DIGITAL MATURITY IN TRADITIONAL INDUSTRIES – AN EXPLORATORY ANALYSIS

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Research paper

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Abstract

The diffusion of new digital technologies renders digital transformation relevant for nearly every industry. Therefore, the maturity of firms in mastering this fundamental organizational change is increasingly discussed in practice-oriented literature. These studies, however, suffer from some shortcomings. Most importantly, digital maturity is typically described along a linear scale, thus assuming that all firms do and need to proceed through the same path. We challenge this assumption and derive a more differentiated classification scheme based on a comprehensive literature review as well as an exploratory analysis of a survey on digital transformation amongst 327 managers. Based on these findings we propose two scales for describing a firm’s digital maturity: first, the impact that digital transformation has on a specific firm; second, the readiness of the firm to master the upcoming changes. We demonstrate the usefulness of this two scale measure by empirically deriving five digital maturity clusters as well as further empirical evidence. Our framework illuminates the monolithic block of digital maturity by allowing for a more differentiated firm-specific assessment – thus, it may serve as a first foundation for future research on digital maturity.

Keywords: Digital Transformation, Digital Maturity, Maturity Models, Exploratory Analysis, Traditional Industries.

1 Introduction

In response to the diffusion of digital technologies such as cloud computing, mobile Internet, social media, and big data (Bharadwaj et al., 2013), we are witnessing fundamental alterations in existing and the creation of new business models, i.e., a digital transformation (Fitzgerald et al., 2013). As a result, firms from all industries (Westerman et al., 2014) must assess their current business model against emerging opportunities and potentially adapt it to the new digital era (Gannon, 2013). To account for this phenomenon, recent literature has established the concept of digital maturity. Although there exist several tantamount terms, such as digital readiness (e.g.Accenture, 2016) or digital transformation index (e.g.,Neuland, 2015), we understand digital maturity as the predominant term and follow Chanias and Hess (2016, p. 4) who define digital maturity as “the status of a company’s digital transformation”. Digital maturity is an important construct for further scholarly inquiry as insights on the paths different organizations take, allow for a more profound understanding of this ongoing socio-technical phenomenon (Tilson et al., 2010). However, in order to realize this potential for knowledge
building, we need to achieve construct clarity (Suddaby, 2010), i.e., a common understanding about the meaning of this construct and its constituting parts. We wish to contribute to this essential goal through our study.

To support managers with the assessment of their firm’s digital maturity, initial practice-oriented literature has already defined scales and corresponding archetypes for the digital maturity of firms and industries. For example, Berghaus and Back (2016) propose five linear digital maturity stages. Similarly, Lichtblau et al. (2015) develop a one-dimensional digital maturity model based on six successive maturity stages and suggest that there are three linear digital maturity archetypes: newbies, beginners, and pioneers. Also PWC (2016) suggests a linear maturity path along the four archetypes: digital novice, vertical integrator, horizontal integrator, and digital champion.

These scales and archetypes have particular advantages for management practice as they aid in understanding the current positioning of a firm and potential needs for action. Nonetheless, these and the majority of the other existing classifications suffer from important shortcomings. Most importantly, the majority of studies suggest a linear path, which would mean that all firms and industries go through the same path of digital transformation with an ultimately desirable state of being fully transformed. We doubt the validity of this concept as from extant empirical work in IS research (e.g., Lucas and Goh, 2009 in photography; Agarwal et al., 2011 in commercial printing; Singh et al., 2011 in healthcare; Piccinini et al., 2015 in automotive; Karimi and Walter, 2015 in newspaper), we know that the phenomenon of digital transformation is context-specific and can take idiosyncratic paths. The logic of a linear digital transformation path thus seems to be a critical oversimplification that invites faulty thinking with the possibility of leading to wrong management decisions.

