transformation, Digitalization, Maturity Model, Digital Transformation Maturity Model**

I. Introduction

A. Motivation

Companies all over the world are facing significant and fundamental challenges in recent years due to the new technological shift. Nowadays, the emergence of new disruptive technologies does not only affect the IT-sphere of organizations but all possible sides of a company's existence: business model and strategy, management practices, business processes, organizational structures, corporate culture and much more [1]–[5]. Hence, the management of the digital shift can be an overwhelming task for companies due to the complex mesh of influencing factors.

During the last decade, the popularity of maturity models has increased dramatically in many industries and has become an established research field in Information Systems [6]. Maturity models aim to assess a company's positioning and as-is situation, define and systematize improvement initiatives, and navigate through the evolutionary process [1], [6]–[8].

While industry and practitioners are paying close attention to this issue, from an academic point of view, digital transformation suffers from underdevelopment of measurement models of digital transformation [2], [9], [10]. Although maturity models have been intensively used for years, several researchers started to question the quality and integrity of those: lack of theoretical grounds, lack of empirical studies, lack of structure during development, lack of specification and documentation on the design process, no description of procedures and methods of construction, unclear evaluation and validation processes, no motivation or aim of the model, problems with models' future reusability and retrievability, and imprecise assessment of the result of their evaluation [6], [7], [11], [12].

A digital transformation maturity model brings a systematized view on digital transformation. This view can be either industry-specific or industry-agnostic [5]. However, existing digital transformation maturity models suffer from several shortcomings that limit their applicability. [8] advocates that existing digital transformation maturity models "[...] tend to be too general and high-level in their coverage". For instance, some models only specify main dimensions without determining criteria that specify each dimension to make it applicable at all [13], [14]. In addition to that, maturity models are required to incorporate dimensions that are potentially operationalizable, e.g., by a set of questions guiding through the maturity assessment. Vice versa, constructing a model that cannot make maturity measurable in practical settings, the overall aim of the model remains unmet [4], [15].

Consequently, the current state of research lacks a theoretically and methodologically profound maturity model for digital transformation, in which not only dimensions are defined but also criteria expected from the business on each dimension as well as a proposed mechanism for practical application of the model. The motivation for our research is the creation of a scientific and industry-proven digital transformation maturity model for IT companies. To ensure

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practical embedding throughout the research, we commence our research endeavor at the "Energy IT". The IT company is paying close attention to digital transformation development and is trying to be on the cutting edge of technologies as well as to be a digital transformation leader in the industry.

Therefore, the research goal of this paper is to develop dimensions and corresponding criteria for a digital transformation maturity model for IT companies.

As research method, we apply the procedure model for developing maturity models by [7]. The method by [7] proposes a structured and iterative development process for maturity models. Furthermore, it includes a comparison of existing maturity models as an initial process step and, hence, reflects already existing work on the subject of maturity models for digital transformation. The resulting artifact and the documented development process contributes to the practical domain of digital transformation in the IT sector and adds knowledge to the scientific domain of maturity models in Information Systems research.

B. Energy IT

The maturity model was developed in collaboration with a subsidiary IT company of an international operating energy enterprise. For privacy and legal issues, alias names have been used for the companies in this study. The aliases of the parent company and the subsidiary are accordingly "Energy" and "Energy IT".

"Energy" is ranked among the most significant European energy generating and energy trading companies. The corporation operates in more than 40 countries and has around 15,000 employees and is headquartered in North Rhine-Westphalia, Germany. Its core markets are Germany, the United Kingdom, Sweden, the Benelux countries, and Russia.

"Energy IT" is an IT outsourcing provider that provides IT services and management consulting for "Energy". In particular, the company operates and maintains the entire IT infrastructure and architecture of "Energy", from data servers and networks to software licenses and employees' computers. "Energy IT" has nearly 1000 employees and is also headquartered in North Rhine-Westphalia, Germany.

Currently, the digital transformation is one key priority of "Energy IT". "Energy IT" considers the digital transformation with respect to various dimensions and does not restrict it to implementing new technologies. For instance, the organization culture, digital capabilities, entrepreneurial thinking are deemed as essential perspectives of the digital transformation, too. Due to the company's efforts and prioritization, "Energy IT" can be said to be relatively advanced concerning digital transformation. For example, the company has already established – or at least plans to in the near future – the use of customer journeys, a company-wide data platform, and co-creation approaches.

Our research paper is structured as follows: Firstly, we present the research background to provide a scientific overview of the topics digital transformation and digital transformation maturity models. Then, in section III, we outline the method that we applied during the development process. The design and development will be described afterward in section IV. Following the development of the digital transformation maturity model, the artifact evaluation is presented. Lastly, the research paper closes with a discussion and a conclusion.

