



LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

MUNICH SCHOOL OF MANAGEMENT
INSTITUTE FOR INFORMATION SYSTEMS
AND NEW MEDIA | PROF. DR. THOMAS HESS



MANAGEMENT REPORT 2/2016

How digital are we? Maturity models for the assessment of a company's status in the digital transformation

Simon Chanias | Thomas Hess

Abstract:

In the context of an ongoing digital transformation, companies across all industries are confronted with the challenge to exploit IT-induced business opportunities and to simultaneously avert IT-induced business risks. Due to this development, questions about a company's overall status with regard to its digital transformation become more and more relevant. In recent years, an unclear number of maturity models was established in order to address these kind of questions by assessing a company's digital maturity. Purpose of this Report is to show the large range of digital maturity models and to evaluate overall potential for approximating a company's digital transformation status.

Publisher

LMU Munich

Munich School of Management

Institute for Information Systems and New Media

www.wim.bwl.lmu.de



1 Background and Objectives

In the context of an ongoing digital transformation, companies across all industries face the challenge to exploit the opportunities of advanced information technologies (IT) for their business and to simultaneously avert the business risks, which arise from these advanced technologies (Matt et al. 2015). There are numerous examples of companies that make successful use of IT-induced business opportunities – such as the car manufacturer BMW that embraces IT in order to create new mobility solutions and related business models or the media company ProSiebenSat.1 Media that has established a dedicated digital business unit, which already generates a substantial part of the company's overall revenue. However, there are also a few striking examples of companies that have failed to avert IT-induced business risks and, thus, a digital disruption of their business model – such as the photography specialist Kodak or the cellphone manufacturer Nokia.

Therefore, a company's management or other stakeholders might raise questions about the company's overall status with regard to its digital transformation. These questions can arise in two contexts. First, they can be asked during a company's internal strategy discussions as a means to derive tangible strategic measures, such as the initiation of digital projects or larger digital programs. Second, these questions might be raised in the external context of a company, for instance in the course of an interfirm comparison by capital market analysts.

In academic literature, there are attempts for assessing a digital maturity degree, for instance by using indicators such as the revenues created with digital products and services or the investments related to IT. These indicators may be helpful to show some aspects of the digital transformation in specific situations. But to get a full picture, these one-dimensional indicators are not adequate. Thus, the use of multidimensional maturity models might be the most appropriate approach for approximating a company's digital transformation status.

In recent years, an unclear number of maturity models was established in order to assess the status of a company's digital transformation. The majority of these approaches was derived in a practical context, mostly by management consultancies. At first sight, many of these models seem to use similar approaches for assessing a company's digital maturity. Yet, on closer inspection, several differences between these models become clear. Purpose of this Management Report is therefore to show the large range of digital maturity models and, on this basis, to evaluate their overall potential for approximating a company's digital transformation status. We focus thereby on the description of typical approaches, and refrain from providing a detailed overview, comparison or evaluation of the numerous existing models.

The remainder of this Management Report is structured as follows: Initially we clarify the understanding of basic concepts. Further, we explain our proceeding (an exploratory review of existing models) and discuss derived design parameters. As a next step, we present two typical maturity models, and also elaborate on their differences. Finally, we conclude with general remarks from a management point of view. On this basis, we aim to contribute to a better understanding of this complex, yet highly relevant and actual topic.

2 Basic Concepts

2.1 Digitization and Digital Transformation

The term “Digitization” is very broad and has different meanings, depending on the context of its use. In addition, it is important to distinguish between the terms “Digitization” and “Digital Transformation”, since these concepts describe different ideas. We define “Digitization” as the technological transfer of information (flows) and tasks to a computer. In the context of companies, the term “Digital Transformation” goes much further and describes the process of change due to an increased use of IT. The concept thereby reflects the pervasiveness of IT-induced changes (Chanias and Hess 2016), affecting both primary activities of a company – such as production or marketing and sales – as well as its support activities – such as controlling or human resources. The concept is also dealing with the ability of a company to handle the process of digital transformation in a systematic way.

Digital Transformation is not a new topic, but its relevance for companies has changed. Companies used early IT initially only for basic administrative tasks. However, due to improved connectivity and new database systems, integrated solutions were introduced at a later stage. The next development was the networking with other companies and subsequently also with private customers based on the infrastructure of the Internet; significantly improved user interfaces strongly facilitated this development. Currently, a new generation of systems for the processing and analysis of data, the integration of different (user) devices as well as the further expansion of the Internet-based connectivity offers again new opportunities.