Therefore, we aim to create a classification scheme for digital maturity that allows for increased variance and reflection. To do so, we investigated the following research question: How can the digital maturity of firms be differentiated? To contribute to answering this question, we conducted a comprehensive literature review as well as an exploratory analysis of survey data on digital transformation amongst 327 managers from traditional industries such as aerospace, automotive, chemicals, electronics, energy, healthcare, logistics, and machinery. To illuminate digital maturity, we investigated the concept’s constituting dimensions and derived archetypes from the empirical data. Furthermore, to get a deeper understanding, we explored the influence of other variables such as firm size, profitability, and ICT skills of employees. The major contribution of this work is that it provides an empirically grounded digital maturity framework that allows a more accurate description of a firm’s maturity levels.

This paper is organized as follows. Section 2 provides a state-of-the-art literature overview on digital maturity levels and archetypes. Section 3 describes how relevant items from the survey were extracted, how they were aggregated on two dimensions, and how these two dimensions were used to identify maturity clusters. Section 4 describes the results from these analyses, namely, the two dimensions to assess digital maturity by and the five resulting archetypes. Section 5 demonstrates the usefulness of the two dimensions by combining them with additional empirical analysis. Section 6 discusses the results, section 7 their limitations and potential avenues for future research, before section 8 concludes.

2 Background

In general, maturity models offer a way to make an object of interest’s progress towards a target state tangible across various management research disciplines – be it for single business units, for an organization, or across whole industries. This concept of maturity refers to the degree of completion or perfection of a desired transformation (Lahrmann et al., 2011) that can also be applied to the context of an organization’s or in a broader sense an industry’s digital transformation.

The literature review conducted by Chianias and Hess (2016) is – to the best of our knowledge – the only available review yet about digital maturity and provides the basis for our investigation. Their
systematic literature review yielded an initial set of 36 studies on digital maturity. The authors decided to exclude studies which either failed to provide sufficient background information on their models’ development process or lacked an organizational or industry focus. This filter process left them with 20 studies which they decided to investigate further. Our review builds up on the 20 studies selected by Chanias and Hess (2016). To account for recently published work, we searched for additional sources by using the most common keywords in the initial data set (e.g., digital maturity, digital readiness, digital intensity) across various common databases (e.g., AIS Library, EBSCO, Google Scholar, Google). Further, we extended our search results via forward and backward referencing (Webster and Watson, 2002). Our final data set includes 25 studies on digital maturity (Table 1).