II. Research Background

A. Digital Transformation

As for the definition of the digital transformation, we relied on the threefold characterization provided by [3]. The first highlighted aspect is technological, digital transformation as adoption of emerging technologies. The second component is organizational, where digital transformation induces organizational changes and shifts in the business models. The last point is social, digital transformation as a social aspect of the new technologies implementations [3]. Therefore digital transformation is much more than just the use of trending digital technologies as it affects all possible sides of companies' and human beings' existence [1]–[5].

Digital transformation creates multiple challenges for companies and industries: higher market volatility, new disruptive competitors, increased customers expectations, innovative touch-points to reach clients or harder competition due to globalization [2], [3], [5], [8], [13], [16]. These challenges stress, e.g., business models and strategies, management paradigms, business processes, organizational structures, corporate culture, and employee's habits and behavior [2]–[5], [13], [17].

However, digital transformation itself is a beneficial change as it might come along with, e.g., optimization of business processes, better organizational performance, increase in productivity and sales, new customer segments, innovative value creation, and seamless and real-time information processing [2], [13], [18], [19].

B. Digital Transformation Maturity Models

Recently, academia is increasingly devoting importance to the concept of maturity models. In this context, three major research streams are shaping. First, researchers investigate the nature of maturity models and their development, for instance, by developing respectively investigating theories, definitions, underlying constructs or applied research methods [6], [7], [20]–[23]. Second, academia is generating methods, guidelines or processes for developing maturity models [6], [7], [21], [22]. Third, researchers design various maturity models for various subject areas such as process management, supply chain management, or IT management [20], [21].

In this context, existing maturity models are intensively questioned by researchers due to, among others, the lack of theoretical grounds, empirical evaluation studies, specification and documentation of the design process or the absence of clearly stated objectives [6], [7], [12], [24].

In order to account for a rigorous and structured design and development of maturity models that overcome the potential pitfalls, the concept requires to be defined and broken down into its encompassing constructs.

The construct maturity, per definition, refers to a state of being very advanced or developed [25]. Essentially, a maturity model aims at capturing the construct maturity (with respect to some subject matter) in mutually exclusive dimensions, which are operationalized by their individual criteria [6], [21]. In other words, the maturity of a subject matter is structured into a set of dimensions that together describe the entirety of the matter.

One widely accepted scientific definition that serves this purpose is proposed by [7]: "A maturity model consists of a sequence of maturity levels for a class of objects. It represents an anticipated, desired, or typical evolution path of these objects shaped as discrete stages. Typically, these objects are organizations or processes" [7].

In general, two types of maturity models can be distinguished. The rather classic approach specifies the individual maturity in the form of fixed levels, where the five-level scale is most common. These fixed levels can be either staged or continuous [21], [26]. In focus area maturity models, on the other hand, every criterion can have disparate levels of maturity in terms of quantity and distance to each other [27].

Maturity models can serve three different functionalities: assessment of the as-is and here-and-now situation (i.e., descriptive), identification of desired maturity stages and provision of guidance on how to achieve it (i.e., prescriptive), and internal (within) or external (across) industry benchmarking (i.e., comparative) [1], [11], [22]. A maturity model is descriptive by design, but it can develop prescriptive and comparative features as the consequence of its application [22].

Furthermore, maturity, or the very advanced or developed state, demands a context [21], [28]. The development of a maturity model for a certain context, in turn, requires the understanding and definition of the peculiarities of that very context or the "entity of maturation" [21], in order to span the dimension space. Essentially, the definition of the context equips the maturity model with these functionalities of being descriptive, prescriptive, and comparative.

Generally, maturity models, as a subclass-concept of models, are in its very essence abstractions of reality concerning the construct maturity [29]. Since a model is always an abstract copy of reality, it becomes outdated if reality changes. In other words, if the context for which a maturity model has been designed evolves over time, the entirety of maturity with respect to the dimensions and levels of this context cannot be represented by the model anymore.

From these defining and constituting aspects of maturity models, the following requirements are proposed. A maturity model shall be:

1) Context-specific [21], [28]
2) Descriptive, prescriptive or comparative [20], [28]
3) Consisting of mutually exclusive dimensions [6]
4) Describe a maturity continuum in its dimensions [7], [28]
5) Operationalizable (i.e., measurable levels) [21], [22], [28]

III. Research Method

A. Maturity Model Development

For the underlying development paradigm, we choose the guidelines of design science to achieve our research goal [30]. Design science explicitly aims at resolving problems with newly developed IT artifacts, such as models or methods [29]. Following this view, we are pursuing a solution to the business problem of undefined levels of digital transformation. In general, design science involves an iterative artifact development in a "design cycle" that is encompassed by a "relevance cycle" and a "rigor cycle" [31]. The relevance cycle, on the one hand, ensures the incorporation of adequate requirements and the applicability to the business problem. On the other hand, the scientific grounding comes into play with the rigor cycle.