2.2 Digital Maturity

Maturity models are very common tools in areas such as software engineering, project management, or quality management. A well-known example is the “Capability Maturity Model Integration” (CMMI) by the Carnegie Mellon University (CMMI Institute 2016), which can be applied to several areas of interest: product and service development (CMMI for Development, CMMI-DEV), service establishment and management (CMMI for Services, CMMI-SVC), and product and service acquisition (CMMI for Acquisition, CMMI-ACQ). Main idea of these broad models is to formalize and optimize processes for avoiding ad hoc practices and, simultaneously, for achieving standardized proceedings. In this context, maturity describes the degree of process mastery and improvement, and – in more general terms – relates to a state of being complete or perfect (Lahrmann et al. 2011). The simplified approach of using maturity levels and related models is chosen when the object of observation is difficult to capture and a basis for decision-making is required.

The term “Digital Maturity” can be defined in two different ways, in analogy to the different interpretations of the term “Digitization” that we described in Section 2.1. First, it could describe to which extent a company’s tasks are performed and information (flows) are handled by IT. Following this technological interpretation, a company would be fully digital when performing all tasks and storing all information by the use of IT. Although, this definition might be an interesting interpretation from a technological perspective, it seems to be less relevant for management matters.

More important from a managerial point of view is a second definition of the term “Digital Maturity”, which is understood as the status of a company’s digital transformation and describes what a company has already achieved in terms of performing transformation efforts. These efforts could include accomplished changes from an operational point of view – such as changes in products or processes – as well as acquired meta-abilities with regard to the mastery of the change process.

3 Review of Existing Maturity Models and Design Parameters

Starting point for our investigation is a systematic literature review, which was conducted in October 2015 and that is based on a keyword search (both in German and English language) in relevant scientific databases and search engines. During this literature review, we derived a longlist comprising 36 maturity models in total. Since not all of the identified models were described in detail by their publishers and showed a company or industry focus, we had to apply a prioritization logic to our longlist. Based on our prioritization, we finally derived a shortlist consisting of 20 maturity models. This exploratory work serves as the basis for this Management Report.

We found that almost all available digital maturity models use key elements of classical maturity models. Although this relation with classical maturity models seems to be a common denominator of the existing models, there are many differences between these with regard to their actual design. For the purpose of our investigation, we therefore derived a set of important design parameters and clustered these in the categories “general aspects of the model”, “data collection and analysis”, and “data presentation” (see Figure 1). The design parameters are described in the following.

General Aspects

Number and focus of dimensions: The key characteristic of digital maturity models is their number and variety of dimensions, which represent competence areas that form the basis for the subsequent maturity level evaluation and determination. The number and focus of these dimensions can differ to some extent. During our literature review, we identified models with a large span of dimensions, ranging from 2 to 16. From a content perspective, typical dimensions cover the aspects (strategic) transformation management, core business comprising the digital product and service offering, digitization of internal processes and operations, digital customer interaction as well as IT use and development. In most cases, however, only an internal perspective is considered and no external perceptions, such as customer feedback, are being used. Further, no model takes exact performance indicators of a company into account, such as existing digital revenues or financial investments.

Adaptive potential: Only few models offer the opportunity to adapt the methodology to the specific context of the company, such as the industry background or other company specifics. Thus, most of the existing models use a standardized approach for assessing digital maturity. Moreover, some models are explicitly revised on a regular basis by their publishers in order to properly reflect the current state-of-the-art in terms of technological developments. The latter aspect is very important,

because digital maturity assessments always match against “moving targets” as (technological) possibilities evolve over time. Therefore, almost all models take current and foreseeable possibilities into account when assessing a company’s digital maturity, with regard to both the changes already achieved (e.g. to what extent can customers be reached through mobile channels) and the expected challenges.

Data Collection and Analysis

Evaluation and data collection: The majority of the investigated models does not provide the opportunity for a self-evaluation, since they are not described in full detail or necessary tools are not publically available. Thus, in most cases a management consultancy has to be mandated in order to conduct the assessment for the company. Still, there are some models, which allow for a manual or assisted self-evaluation, mostly by means of rough guidelines or an online questionnaire. These models further break down their main dimensions by using maturity areas, lead questions or specific indicators, which have to be evaluated by company representatives.