<table>
<thead>
<tr>
<th>Study</th>
<th>Archetype dimension(s)</th>
<th>Method for archetype development</th>
<th>Digital maturity archetypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accenture (2016)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity scores</td>
</tr>
<tr>
<td>Arthur D. Little (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes, but industry clusters; linear maturity scores</td>
</tr>
<tr>
<td>Arrk Group (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity levels</td>
</tr>
<tr>
<td>Berghaus and Back (2016)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity levels</td>
</tr>
<tr>
<td>Booz and Company (2011)</td>
<td>Linear, one dimension: dig. maturity level per industry</td>
<td>Argumentative</td>
<td>Leaders, midfiel, laggards</td>
</tr>
<tr>
<td>Digital Transformation Group (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; two-dimensional maturity assessment</td>
</tr>
<tr>
<td>dStrategy Media (2014)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>DT Associates (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>Forrester (2016)</td>
<td>Linear, one dimension: digital maturity level</td>
<td>Argumentative</td>
<td>Sceptics, Adopters, Collaborators, Differentiators</td>
</tr>
<tr>
<td>G+F Mittelstandsexperten (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>iDeers (2013)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>Jahn and Pfeiffer (2014)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>Kaufmann (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity levels</td>
</tr>
<tr>
<td>KPMG (2016)</td>
<td>Non-linear, two dimensions: operational effectiveness, transformation intensity</td>
<td>Argumentative</td>
<td>Reactive participant, digital operator, ambitious transformer, smart digitalist</td>
</tr>
<tr>
<td>Lichtblau et al. (2015)</td>
<td>Linear, one dimension: digital maturity level</td>
<td>Argumentative</td>
<td>Newbies, beginners, pioneers</td>
</tr>
<tr>
<td>Lünenendonk (2016)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity levels</td>
</tr>
<tr>
<td>Neuland (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; linear maturity scores</td>
</tr>
<tr>
<td>PWC (2016)</td>
<td>Linear, one dimension: digital maturity</td>
<td>Argumentative</td>
<td>Digital novice, vertical integrator, horizontal integrator, digital champion</td>
</tr>
<tr>
<td>Roland Berger (2015)</td>
<td>Linear, one dimension: industry</td>
<td>Argumentative</td>
<td>3 waves of digital transformation (industries are being affected at different points in time)</td>
</tr>
<tr>
<td>Strategy and Transformation Consulting (2015)</td>
<td>-</td>
<td>-</td>
<td>No archetypes; one-dimensional maturity assessment</td>
</tr>
<tr>
<td>Telekom (2016)</td>
<td>Linear, one dimension: digital maturity</td>
<td>Argumentative</td>
<td>Digital leaders, rest-of-the-world</td>
</tr>
</tbody>
</table>
Our review reveals several insights: All sources stem from the period between 2011 and 2016. The majority was published as practice reports – the exceptions are Berghaus and Back (2016), Neuland (2016), and MIT Center for Digital Business and Capgemini (2011, 2012) – which originated in cooperation with research institutes. Only two of these articles, Berghaus and Back (2016) and Jahn and Pfeiffer (2014), have been published in peer-reviewed outlets. Most of the studies settle for the assessment of an organization’s, or industry’s respective digital maturity. The studies often rely on literature analysis, expert interviews, or quantitative surveys to develop their digital maturity models, but seem to lack a sophisticated approach in the derivation of their respective digital maturity levels and archetypes. The dominant method used to develop the dimensions is argumentative. Only one study, Deloitte (2013), used an empirical approach. The developed levels and archetypes are one-dimensional in most cases. The major exceptions in this regard are MIT Center for Digital Business and Capgemini (2011, 2012) and KPMG (2016) which each suggest two non-linear dimensions to classify their maturity archetypes.

Even though the proposed archetypes are useful, our literature review suggests three substantial shortcomings in the existing work. First, most of the studies are non-academic and, thus, may miss the necessary methodological rigor required to provide a basis for further research in this area. Second, most of the existing archetypes have not been empirically grounded, which may again question the rigor, and also the empirical relevance, of the existing models. Third, and this is the most critical issue, most studies assume a linear evolutionary path for organizations undergoing digital transformation. In our view, the assumption of a linear relationship among the archetypes does not hold true. Depending on various organizational characteristics, such as company size, business model, or industry, such a linear relationship does not seem to be the optimal answer and, such models may not offer sufficient guidelines for companies undergoing digital transformation endeavors.

3 Exploratory Empirical Analysis

The objective of this research was to identify a more fine-grained, empirically grounded classification of a firm’s digital maturity. To do so, we decided to employ an exploratory multi-industry research design (e.g., Hitt and Brynjolfsson, 1997), for two reasons. First, the literature review in the previous section has revealed that practically no scientific literature on digital maturity exists and that practice-oriented literature has severe shortcomings. Second, a case study or singly industry research design would have hindered the generalization of our findings and thus conflict with our initial goal to provide reliable insights across industries.

For our analysis, we drew on a survey on digital transformation amongst German managers, which was hosted by the Bundesverband der Deutschen Industrie (BDI)\(^1\). The objective of the survey was to gain insights on how well-prepared traditional sectors from the German economy are for digital transformation. For the study, eight such traditional sectors were in focus: aerospace, automotive, chemicals, electronics, energy, healthcare, logistics, and machinery. To gain a significant population size in each sector, a compensation-based respondent panel from an online professional marketing firm was used. The respondents had to assume themselves capable of assessing the digital transformation maturity of their firms and work on a management position, e.g., in the IT department or business development. The survey was open until at least responses were gathered from each sector, resulting in 327 useful responses in total – exceptions were energy (22 responses) and aerospace (7 responses). The

\(^1\) The BDI is the umbrella organization of various German industry organizations.
questionnaire covered 36 items, including descriptive information of the firms (e.g., industry segment, firm size, and profitability), the assessment of the digital transformation, ICT budget and equipment, political demands with regards to digital transformation, and some other focus topics (e.g., cyber security).