Alongside these design science research cycles, our concrete development process adopts the procedure for developing maturity models by [7] since it is tailored to the IT management area. Hence, it fits the case of "Energy IT" and our research goal. The procedure model sets out eight fundamental requirements and eight steps to be executed for the development of a maturity model [7]. Those eight requirements are established as specifications of the prominent design science research guidelines proposed by [30] for the development of maturity models and are inherently embedded in the procedure model (cf. figure 1) that we applied as follows:

Beginning with the *problem definition*, we provide arguments to verify the importance of our research from a practical (cf. subsection I-A) and a scientific perspective (cf. subsections II-A and II-B). As the comparison of what has already been developed is crucial for the design of artifacts, we conducted the *comparison of existing maturity models* by means of a literature review to examine overlaps or shortcomings of current models (cf. subsections III-B and IV-A). Based on these findings, we selected the creation of a new maturity model as our underlying *development strategy* but by also considering established model dimensions of prior work. The *iterative maturity model development* – being the core component of the procedure model – commenced with the initial design that pertains to prior digital transformation maturity models. Subsequently, the specific case of "Energy IT" and the interview results were considered during the iterative development (cf. subsections III-C, IV-B, and IV-C). The *conception of transfer and evaluation* is twofold: On the one hand, we are planning to disseminate and to discuss our maturity model with the scientific community during a conference and, afterward, the artifact will be further developed for a journal outlet. In addition, we brought the digital transformation maturity model into practice by providing it to employees of the "Energy IT". On the other hand, we decided to evaluate the artifact against requirements and – preliminary – by expert assessment. Accordingly, the *implementation of transfer media* relates to the dissemination of our findings.

As *evaluation* is an essential part of design science [7], [29]–[32] we conduct several evaluation steps, whether inherent to the method by [7] due to its iterative nature or done explicitly,

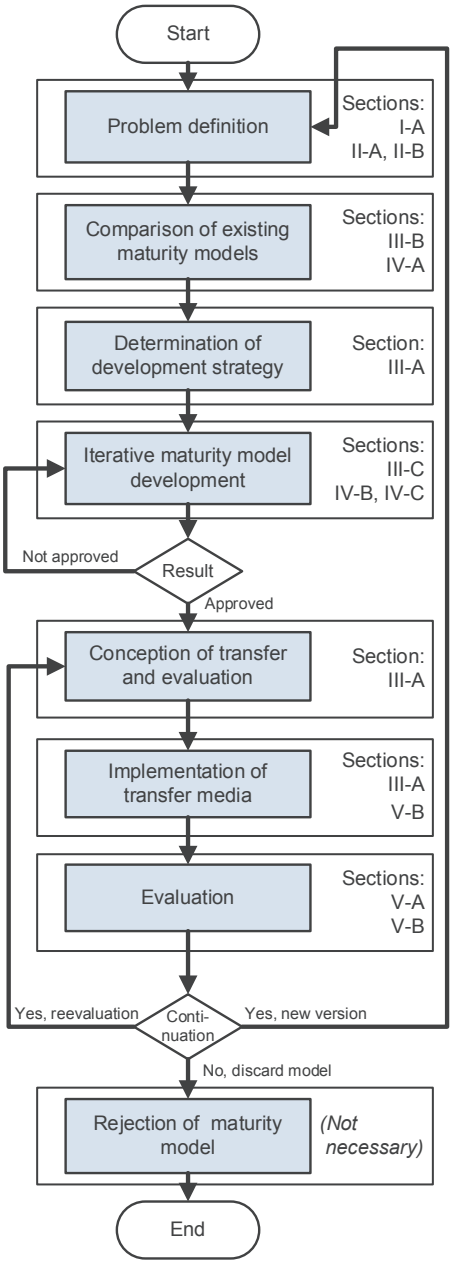

Fig. 1. Procedure Model for Developing Maturity Models based on [7].

i.e., as part of the evaluation concept (cf. subsections V-A and V-B). While iteratively developing the artifact, we continually test the artifact regarding comprehensiveness, consistency, and problem adequacy [7]. After the second iteration, the artifact will be assessed based on feature comparison [33], whereas the five requirements from subsection II-B have to be met. Furthermore, the artifacts' usefulness and applicability in a real-world scenario will be evaluated with the former interviewees from the development process.

B. Literature Review

To summarize the results of previous studies, we conduct the literature review methodology proposed by [34]. For a clear scope definition, the author proposed to use the taxonomy of literature reviews presented by [35]. The taxonomy by [35] consists of characteristics that are necessary for the reviewer to conduct meaningful literature review [34].