Digital maturity level determination: A large variety of qualitative and quantitative approaches exist in order to determine digital maturity. Qualitative models, for instance, can be based on semi-structured management interviews and perform their assessment on an interpretative basis. Quantitative models mostly use structured questionnaires with Likert scales and can be very simple, e.g. by using a summarized score for each dimension, or very complex, e.g. by combining various mathematical-statistical score computation procedures. Some models also rely on a (dynamic) weighting of dimensions and related indicators.

Data Presentation

Digital maturity assessment: The majority of models conducts an assessment based on four to five evolutionary maturity levels. While some models use status levels describing the internal digital penetration, other models use certain archetypes or clusters of companies that describe common characteristics of these. Again, different perspectives can be taken: either by considering the company as a whole or by only looking at specific areas of it. Furthermore, the assessment can take place on level of only one selected company or in comparison between companies of the same or other industries.

Result visualization: To depict their results, quantitative models use computed, numerical scores that are expressed as absolute figures or percentages. In some cases, these scores only serve as an intermediary step and are again being matched with distinct maturity levels or company clusters, which provide further, yet generic information on the overall status. Most of the qualitative and also some of the quantitative models provide a graphical illustration of their results, for instance by using a matrix or a spider diagram.

Benchmarking and gap analysis: Only few models provide the opportunity to compare their results to other companies. The overall significance of the benchmarking also depends on the availability of data from companies with the same industry background that represent direct competitors. Further, due to the design of those models, which rely on best practices, a gap analysis can be conducted to a certain extent in order to identify areas of improvement. However,

almost no model provides advice in digital transformation capability building or in deriving concrete measures for addressing identified gaps. For this purpose, again, additional consulting services would be required – which might be a main target of the models proposed by management consultancies.

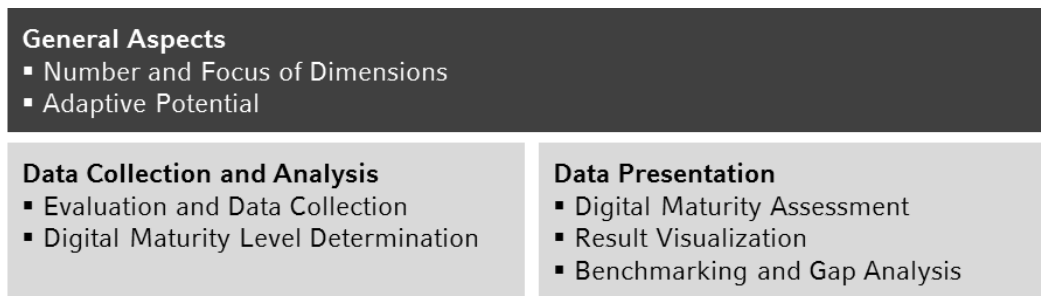


Figure 1: Overview of Derived Design Parameters by Category

4 Typical Models for the Assessment of a Company's Digital Maturity

In order to illustrate the variety of existing practices and their differences, we chose two contrasting, yet typical digital maturity models. Although the objective of both models is to provide practitioners the means to determine the digital maturity of companies, the models consider different dimensions and aspects. These will be described and analyzed in the following.

4.1 MIT Center for Digital Business and Capgemini Consulting

Based on a series of joint studies with a global reach, the MIT Center for Digital Business and Capgemini Consulting (2011, 2012) proposed a framework for assessing digital maturity. The framework allows to evaluate companies in two dimensions and to assign them to one of four digital maturity levels (Westerman and McAfee 2012). The first dimension "Digital Intensity" (the "what") describes a combination of strategic assets, digital elements, digital capabilities, and investments. The second dimension "Transformation Management Intensity" (the "how") addresses managerial aspects that drive digital transformation and comprises aspects such as digital vision, governance and engagement. Together, both dimensions represent the digital maturity of a company. A strong digital transformation creating value for all stakeholders can only be achieved when the firm is fully mature on both dimensions.