To analyze the survey data, we proceeded in two phases. First, we identified the questions which were either addressing the impact of the digital transformation on the firm, or the firm’s reaction to account for this impact and conducted a factor analysis to assure the discriminant validity of the items. Second, we clustered the firms from the survey across these two dimensions. All analyses were conducted in SPSS 23.

### 3.1 Phase 1: Empirical Identification of Dimensions

For extracting the most relevant questions from the survey we consulted the definition of digital maturity, i.e., “the status of a company’s digital transformation” (Chaniás and Hess, 2016, p. 4), as well as the findings from the literature review, i.e., the need for reflecting firm-specific rather than only linear paths. Thus, on the one hand, we wanted to exclusively include questions related to a firm’s status of the digital transformation; on the other hand, we wanted to include sufficient questions for measuring different impacts and reactions of firms to the digital transformation. As a result, we extracted four questions directly addressing the digital maturity of the firms, each rated on a five point scale. For instance, we included the question “How intensively has your firm already assessed potential challenges of the digital transformation?” but excluded the question “How do you assess the opportunities for your industry to benefit from the increasing digitization?” as this question related to the industry, not the specific firm.

Next, we conducted a factor analysis to assess the validity of the constructs and to reveal the most important factors of digital maturity (similar to e.g., the exploratory analysis of Soliman and Janz, 2003). We applied the elbow rule to the scree plot to determine the number of factors, indicating that a two factor solution would be most useful. The first factor explains 62% of the variance and the second factor accounts for additional 19%. The factor loadings of all items were greater than or equal to 0.7 and Cronbach’s Alpha (Cronbach, 1951) was 0.888, which means a very good internal consistency (DeVellis 2012).

Afterwards, we carefully reviewed and discussed the two underlying questions for each factor (Table 2). We decided to name the first factor “digital impact” as both questions concerned the impact that the digital transformation may have on the focal firm. For the second factor, we agreed on “digital readiness” as both questions assigned to this factor asked, if the interviewee considered her or his firm ready for upcoming changes.

<table>
<thead>
<tr>
<th>Question</th>
<th>Factor 1: Digital impact</th>
<th>Factor 2: Digital readiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you assess the impact of the digital transformation on your firm’s innovation capabilities?</td>
<td>0.865</td>
<td>0.211</td>
</tr>
<tr>
<td>Overall, will the digital transformation affect your firm positively or negatively?</td>
<td>0.842</td>
<td>0.259</td>
</tr>
<tr>
<td>How do you assess the digital maturity of your firm (i.e., readiness with regards to the digital transformation and the ability to benefit from the increasing digitization)?</td>
<td>0.165</td>
<td>0.890</td>
</tr>
<tr>
<td>How intensively has your firm already assessed potential challenges of the digital transformation?</td>
<td>0.331</td>
<td>0.795</td>
</tr>
</tbody>
</table>

*Table 2. Factor loadings from the factor analysis.*

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2 In addition, several additional questions were used to assess how they potentially affect the digital maturity of a firm (e.g., firm size, see Section 5),
3.2 Phase 2: Calculation of Firm Clusters

The objective of the second phase was to identify empirical maturity clusters of firms along the dimensions, i.e., “digital impact” and “digital readiness”, identified in the previous phase. To do so, we conducted a cluster analysis, which serves as a method to form groups of objects with objects in same group being as similar as possible and the difference between groups being as dissimilar as possible (Kaufman and Rousseeuw, 2005). We followed the recommendation from Punji and Stewart (1983) who compared different clustering methods for their performance and found that two stage approaches, combining a hierarchical and iterative partitioning, delivers the best results.