Our literature review is focused on "study outcomes" as we want to compare existing digital transformation maturity models. The goal of the study is to explore "central issues" with existing digital transformation maturity models. Organizationally, the current literature review aims to synthesize existing knowledge. Therefore, it is a "conceptual" aim. The perspective of the review is a "neutral presentation", so the other maturity models will not be criticized in this study. The audience of the current literature review is "specialized scholars" and "practitioners". Moreover, the coverage of the literature review is "exhaustive", thus will include all literature relevant to the topic [35].

The final search string, including keywords like "digital transformation", "digitalization", "maturity", and "maturity model", plus an existing literature review on digital transformation maturity models by [5] revealed 17 digital transformation maturity models, both from scientific and commercial backgrounds.

For the further course of our research, we agreed to only focus on those digital transformation maturity models that propose dimensions, are empirically grounded, and are well-documented regarding their development process in the form of peer-reviewed papers. Additionally, it was examined if the analyzed models are in line with the general understanding of digital transformation, as proposed by [3]. The final sample included four digital transformation maturity models, all from scientific background:

- "Digital Maturity Model" [1][1]
- "Digital Transformation Framing" [36]
- "Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises" [4]
- "Digital Maturity Model for Telecommunications Service Providers" [8]

The four selected digital transformation maturity models are used for the development process. This article does not intend to provide a literature synthesis of existing maturity models. For a more detailed analysis and comparison of existing digital transformation maturity models, we refer to the literature review by [5].

C. Interview Design

For the iterative maturity model development, we conduct semi-structured interviews with experts from the case company "Energy IT". During the interviews, the respondents mostly

[1]This digital transformation maturity model was first published in [13]. Since the paper is in the German language, we refer to the English follow-up paper [1].

share their own beliefs, experience, or attitudes. The interviewee could have a role as a citizen, consumer, employee of an organization, or any other role which he/she represents in their life. The respondents should have value for the interview, i.e., understanding particular topics and having specific knowledge about it [37].

Based on the research of [7] and [11], professionals with practical industrial experience can make a valuable contribution to the creation of a digital transformation maturity model. Thus, specialists in "Energy IT" who are skilled in digital transformation and regularly participate in the implementation of the digital transformation initiatives were chosen as the respondents (cf. Table I).

TABLE I
OVERVIEW OF INTERVIEWEES

#	Position	Level	Experience
1	Head of the Digital Transformation Department	L2	20 years
2	IT Project Manager	L4	15 years
3	Senior IT and Program Manager	L3	10 years
4	Senior Consultant in the HR IT Department (Digital Transformation ITIL)	L4	5 years
5	Digitalization Transformation Manager	L4	5 years
6	Senior Vice President of the "Energy IT" (Chief Technology Officer)	L1	20 years
7	Enterprise Architecture Manager	L4	15 years
8	Senior IT Strategy & Architecture Manager	L3	25 years

The management structure in "Energy IT" is vertical and consists of four levels: executives (L1), senior managers & head of departments (L2); team leaders (L3); and team members (L4). Within the study, we assess points of view and opinions of experts from all four levels. Executive and senior levels were presented by one representative from each level. Further, two team leaders and four participants from the first-line management participated.

A semi-structured interview consists of a defined area of exploration with the use of predefined questions. Still, a researcher is free to refine questions, ask additional questions, or clarify the information they have obtained before. That type of interview is based on an interview schedule or interview guidelines with predetermined information and questions. Often, semi-structured interviews use open-ended questions that give more flexibility to the respondent but do not allow him/her to go beyond the topic [37]–[41].

The main point of preparation for semi-structured interviews is the creation of the interview guidelines. This document focuses on initial questions for the respondents and specifies potential areas of discussion related to the topic. The interview questions should generate data that will help to reach our research goal (cf. subsection I-A). The questions do not necessarily need to match the research goal exactly but should motivate respondents to talk about the topic [37].

Prior to the interviews, all participants are informed about the nature of the study, the type of interview to be performed, and the estimated length (i.e., 45 minutes). Respondents are told that there are no "right" or "wrong" answers to motivate them to share his/her experiences [38].

For better understanding and connection between the respondents and the interviewer, all except from one interview were conducted face-to-face [42]. A dedicated conference room was booked for each interview to provide a safe space, free of distraction and interruptions. All participants were aware that no personal information would be disclosed (confidentiality), the company and their names will be anonymized due to legal issues (anonymity). The interviews were recorded and subsequently transcribed. After that, each interview transcript was coded according to a set of codes.

IV. MATURITY MODEL DESIGN

A. Comparison of Existing Maturity Models

For the purpose of our research, we picked four maturity models from the existing literature (cf. subsection III-B): [1], [36], [4], and [8]. The corresponding dimensions are depicted in Table II.

The first model is proposed by [1]. This generic model was developed through a literature review, interviews, and focus group assessment. At first, the author analyzed existing scientific studies on digital transformation. Next, exploratory interviews were performed with seven digital transformation practitioners and decision-makers. After analyzing the interviews, initial dimensions and their criteria of digital transformation were prepared. This first draft maturity model was assessed in a focus group with the participation of eleven digital transformation leaders.