In this model, the digital maturity of a company is depicted in a digital maturity matrix, which is a 2x2 matrix categorizing four different digital maturity levels or archetypes (see Figure 2):

- **"Beginners"** are still at the beginning of their digital transformation as they are immature in both dimensions. They use traditional digital means (e.g. ERP systems), but do not utilize and exploit the opportunities that advanced means offer. On the one hand, the reason for this could be that they are unaware of the possibilities of new digital technologies, skeptical regarding them or have started using them ineffectively. On the other hand, a company could also choose to be a "Beginner". This could be owed to the type of industry (e.g. chemicals, engineering) or business relations (B2B vs. B2C) it uses to conduct its operations.

- **“Fashionistas”** have tested and started to implement various digital technologies. However, they lack management skills to create a successful and sustainable digital transformation strategy. The implemented technologies do not interact with each other and therefore do not generate synergies. While “Fashionistas” may externally make a good impression, they lack substance and steadiness. The next critical challenge for them is to coordinate their digital activities in order to create an overall collective value.
- **“Conservatives”**, on the contrary, describe companies, which are aware of the potential of advanced IT and are able to manage them effectively. They might be experts on the digital field and are well aware of the digital transformation necessity for the company. However, they view new technologies with skepticism. Due to their conservatism and cautiousness, they might miss out on precious chances to add value to the firm and run the danger of becoming less competitive.
- **“Digiratis”** are the digitally most mature group of companies. They have implemented the newest digital trends and coordinate them with a strong vision and digital culture, resulting in an effective value creation. Consequently, they have a competitive advantage and outperform other companies in their industry.

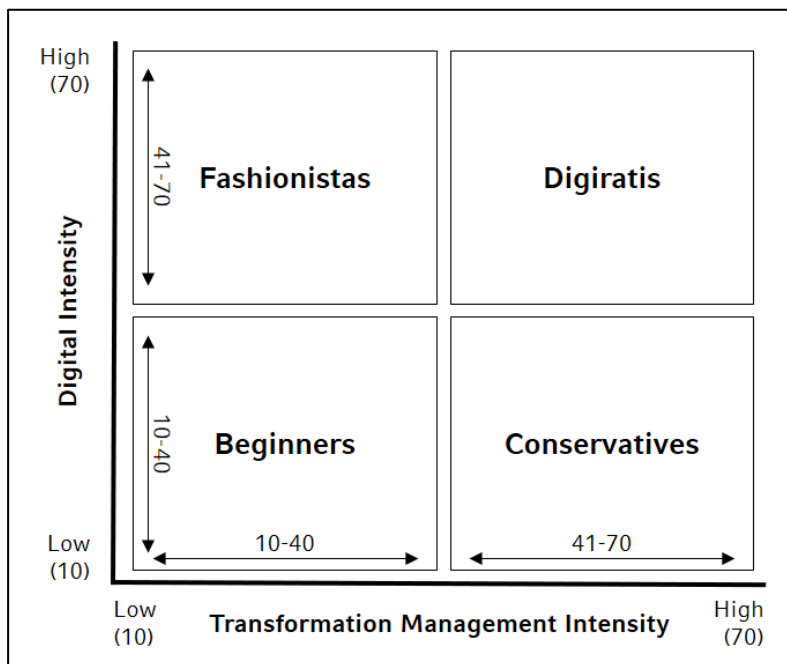


Figure 2: Digital Maturity Matrix (adopted from MIT Center for Digital Business and Cappemini Consulting 2011)

The maturity assessment is based on a self-evaluation with 10 lead questions for each of the two main dimensions (Westerman et al. 2014). Each dimension can be evaluated by rating these lead questions with scores from 1 to 7. Thus, the value 10 represents the lowest possible score per dimension and the value 70 the maximum; this implies that no weighting of the questions takes place. Finally, the digital maturity of a company is the combination of these separate dimensions, whereas the value 41 represents the threshold on each dimension. “Beginners”, for instance, show on both axes a value below 41 and are therefore assigned to the quadrant at the bottom left. Although there are further publications on this model available (e.g. Fitzgerald et al. 2013), which classified a large number of companies and studied the relationship between the company’s digital maturity level and economic indicators such as profitability or market valuation, no dedicated or enhanced tools

are publically available for the self-evaluation that consider specifics of the evaluated company.