First, a hierarchical approach has the objective of identifying a suitable number of clusters. We used Ward’s method, which is an agglomerative clustering procedure, starting with the combination of the two closest objects into one group and repeating this step until all objects are classified (Landau and Everitt, 2004). Thus, in our case it took 326 iterations to classify the 327 data sets. To measure the distance between two objects, we used the squared Euclidean distance. The analysis of the coefficients and the dendrogram revealed that a three, a five, and also a six cluster solution would be suitable.

Second, the iterative partitioning procedure has the objective to specify objects of each cluster more accurately. We applied the k-means method, which goes through several iterations of partitioning the objects into a predefined number of clusters, until each object is closer to the mean vector of its own group than to the mean vector of any other group. As the number of suitable clusters has not been clearly determined by the hierarchical clustering in the first step, we calculated the three, five, and six cluster solution independently and evaluated them for their explanatory power (similar to e.g., Malhorta et al., 2005). Finally, we decided to use the five cluster solution as it was most explanatory for understanding archetypical combinations of the two digital maturity dimensions.

4 Results

The results of this research are twofold. First, we have empirically derived a classification scheme for digital maturity archetypes. Second, we have calculated digital maturity clusters from the survey data.

4.1 Digital Maturity Scales

The factor analysis has revealed two dimensions for measuring digital maturity. The first dimension can be labelled as digital impact as it describes the effect of the digital transformation on a focal firm. The second dimension can be labelled digital readiness as it relates to a firm’s state of preparedness with regard to digital transformation. Combined, these scales span a two-dimensional area allowing for a comparative analysis of the digital maturities of different firms.

4.2 Digital Maturity Clusters

The five empirically derived digital maturity clusters differ along the two aforementioned dimensions of digital impact and digital readiness. The mean value for each dimension aids in better understanding each of the five clusters (Figure 1).
Figure 1. Firms from the survey clustered by their digital maturity.

The first cluster covers firms that were, in comparison, weakly affected by the digital transformation and therefore said digital transformation was less important to them. These firms are comparatively smaller (35% with less than 250 employees vs. 19% in overall sample), often stem from the health (19% vs. 13% in overall sample) or the electronics (23% vs. 13% in overall sample) industry, often have a small IT budget (2% of revenues for 23% vs. 5% in overall sample), and often have employees with low or very low ICT skills (34% vs. 7% in overall sample).

The second cluster describes firms that are likely to be significantly affected by the digital transformation, but failed to prepare for it. These firms are comparatively small (48% with less than 250 employees vs. 19% in overall sample), more often stem from the Automobile industry (26% vs. 14% in overall sample), and tend to have employees with low or very low ICT skills (17% vs. 7% in overall sample).

The third and the fourth cluster cannot be clearly characterized with regards to their digital maturity, as the respondents assumed their firms to be affected in a comparatively stronger manner, but also as being more sufficiently prepared. Firms from the third cluster compare to the average firm in many aspects, but have comparatively few employees with high or very high ICT skills (18% vs. 40% in overall sample). Firms from the fourth cluster compare to the average firm in many aspects, but comparatively have many employees with high or very high ICT skills (59% vs. 40% in overall sample).

The fifth cluster contains firms who have realized that they will be affected very strongly and so, have also prepared accordingly. These firms are comparatively more profitable (EBIT >10% for 47% vs. 29% in overall sample), have lower revenues (revenue <EUR 50 m for 38% vs. 30% in overall sam-
ple), have a high IT budget (IT budget >10\% of revenues for 34\% vs. 15\% in overall sample), and have employees with very high ICT skills (34\% vs. 6\% in overall sample).

5 Further Empirical Evidence

To further illustrate the relevance of the proposed classification scheme, this section provides additional empirical evidence by testing other variables from the survey along the two dimensions. We extracted the variables firm size, industry, profitability, revenue, B2B vs. B2C, IT budget, and ICT competency of employees. All of these variables were either ordinal or categorical. For each of these variables, we tested whether they may result in different mean values along the two dimensions “digital impact” and “digital readiness”. As all independent variables – except for B2B vs. B2C – had multiple categories, we used the analysis of variance (ANOVA). The necessary preconditions for this method (Landau and Everitt, 2004) – normality (tested by Kolmogorov-Smirnov and Shapiro-Wilk test) and homogeneity of variance (tested by Levene test) were fulfilled in most, but not in all of the cases. We further elaborate on this issue in the limitations section. The results of the ANOVA indicate if significant differences exist among categories of each independent variable. This difference is indicated for six variables along each of the two dimensions (Table 3).