The second found model is [36]. This multi-industrial model was developed based on interviews with three C-level digital transformation leaders from three different industries: heavy manufacturing, telecommunication, and insurance. Afterward, the interviews were analyzed. The dimensions and their criteria that are identified in at least two interview transcriptions were finally summarized.

The third digital transformation model is proposed by [4]. This model for the manufacturing industry was developed through a literature review of existed digitalization models in Industry 4.0. After literature analysis, initial dimensions and their criteria were prepared. Then the maturity model was assessed via 23 questionnaires distributed among digital transformation practitioners and researchers.

The last model is [8]. This digitalization model for the telecommunication industry was developed based on panel research. Ten professionals regarding digital transformation in the telecommunication industry were brought together to create a digital transformation maturity model in an iterative manner.

The dimensions of the four digital transformation maturity models were analyzed. The purpose of the dimensions is to cover essential and fundamental business areas impacted by digital transformation [6], [22]. The analysis showed that quite often differently named dimensions from distinct models logically mean the same and could be aggregated. Subsequently, the dimensions mentioned above were synthesized.

TABLE II
COMPARISON TABLE OF DIGITAL TRANSFORMATION MATURIY MODELS

Digital Transformation Maturity Models			
[1]	**[36]**	**[4]**	**[8]**
1 Strategy	1 Strategy	1 Strategy	1 Strategy
2 Technology	2 Technology	2 Technology	2 Technology
3 Organization	3 Organization		3 Organization
4 Customer experience	4 Customer	3 Customer	4 Customer
	5 People	4 People	
	6 Ecosystem		5 Ecosystem
	7 Innovation		6 Innovation
		5 Operations	7 Operations
5 Culture & expertise		6 Culture	
6 Product innovation		7 Products	
7 Process digitization		8 Leadership	
8 Collaboration		9 Governance	
9 Transformation management			

Culture & expertise by [1] means the same as *people* by [36] and *people* and *culture* by [4]. These aspects can be aggregated in one dimension *people*. *Collaboration* by [1] is the same element as the *ecosystem* by [36] and *ecosystem* by [8]. These elements can be summarized as *collaboration*. The *technology* dimension is presented in all four models and, thus, will stay without changes. *Organization* is found in all models, except for the model by [4], in which this component is presented via *leadership* and *governance*. *Innovation* is introduced in the models by [36] and [8], but single innovative criteria from other models will be later added to this dimension. *Operations* is presented in the models by [4] and [8] as well as in the [1] model (under the alias *process digitization*). *Customer* and *strategy* elements are mentioned in all four models, so, in our initial model, they will remain unchanged. *Products* by [4] and *product innovation* by [1] were initially not selected as a dimension since we develop the maturity model along with the case company "Energy IT", which is an IT service provider and does not rely on (physical) products, but services. However, some criteria from these dimensions will be partly added later to the *innovation* dimension in our maturity model.

B. Initial Design

Since we consider fixed level maturity models with a predefined number of maturity levels less suitable to express the complexity of the digital transformation, we decided to develop a focus area maturity model [27], [43]. The digital transformation criteria, grouped into dimensions, are the focus areas presenting essential activities that should be performed by the company to achieve a high level of digital transformation maturity. Thus, after the comparison of the existing models (cf. subsection IV-A), eight focus areas were chosen for the initial artifact design: *people*, *collaboration (ecosystem)*, *technology*, *organization (leadership / governance)*, *innovation*, *(6) operations (process digitalization)*, *customer*, and *strategy*.

The first dimension of our model is *people*. Both, [1] and [4], paid attention to the importance of digital affinity and IT competences. [4] mentioned technological openness as a crucial aspect of a digitally maturing company. [36] and [1] agreed on the importance of a proactive mindset. Furthermore, [36] underlined the importance of constant training and talent development, while [1] emphasized the value of readiness to take risks and "no blame".

The second dimension in our model is *collaboration*. The importance of the digital platform for partners was mentioned by [1], [36], and [8]. [4] and [8] emphasized the value of a digital collaboration culture. Also, [1], [36], and [4] agreed on the importance of a knowledge-sharing culture and knowledge management, while [1] and [36] paid attention to the importance of cooperation with academia and cross-industry collaboration.

The third dimension of our model is *technology*. [1] and [36] emphasized the value of modern data technologies like big data. [4] brought the importance of machine learning and innovative technologies.

The fourth dimension in our model is *organization*. [4] mentioned the existence of central coordination as a crucial aspect of a digitally maturing company. They also agreed with [1] that the responsibility of transformation rests with senior leaders as well as the necessity of prioritization, investments, and resources.