4.2 IWI-HSG and Crosswalk

The “Digital Maturity Model” proposed by the Institut für Wirtschaftsinformatik at the University of St. Gallen (IWI-HSG) and the Swiss management consultancy Crosswalk (2015, 2016) was specifically designed for practical use. It is supposed to support practitioners in analyzing companies’ digital maturity and helping them to uncover new business potentials. The approach was initially developed in 2015 using the well-known “Business Engineering Framework” (Österle and Winter 2003) as a conceptual background, which describes the transformation from the industrial into the information era. The “Digital Maturity Model” was eventually created based on a literature review, expert interviews and focus groups. It was applied already in two online surveys in 2015 and 2016 with several hundreds of participating companies.

The “Digital Maturity Model” comprises nine dimensions consisting of maturity criteria, which are again measured by several best practice indicators. While the 2015 edition of the model was based on 59 different indicators, the 2016 edition used 60 indicators, since the best practice indicators are revised on a regular basis in order to stay up-to-date. The nine main dimensions of the model can be described as follows:

1. **“Customer Experience”** examines whether a company can adapt to the digital customer behavior and their new expectations.
2. **“Product Innovation”** evaluates aspects of the extension and the development of products and services by the use of IT.
3. **“Strategy”** considers the existence of a digital transformation strategy and its interplay with the corporate strategy. Also, other aspects are considered such as the internal and external perception of the company as being “digital”.
4. **“Organization”** addresses questions of how a company adapts its structure in order to enable a digital transformation.
5. **“Process Digitization”** is concerned with the adaption, standardization, and automation of internal processes.
6. **“Collaboration”** investigates the employee level interaction (i.e., communication, networking, knowledge sharing etc.) in the digital transformation process.
7. **“ICT Operations & Development”** examines technological capabilities of a company (i.e., infrastructure, agile methods etc.)
8. **“Culture & Expertise”** looks at critical internal requirements for the sustainable success of a company’s digital transformation. Exemplary aspects are a digitally conscious company culture, a willingness to take risks or a culture that accepts failures.
9. **“Transformation Management”** assesses top management’s approach to manage the company’s digital transformation process, for instance the distribution of roles and responsibilities or the availability and regular assessment of distinct key performance indicators (KPIs).

Main objective of the “Digital Maturity Model” is to categorize companies in five ascending maturity levels, which are described in Table 1.

Level	Description
Level 1: Testing	The need to act has been recognized by top management and first resources have been provided in order to pursue digital activities. Further, first experiments with digital products and services have been conducted.
Level 2: Establishing	The company has gained an over-departmental understanding of the necessity to digitally transform and digital projects have a high priority.
Level 3: Consolidating	Management has defined strategic targets for the digital transformation and drives the transformation as a strategic change project. Digital and mobile channels have been integrated into core processes.
Level 4: Structuring	A digital roadmap and dedicated digital transformation strategy is in place. New technologies are regularly evaluated at an early stage. Processes are automated and advanced analytics are used.
Level 5: Optimizing	Certain functional areas are being expanded. Digital transformation is a predetermined business objective for the management and has been translated into measurable, operative goals. The digital potential in core activities and processes is fully utilized.

Table 1: The Model's Five Stages of Maturity (adopted from IWI-HSG and Crosswalk 2015)

In order to assess a company's digital maturity level, an online questionnaire has to be completed – as part of a comprehensive campaign that simultaneously evaluates a greater number of companies during a certain assessment period. For each of the best practice indicators, the participants have to rate their answers on a 5-point Likert scale. Each indicator is dynamically rated based on its degree of difficulty using a certain algorithm, i.e. the more companies comply with an indicator, the easier it is rated. Afterwards, they are categorized into the five levels of maturity by means of a cluster analysis, classifying the easiest indicators as maturity level 1 and the most difficult ones as maturity level 5 (see Figure 3).