<table>
<thead>
<tr>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>F (Digital transformation impact)</td>
<td>2.948</td>
<td>0.717</td>
<td>2.389</td>
<td>2.173</td>
<td>1.005</td>
<td>2.562</td>
<td>25.951</td>
</tr>
<tr>
<td>p (Digital transformation impact)</td>
<td>0.033**</td>
<td>0.658</td>
<td>0.038**</td>
<td>0.072*</td>
<td>0.317</td>
<td>0.027</td>
<td>0.000***</td>
</tr>
<tr>
<td>F (Digital transformation readiness)</td>
<td>5.759</td>
<td>0.825</td>
<td>6.410</td>
<td>4.500</td>
<td>0.027</td>
<td>10.212</td>
<td>28.908</td>
</tr>
<tr>
<td>p (Digital transformation readiness)</td>
<td>0.001***</td>
<td>0.567</td>
<td>0.000***</td>
<td>0.001***</td>
<td>0.869</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
</tbody>
</table>

***Significance at 1\% level; **significance at 5\% level; *significance at 10\% level.

Table 3. Results from the ANOVA.

Whereas Table 3 explains which independent variables have a significant impact on the two dependent variables, it does not give any indication on how the dependent variables are affected. Therefore, we visualized the mean values of the different categories from the independent variables for digital transformation impact and readiness in Figure 2. For instance, the first diagram in Figure 2 shows that firms with a size of 5,000 and more employees on average expect a digital impact of 3.76 and have a digital readiness of 3.45. In contrast, firms with a size of 50-249 employees on average expect a digital impact of 3.49 and have a digital readiness of 2.97.
Figure 2. Mean values for independent variables along the two dimensions of digital maturity.
As a result, the combination of Table 3 (i.e., the test for significance) and Figure 2 (i.e., the visualization of the mean values) allow for better interpreting the findings: firms with more employees seem to be more strongly impacted (p<.01) and better prepared (p<.05) for the digital transformation. With regards to the industry cluster, no significant effects could be identified. A high EBIT margin seems to predict a slightly stronger impact (p<.05) and clearly better prepared firms (p<.01). Even though revenue seems to have a significant impact, it is difficult to identify a clear trend if firms with less or more annual revenue are more strongly affected or better prepared. A difference between firms operating in the B2B sector and B2C sector could not be identified. Firms with a higher IT budget seem to be impacted more strongly (p<.05) and better prepared (p<.01) – an exception might be firms with an IT budget >20% (n=8). Finally, the ICT competency of employees seems to have a significant impact on both scales of digital maturity (p<.01) with higher skilled employees meaning higher impact and readiness.

6 Discussion

We know from management fashion theory (Abrahamson, 1991) that the emergence of hypes and fads is connected to fundamental uncertainty in managerial practice. To reach more clarity, managers look for advice externally. Thus, practice-oriented literature has recently introduced and emphasized the concept of digital maturity, illustrating the magnitude of change for incumbent firms and providing assistance on the path to be taken. Some assumptions that these studies rely on, however, can be risky and potentially lead to faulty decisions and perceptions concerning digital transformation. Most importantly, these studies neglect potential differences in the impact of the digital transformation for each firm, but rather suggest that there is an ultimate state of a fully digitalized firm and that all firms should thrive for this same ultimate state. Our empirical data, however, indicates that this is an oversimplification. The factor analysis suggested that it is useful to differentiate between the expected impact of the digital transformation on a specific firm and the perceived readiness of the firm for the digital transformation. Amongst some other empirical evidence, also the findings from the cluster analysis indicated the usefulness of these two dimensions. For instance, some firms who expect to be strongly affected are yet comparatively weakly prepared (cluster 2) and some other firms expecting to be affected less strongly are already better prepared (cluster 3) – such important differences could not be explained with formerly predominant linear classification schemes of digital maturity.