The fifth dimension of our model is *innovation*. [4] paid attention to the importance of decentralization processes and interdepartmental collaboration for successful digital transformation. [1] and [36] agreed on the importance of the usage of digital transformation for creating new products and services, as well as the significance of sharing ideas and evaluating processes in the company. Moreover, [1] mentioned that online and offline interaction with the company should be seamless. [1] and [8] emphasized the value of agile management for successful digital transformation.

The sixth dimension in our model is *operations*. [1], [36], and [4] agreed on the importance of standardization and automatization of processes and regular process checks for operational improvements. [1] also emphasized the value of automatization of routine procedures as well as the usage of real-time data.

The seventh dimension in our model is *customer*. [1], [36], and [8] mentioned the customer-centricity approach as well as the customer journey experience and customer satisfaction as an influential aspect of a digitally maturing company. Additionally, [1] emphasized the value of omni-channel communication with customers. [36] and [4] agreed on the importance of the utilization of customer data and self-help tools.

The last dimension in our model is *strategy*. [1] paid attention to the importance of goal definition, its measurability, and its periodical review. [36] emphasized the value of the enactment of a digital transformation strategy and its documentation and alignment within the company. [1] and

[4] highlighted the importance of a digital transformation roadmap.

C. Exploratory Artifact

After having designed the initial model with eight dimensions, we brought it into the interviews for further discussion and assessment. It was not possible to discuss all eight dimensions of the initial digital transformation maturity model with all respondents due to their different digital transformation experience and knowledge as well as time constraints. Three interviewees gave their opinion on all eight dimensions during our eight interviews. The other four interviewees discussed six out of eight aspects each. One respondent (from L3; cf. subsection III-C) had only time to express his viewpoint regarding five out of eight dimensions.

However, the interview data provided sufficient insights to refine and enhance the initial model. Some dimensions were renamed, some combined with others, and one dimension was excluded. For instance, the initial dimensions *people*, *collaboration*, and *organization* were renamed into *culture*, *ecosystem*, and *governance* for a clear understanding and better fitting to the current criteria in these dimensions. In this context, one interviewee emphasized the importance of knowledge-sharing: "*I saw so many times and over a lot of years here that people don't share their knowledge. Keep it for themselves to make them more important*".

The criteria of the initial dimension *innovation* were distributed between the resulting dimensions *culture*, *ecosystem*, and *operations*. One interviewee explicitly agreed on the importance of a proper "failure culture": "*You can make a mistake. No worries of try and fail. Just go for it.*"

The criteria of the initial dimension *customer* were added to the resulting *ecosystem* dimension. The dimensions *operations* and *strategy* remained unchanged. Here it was stated that " *[. . .] [it] is very very important that everyone in the organization understands what the digital transformation means and sees how we, how that organization is going in their journey*".

The *technology* dimension was excluded entirely, because, based on the interview with the head of the digital transformation department, digital transformation management in "Energy IT" does not rely on any particular technology, but tends to see how they affect the business side: "*[. . .] But all those [technologies] were also there before [Digital Transformation]. Just put the [new] names around. So I would say, in this case, digital transformation is just highlighting what we've done with a new fancy logo spinning thing around. Like, for example, the Internet of Things. Or Big Data. Guys, it is just a database. Get over yourselves [. . .]*". Consequently, the enumeration of technologies in the *technology* dimension will not deliver any significant benefits to the digital transformation maturity model for the "Energy IT".

Five revised focus areas *culture*, *ecosystem*, *operations*, *governance*, and *strategy* are characterizing the digital transformation maturity of a company. Thereby, *culture* refers to the leaders' and employees' attitudes towards digital interaction and preferences to digital solutions, i.e., digital culture and the acceptance of idea pitching. Established knowledge management and sharing and digital collaboration are also criteria to assess the culture. Lastly, digital skills training reflects the company's commitment to the importance of educated employees for mastering digitalization. The *ecosystem* refers to the collaboration within and outside the company. As this needs a high openness to other organizations, a promising ecosystem contains seamless interactions with associates, usage of their data, business and IT synergy, customer centricity, and cooperation with academia and industry. In contrast, *operations* refers to internal processes and is specified by the presence and degree of process standardization and automatization, the checking for process improvements, service launches based on digital technologies, and the absence of operational silos. *Governance* also reflects an internal perspective and describes how digital transformation leadership reacts to the changing environment. This is captured by the criteria digital transformation responsibility and prioritization, monitoring of the emerging technologies, digital transformation management with digital skills, incorporating success stories, and fast-reacting on security and legal issues. *Strategy*, as the fifth focus area, reflects the inclusion of the digital transformation into the business strategy. For this, the following criteria apply: digital transformation goals, digital transformation roles, digital transformation strategy, digital transformation roadmap, and considering the as-is compared to envisaged to-be states.