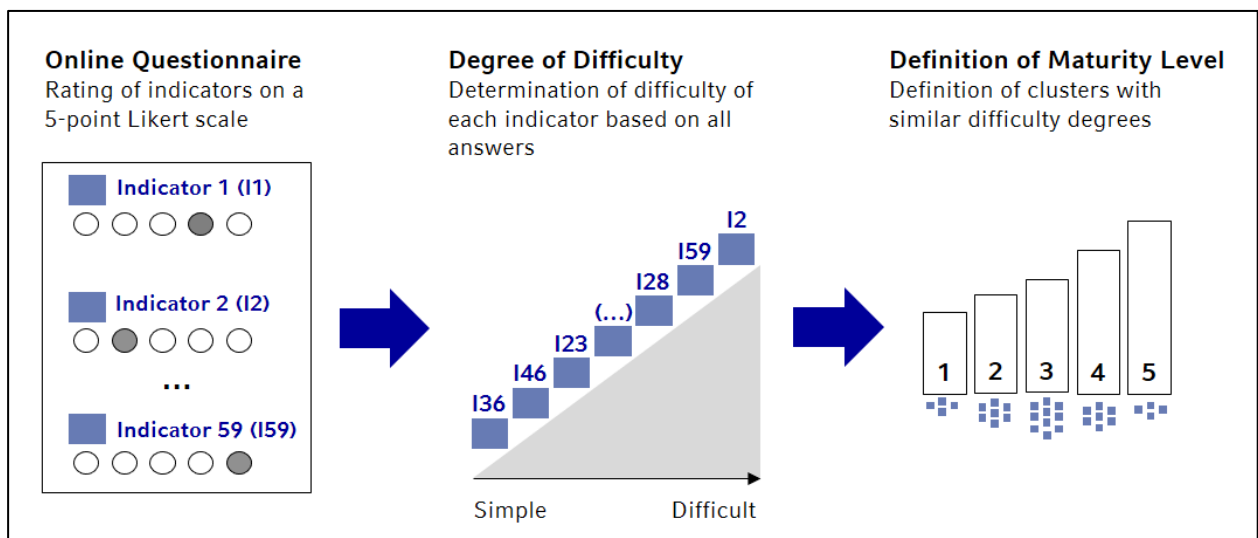


Figure 3: Determination of the Indicator-based Maturity Levels (adopted from IWI-HSG and Crosswalk 2016)

In order to ensure that a company is not categorized in maturity level 5 without fulfilling the requirements of the lower stages, a company can only move up when it meets the criteria of the former stages. This results in a company's cluster maturity level. In addition, a company is rated based on its percentage maturity level which takes all of the fulfilled indicators into account. Each indicator is allocated on the basis of its difficulty a certain maximum number of points. Afterwards, the percentage of the achieved points in relation to the maximum points is calculated, resulting in the percentage maturity level of a company. The overall maturity level is derived by computing the mean value, a numerical score, of the two levels (see Figure 4).

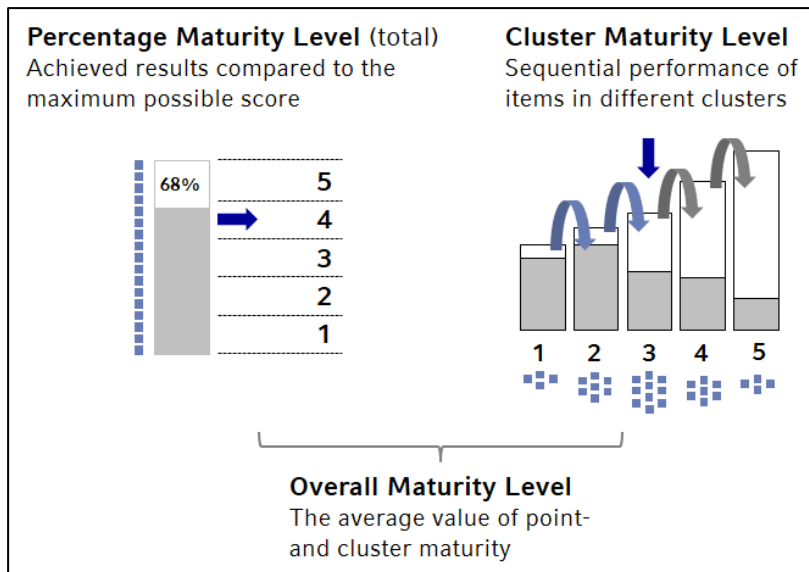


Figure 4: Determination of the Overall Maturity Level (adopted from IWI-HSG and Crosswalk 2016)

The questionnaire of the “Digital Maturity Model” comprising the best practice indicators and a detailed description of the methodology are publically available for download. Therefore, the assessment can be retraced to some extent. Yet, due to the design of the model that requires a larger set of participating companies for the dynamic indicator rating and the required complex mathematical-statistical computation, it is not possible to conduct the assessment independently and to understand the exact composition of the score without the support of the model's issuer.