In some other points, our model on digital maturity is in accordance with existing literature. For one, our model’s first dimension, digital impact, finds evidence in some other existing work on digital maturity archetypes. For instance, KPMG (2016) defines four digital maturity archetypes subject to an organization’s operational effectiveness and – similar to our study – its transformation intensity. Our model’s second dimension, digital readiness, acknowledges the importance of the status quo of an organization’s digital transformation, which is referred to as digital maturity level by most other studies (e.g., Berghaus and Back, 2016; Forrester, 2016; Neuland, 2015; PWC, 2016). However, even though the two dimensions can be found in existing research, their combination as a two-dimensional model is rare, as most other studies assume linear models. Only the MIT Center for Digital Business and Capgemini (2011, 2012) and KPMG (2016) share our understanding that one, often linear dimension is insufficient to appropriately describe digital maturity and assumed two-dimensional models.

Thus, with our approach, we contribute to the scholarly path to achieve construct clarity (Suddaby, 2010) with regard to digital maturity, by providing explorative empirical insights that can be compared and contrasted with existing conceptual work. Thus, in the spirit of the recent call by Grover and Lyytinen (2015, p. 285) for more data-driven research, we aim to “to discern regularized empirical patterns of importance, and thereby to influence the intellectual framing of what we need to know”. Moreover, we want to contribute to a more differentiated view on the kind and magnitude of digital transformation in the respective settings and shed some light on the current state of organizations in that regard. With the increasing ubiquity of this topic in scholarly and practitioner conversations, arises the
danger of the emergence of unreflected fashions and fads (Abrahamson, 1996), as well as the bandwagon phenomena (Fiol and O’Connor, 2003). This danger has explicitly been observed in relation to IS-enabled developments in the past (Wade, 1995; Baskerville and Myers, 2009). With this work on digital maturity, we try to contribute to counteracting these dangers and to providing a perspective that allows for a mindful assessment of digital transformation in research and practice (Swanson and Ramiller, 2004).

Even though it might be possible to define further dimensions of digital maturity – surveys with more questions on digital maturity are being conducted – a two-dimension solution has the advantage of a more easily understandable graphical visualization. The two dimensional solution also appears reasonable and somehow exhaustive for some various other reasons. The two dimensions target two very important aspects when it comes to managing organizational transformation. We know from the established body of literature on fundamental organizational change that incumbents can and have survived disruptions (e.g., Danneels, 2004; Markides, 2006; Yu and Hang, 2010). Regarding the pivotal factors for incumbent survival, research has pointed to an important conceptual dichotomy. For instance, Lucas and Goh (2009, p. 54), summarizing their findings on the Kodak-Case, state: “The most important observation is that management has to recognize the threats and opportunities of new information and communications technologies and marshal capabilities for change”. Thus, the first decisive factor is the cognitive managerial ability to recognize the kind and magnitude of emerging change. This is what the first dimension of our framework, digital impact, refers to. Second, managers need to prepare their organizations to compete with fundamentally reconfigured resource bases. This is what the second dimension of our framework, digital readiness, describes. Apart from that, more specifically, as Kranz et al. (2016) show, the ability to fundamentally innovate business models, an imperative in organizational transformations (Besson and Rowe, 2012), is dependent on managerial perception and the organizational preparedness to swiftly alter its resource base.