All five focus areas respectively dimensions and their criteria are illustrated in figure 2, whereby the criteria, which were added according to the feedback from the interviews, are marked grey. To preliminary measure the criteria continuum, a five-level Likert scale [44] was used.

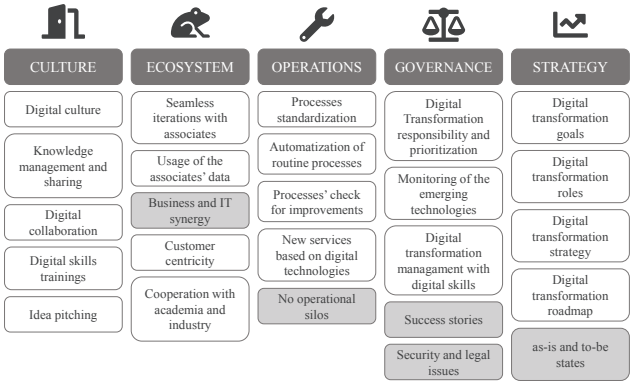

Fig. 2. Exploratory Digital Transformation Maturity Model.

V. Evaluation

A. Feature Comparison

To assess the exploratory artifact and implicitly the development process described in the previous sections, we tested the developed digital transformation maturity model against the five requirements from subsection II-B in the form of a feature comparison [33]. At this stage, the developed

digital transformation maturity model does not have a maturity continuum. Therefore, the exploratory artifact fulfills only three out of five requirements (i.e., features), whereas two features relating to the maturity continuum have not been met. The results are summarized in Table III.

TABLE III
REQUIREMENTS FOR DIGITAL TRANSFORMATION MATURITY MODELS.

#	Requirements	Artifact
1	Context-specific	Yes
2	Descriptive, prescriptive or comparative	Yes
3	Mutually exclusive dimensions	Yes
4	Maturity continuum	No
5	Operationalizable	No

The artifact is context-specific with the digital transformation being the object of maturation. Further, the digital transformation maturity model was developed along with an IT company (i.e., "Energy IT") and primarily focuses on companies in the IT sector.

The maturity model allows positioning an IT company with respect to its digital transformation maturity which accounts for a descriptive character of the model. Although, without the maturity continuum, the digital transformation maturity model is neither predictive nor comparative.

Through the iterative development process and continuously reflecting the artifact concerning comprehensiveness & consistency, we argue for the dimensions (cf. first iteration; subsection IV-B) and criteria (cf. second iteration; subsection IV-C) to be mutually exclusive.

As a consequence of a yet not developed maturity continuum, the operationalizability of the artifact is not given at the current development stage. To preliminary test the artifact, we used a five-level Likert scale [44] to make the digital transformation maturity model applicable. However, we argue that by adding levels with respective characteristics to the criteria, these become measurable. For instance, we can measure the criterion *automization of routine processes* by the degree of fully automized delivery processes implemented in the company.

B. Preliminary Practitioners' Assessment

Furthermore, the exploratory artifact was additionally assessed with the former interviewees from the development process in order to test its usefulness and applicability in a real-world scenario.

The feedback was overall positive. For instance, the decision to omit individual dimensions and criteria was affirmed by the experts. Two experts acknowledge the usefulness of the artifact as a starting point for digital transformation, whereas one expert emphasized the potential to apply the artifact in "*[. . .] any organization embarking on a digital transformation journey*".

Although, one expert stated that the new digital transformation maturity model is "*[. . .] more reflective of a real-world environment*", two experts (both L3; cf. subsection III-C) mentioned the possibility to enhance the artifact by environmental aspects like customers.

In the following development iterations, these suggestions need to be tested since they are only snapshots of the current experts and the company's situation and do not necessarily have to be necessarily useful. Taking the overall feedback into consideration, the latest iteration leads to an improvement of the artifact.

VI. DISCUSSION

In this section, we discuss the artifact as well as the most crucial decisions along the development process.

The scientific literature regarding digital transformation maturity models was surprisingly scarce. In the first iteration, we decided to only rely on digital transformation maturity models with a well-documented development process in the form of peer-reviewed papers. By this decision, 13 commercial digital transformation maturity models, mainly published in grey literature, were discarded from the development process. Due to better resource accessibility and closer relationships to potential case companies, in extracts, these commercial maturity models might be at least as appropriate than the maturity models from scientific background. Though, the documentation of each development process needs to be validated in order to meet all requirements from the method by [7].

As a theoretical foundation, the threefold characterization, i.e., technological, organizational, and social, by [3] was chosen. However, in the course of the second iteration, *technology* was dismissed as a dedicated dimension, since digital transformation in the case company does not rely on particular technologies (cf. subsection IV-C). In the exploratory artifact, the technological aspect is inherent to all dimensions or criteria. Thus, technological aspects, which are agnostic to specific technologies and solutions like data management, data integration, or standardization can be discussed in further development iterations [1], [7], [36]. Additionally, aspects like technology intelligence [45], [46] and digital intelligence [47] might be prosperous dimensions or criteria for the digital transformation maturity model.