4.3 Model Comparison

Finally, we classified and compared the two exemplary models by MIT/Capgemini Consulting and IWI-HSG/Crosswalk based on the design parameters presented in Section 3. As shown in Table 2, there are large differences between the models particularly with regard to the design parameters from the categories “general aspects of the model” and “data collection and analysis”. Yet, even based on this systematic comparison of both models, no evaluation or recommendation can be given, which model potentially suits better for assessing a company's digital maturity. The suitability mainly depends on the preference of the management, for instance whether management prefers a more extensive and sophisticated method or whether a quick assessment shall be conducted on a high level.

Design Parameter	MIT/Capgemini Consulting	IWI-HSG/Crosswalk
Number and Focus of Dimensions	<ul style="list-style-type: none"> ▪ 2 dimensions addressing the digital and transformation management intensity 	<ul style="list-style-type: none"> ▪ 9 dimensions addressing a holistic internal and external view of the company
Adaptive Potential	<ul style="list-style-type: none"> ▪ No adaptations possible ▪ No consideration of company specifics 	<ul style="list-style-type: none"> ▪ Regular updates of best practice indicators ▪ Consideration of industry characteristics ▪ No consideration of company specifics
Evaluation and Data Collection	<ul style="list-style-type: none"> ▪ Manual self-evaluation ▪ 10 lead questions for each dimension ▪ Questions with a 7-point Likert scale 	<ul style="list-style-type: none"> ▪ Assisted self-evaluation (online questionnaire) ▪ Best practice indicators (ca. 60) for each dimension ▪ Questions with a 5-point Likert scale
Digital Maturity Level Determination	<ul style="list-style-type: none"> ▪ Simple quantitative approach based on a summarized score for each dimension ▪ No weighting of indicators 	<ul style="list-style-type: none"> ▪ Complex quantitative approach based on combination of various mathematical-statistical score computation procedures ▪ Dynamic weighting of indicators
Digital Maturity Assessment	<ul style="list-style-type: none"> ▪ Company and industry level ▪ Based on 4 levels: Beginners, Fashionistas, Conservatives, Digiratis 	<ul style="list-style-type: none"> ▪ Company and industry level ▪ Based on 5 levels: Testing, Establishing, Consolidating, Structuring, Optimizing
Result Visualization	<ul style="list-style-type: none"> ▪ Numerical score ▪ Maturity level / archetype allocation ▪ Graphical illustration based on a 2x2 matrix 	<ul style="list-style-type: none"> ▪ Numerical score ▪ Maturity level allocation
Benchmarking and Gap Analysis	<ul style="list-style-type: none"> ▪ Benchmarking data on industry level available ▪ No gap analysis possible 	<ul style="list-style-type: none"> ▪ Benchmarking (also on industry level) due to dynamic indicator weighting and best practice matching ▪ No gap analysis possible

Table 2: Model Comparison

5 Conclusion and Outlook

Meanwhile, a large number of maturity models was established for assessing a company's digital (transformation) maturity. For management representatives, digital maturity models mostly can serve as a first introduction into a further and deeper examination of questions with regard to a company's digital transformation. These models are particularly relevant when both meta-capabilities in terms of transformation management and technological-driven changes in products, processes or business models shall be considered from a holistic perspective. Looking at these models in detail, however, we found many differences concerning their actual design as already demonstrated by the comparison of the two exemplary models presented in this Management Report. Thus, existing methods differ largely

from a content perspective (i.e. the underlying dimensions) and with regard to their methodological approaches in terms of data collection, analysis and presentation.

Beyond the content-related and methodological heterogeneity of the various existing digital maturity models, we see several practical issues that apply to almost all of them. To begin with, the models' focus on a general classification of companies in certain levels might be too vague for the majority of medium to larger sized companies. Yet, a digital maturity assessment should be first and foremost a basis for identifying reference points for new digital initiatives and, therefore, should provide a company's top or middle management with a differentiated map of potential areas of action. Thus, in order to establish models that can help management to identify concrete areas of improvement and to derive concrete actions, more specific assessment approaches would be required; these approaches could be analysis tools that focus on selected areas of a company, such as the use and penetration of current concepts in distinct process areas or products.