However, both dimensions are related to fundamental organizational challenges. First, accurately assessing upcoming change as well as preparing the organization for it, is far from trivial for managers from traditional industries. As literature on path dependency (Sydow, 2009) shows, there is a strong tendency to reinforce the current path of development and to blind out potential deviations, that maybe crucial in a situation of organizational transformation. It is particularly challenging for incumbents to find radical new cognitive frames for value creation and value capture (Bohnsack et al., 2014). Our research underpins the transformative impacts (Lucas et al., 2013) of IS in the digital era, as also incumbent managers from traditional industries realize it. However, diversification in the perceived digital impacts also point to needed differentiation and reflection to avoid actionism and oversimplification (Wang, 2010). Second, organizational inertia often inhibits fundamental organizational change, even when it is recognized and well understood as to its consequences by managers (Tripsas and Gavetti, 2000; Besson and Rowe, 2012). The diversity regarding the digital readiness dimension in our findings point to the challenges experienced especially by traditional incumbents in digital transformation. These challenges might result from specific characteristics of these industries that regularly have been and still do depend on physical core products or processes that, due to their enduring importance, need to be a part of their digital transformation (Piccinini et al., 2015). The existing knowledge on digital disruption (e.g., Karim and Walter, 2015) cannot simply be extrapolated, especially since these phenomena were mostly documented in media and entertainment industries and thus may not apply in the same way to these industrial-age (Yoo et al., 2010) contexts.

Our research has several implications for managerial practice as it demonstrates that digital transformation may have disruptive potentials for existing firms, but that the impact must not be exaggerated, but systematically analyzed with reasons grounded in the specific organizational situation (Swanson and Ramiller, 2004), before appropriate measures are defined. The findings from this research suggest that firms will be affected with a different impact by the digital transformation and that, in the future, it will not be desirable for all firms to reach an ultimate state of digital transformation (as several of the proposed linear digital maturity archetypes in informal literature suggest).
7 Limitations and Future Research

Our study is subject to several limitations that should be addressed by future research. First, the study is of an exploratory nature and discovers new dimensions to assess digital maturity. In doing so, it offers only the first step to a far away goal. Future research could make a significant contribution by employing formal construct development procedures to measure the two proposed dimensions, digital impact and digital readiness, more accurately. Second, the requirements of the ANOVA, i.e., normality (e.g., Kolmogorov-Smirnov-Test) and homogeneity of variance (e.g., Levene-Test) were not fulfilled in all cases. Nonetheless, in most cases it was fulfilled and the ANOVA is rather robust against these deviations (e.g., Schmider et al., 2010). Third, the survey data that we used was based on the perception of individual interviewees. Although prior research (see Govindarajan and Kopalle, 2006) has shown the usefulness of subjective measures especially in the context of organizational change and innovation, they are, of course, always susceptible to individual biases. For instance, our survey data suggests that CEOs tend to assess the digital readiness more positively than other survey participants. Thus, future research could aim at surveying multiple interviewees from one firm (e.g., from business and IT as well as from operational and top-management) to more accurately assess digital maturity. Another option would be to develop other measures for the two digital maturity dimensions that do not depend on the individual assessment of a firm’s employees. Fourth, by using the available data sample we could not show statistically significant differences in digital maturity for some of the variables, which we initially assumed to have a significant impact. For instance, we assumed the digital impact to be different between B2B and B2C firms or the digital readiness to be different from industry to industry. Therefore, a combination of larger data samples and more specific questions or other measures on digital impact and digital readiness might reveal additional insights on these and other variables. Further, we point to more qualitative, in-depth case study researchers to delineate the respective characteristics of digital transformation in different industry settings, and describe the unique challenges of incumbent firms as they try to evolve their digital maturity. With regard to the influential factors, our data suggests that ICT skills as well as IT budget and readiness are highly correlated. Further research could differentiate what specific skills are relevant and how IT budgets are spent to shed more light on these interesting hints.

8 Conclusion

The objective of this research was to take a first step of a long way towards construct clarity by developing a more differentiated classification scheme for assessing the digital maturity of a firm. The result was a two-dimensional framework that allows for measuring digital maturity as a combination of the impact of digital transformation on the focal firm and the readiness of the focal firm to master upcoming changes. Through our framework, we contribute to a better understanding of the digital transformation as we have offered multiple avenues for future research targeted at a more fine-grained development and exploration of these two scales. To managers, the perspective of firms taking different paths to prepare for digital maturity will likely be more useful, than the oversimplification of linear paths.
References