Furthermore, the customer perspective and the customer centricity approach are recurring aspects regarding digital transformation [3], [18]. Consequently, as proposed in the initial iteration and aligning with the practitioners' assessment (cf. subsection V-B), *customer* might become again a dedicated dimension, whereby the corresponding criteria can be merged back into the dimension.

With the presented maturity model, we are able to address the typical weaknesses of previous models. In particular, we have focused on a theoretical foundation, analyzing qualitative data, and a structured and transparent approach to the development process. The structured application of the method by [7] and the evaluation of eight semi-structured interviews strongly contribute to a solid foundation. Nevertheless, the evaluation already carried out could be supplemented by further evaluation steps with employees from other companies in order to achieve further generalizability.

In the course of the iterative development process, a five-level Likert scale [44] was used, to preliminary measure the continuum of our artifact, which, to a certain extent, contradicts the basic idea of focus area maturity models. In a prospective iteration, we plan to design a maturity matrix for the individual criteria [27].

The artifact has been developed specifically for IT companies. Although the company under investigation solely operates in the energy sector, the development of our artifact comes without any sector-specific influence. Beyond the application to IT companies, the digital transformation maturity model might be transferable to other domains. Considering the high degree of service-orientation and the limited presence of technological aspects, the maturity model can be applied to other domains of the service sector. Especially at this stage, without the maturity continuum, the criteria might be utilizable in other domains, albeit with a divergent maturity matrix.

Maturity models are living artifacts [7]. With this in mind, even after further development iterations, the final maturity model remains a snapshot of the current situation, including all to this point existing theories, paradigms, and artifacts. Therefore, the final digital transformation maturity model needs to be changed over time, especially due to the fast pace of the digital transformation.

VII. Conclusion

In order to provide companies with the opportunity to uncover the areas that are lacking behind in their digital transformation process or self-assess their current transformation status, we developed dimensions and corresponding criteria for a digital transformation maturity model fitting to IT companies. Therefore, we picked an IT company from the energy sector to ensure the highest empirical embedding throughout the development process. This case serves as a first and exemplary application scenario.

As research method, the procedure model by [7] was applied. Based on the surprisingly scarce literature on digital transformation maturity models and eight expert interviews, we iteratively designed and evaluated a maturity model tailored to IT companies. As a result, we synthesized five dimensions: culture, ecosystem, operations, governance, and strategy. Each dimension consists of further criteria specifying the respective dimension.

To assess the developed artifact, we conducted several steps within and after the development iterations. In addition to the already inherent evaluation within the method by [7], we tested the exploratory artifact against the requirements from subsection II-B and conducted additional practitioners' assessment with the expert from the development process. At the current state, the exploratory artifact meets three out of five requirements, whereas, the digital transformation maturity model is context-specific, descriptive, and has mutually exclusive dimensions, though, without maturity continuum, it is not operationalizable, yet.

Regarding the exploratory artifact, the experts confirmed the usefulness of the artifact and its empirical grounding. Further, in this context, the ability to transfer the artifact to other companies was mentioned. In conclusion, our artifact shows a high fit with the needs of the company under investigation and can serve as a blueprint for other IT companies. With our research, we contribute to a better understanding of the critical areas affected through digital transformation. Moreover, the artifact provides new opportunities for an assessment of the current state of digital transformation, which explicitly accounts for the needs of IT companies.

However, our research is constrained by some limitations. The comparison of existing digital transformation maturity models was restricted to peer-reviewed papers, whereby a multitude of digital transformation maturity models from commercial background was dismissed due to this condition. After two development iterations, the artifact is only in an exploratory state without appropriate maturity levels. Moreover, the expert feedback was limited to eight interviewees from a single company.

In future research, we plan to continue the development of the digital transformation maturity model, whereas different approaches can be chosen. For instance, the suggestions from the practitioners' assessment, i.e., considering further external aspects like customers can be used as an entry point the next iteration. Moreover, the initially excluded commercial maturity models identified in the literature review by [5] can be used as a basis for an additional iteration. Future iterations can also incorporate knowledge from the subject area digital transformation itself, instead of solely focusing on synthesizing existing models. To enhance the evaluation, the digital transformation maturity model can be assessed with digital transformation experts from other companies within or apart from the IT sector.

Notwithstanding the mentioned ideas for future improvement, following the method by [27], a maturity matrix and corresponding assessment questions to determine the digital transformation maturity profile of a company can be developed to complement the existing digital transformation maturity model.

With the research background and the yet exploratory artifact, we strengthen the conceptual foundation for future research on maturity models and address practical matters of the IT sector.

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