Another issue is the generic approach that most maturity models take based on standardized questionnaires. The achievement of the state-of-the-art in the context of a digital transformation highly depends on the industrial context and the considered functional area of a company. Therefore, a differentiated and timely review of the state-of-the-art is required in order to provide a proper reference point for the assessment. Also, we found some maturity models to only focus on the technological side of digital transformation by using indicators such as IT investments, which again only provides a very incomplete picture, since digital transformation has implications both from a business and technological perspective. In this sense, it seems also not to be appropriate when assessing digital maturity purely from an outside perspective (e.g. by crawling website data). Lastly, the use of complex mathematical-statistical computation procedures for determining numerical scores and related maturity levels is questionable, since these results are hardly reproducible due to a lack of transparency and, therefore, difficult to communicate to management and other stakeholders.

It might be no coincidence that the majority of existing models was proposed by or developed in collaboration with management consultancies, since these professional service providers have broad knowledge on transformation management and, moreover, can oversee the state-of-the-art with regard to current technological concepts. However, most management consultancies likely perceive digital maturity assessments as entry points into larger consulting assignments and therefore might provide a biased perspective. Therefore, an ideal solution for ensuring objectivity would be to mandate a specialized assessment service provider that has the specific background and is not interested in selling additional consulting services.

Glossary

Information Technologies (IT)	IT describes an indefinite set of technologies for the processing and storage of information as well as for the handling of communication between computers, machines and human beings.
Digitization	Digitization describes the technological transfer of information (flows) and tasks to a computer.
Digital Transformation	Digital Transformation describes the process of change in companies due to an increased use of IT. It reflects the pervasiveness of IT-induced changes, affecting both primary and support activities of a company. The concept is also dealing with the ability of a company to handle the process of digital transformation in a systematic way.
Digital Maturity	<ul style="list-style-type: none"> ▪ <i>Technological interpretation:</i> The extent to which a company's tasks are performed and information (flows) are handled by IT. ▪ <i>Managerial interpretation:</i> The status of a company's digital transformation, describing what a company has already achieved in terms of performing transformation efforts.

References

- Chnias, S. and Hess, T. (2016). Understanding Digital Transformation Strategy Formation: Insights from Europe's Automotive Industry. PACIS 2016 Proceedings.
- CMMI Institute (2016). CMMI Models. Available under: <http://cmmiinstitute.com/cmmi-models>.
- Fitzgerald, M., Kruschwitz, N., Bonnet, D., and Welch, M. (2013). Embracing Digital Technology. Research Report. MIT Sloan Management Review.
- Hess, T., Matt, C., Benlian, A. and Wiesböck, F. (2016). Options for Formulating a Digital Transformation Strategy. MIS Quarterly Executive, 15 (2), 103-119.
- IWI-HSG and Crosswalk (2016). Digital Maturity & Transformation Report 2016. Online Publication.
- IWI-HSG and Crosswalk (2015). Digital Transformation Report 2015. Online Publication.
- Lahrmann, G., Marx, F., Mettler, T., Winter, R., und Wortmann, F. (2011). Inductive Design of Maturity Models: Applying the Rasch Algorithm. In Service-Oriented Perspectives in Design Science Research (Jain, H., Sinha, A. P. and Vitharana, P.), 179-199. Springer, Berlin, Heidelberg and New York.
- Matt, C., Hess, T. and Benlian, A. (2015). Digital Transformation Strategies. Business & Information Systems Engineering, 57 (5), 339-343.
- MIT Center for Digital Business and Capgemini Consulting (2012). The Digital Advantage: How Digital Leaders Outperform their Peers. Online Publication.
- MIT Center for Digital Business and Capgemini Consulting (2011). Digital Transformation: A Roadmap for Billion-Dollar Organizations. Online Publication.
- Österle, H. and Winter, R. (2003). Business Engineering. In Business Engineering – Auf dem Weg zum Unternehmen des Informationszeitalters (Österle, H. and Winter, R.), 3-19. 2nd Edition. Springer, Berlin, Heidelberg and New York.
- Westerman, G., Bonnet, D., and McAfee, A. (2014). Leading Digital: Turning Technology into Business Transformation. Harvard Business Review Press, Boston, Massachusetts.
- Westerman, G. and McAfee, A. (2012). The Digital Advantage: How Digital Leaders Outperform Their Peers in Every Industry. Research Brief by the MIT Center for Digital Business.