Copenhagen Business School 2017

AN EXPLORATORY STUDY OF DIGITAL TRANSFORMATION MATURITY MODELS

How can digital maturity models be defined, classified and selected?

MSc in Business Administration and Information Systems(E-business)

KAN-CEBUO2000U-Master's Thesis

Date of submission: 15th of May2017

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No.of characters: 166.870 excl. tables & figures

No.of pages: 80

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ACKNOWLEDGEMENTS

This thesis complements my two years master program in MSc in Business Administration and Information Systems (E-business) at Copenhagen Business School, 2017.

First, I would like to thank my supervisor Lester Allan Lasrado and my co-supervisor Till Winkler for always offering personal sparring through their commitment, dedication and academic competences, which have helped me to reach the end of this thesis.

At last but not least I would like to thank my family and friends for their love, support and understanding during the whole process. A special thanks to my dad, who taught me that hard work and dedication is the key to success, without his support and encouragement I had not reached this stage today.

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ABSTRACT

In recent years digital maturity models have been developed in order to help companies to address questions about the company's overall status with regards to its digital transformation by assessing their digital maturity. However, the existence of a wide range of digital maturity models result in that companies cannot see the wood for the trees, hence, companies risk selecting a maturity model that do not fit the organizational purpose of the maturity assessment. This is the main research problem and motivation behind this thesis, and answers following research question:

How can digital transformation maturity models be defined, classified, and selected?

The research question is answered through an exploratory mixed-model study and provides a comprehensive analysis of existing digital maturity models (N=25). First a qualitative content analysis has been conducted in order to answer how digital maturity models can be defined by examining what is measured and how the maturity is measured, which is summarized in a conceptual model in order to strengthen the foundation of these models in academia. Secondly, in order to answer the second part of the research question a quantitative cluster analysis of the sampled models and a multidimensional scaling have been conducted to create a meaningful comparison, distinction and classification of the sampled maturity models. Lastly, the insights gained from the qualitative and quantitative analyses are used to create classification-trees that help practitioners to select the maturity model that best fits their organizational needs.

The main findings of the thesis are that digital maturity models assesses the status of a company's digital transformation by measuring what the company has already achieved and transformed in terms of their digital initiatives in five main capability areas. Furthermore, the sample of 25 maturity models has been classified in three clusters. Based on the most common properties in each cluster, the classification analysis has shown that the purpose of use and the methodological approach are linked to each other, as the assessment is addressed in more detail when moving from the beginner-oriented (descriptive) to benchmark-oriented (comparative) to the most detailed namely the consulting-oriented maturity models (descriptive, prescriptive, comparative) with regards to the data collection, determination and presentation. The classification-trees are based on aforementioned insights, which help the practitioner to select the most appropriate maturity model in a systematic manner.

1. INTRODUCTION

In the recent years a number of digital maturity models have been developed to assess the status of a company's digital transformation, where the majority of these models are developed mostly by management companies in a practical context. Yet, so many digital maturity models may result in that companies cannot navigate through the jungle of maturity models and thus ending up by choosing an inappropriate model in relation to their initial purpose and their organizational needs. From a quick glance, many of these models seem to use a similar assessment, in fact, a closer look on these models reveals that there exist several differences between these models. Hence, the purpose of this thesis is to explore the large number of existing digital maturity models and based on that, define, classify and come up with suggestions that allow a well-informed digital maturity model selection, which is the most appropriate depended on the needs of the company and its stakeholders.

1.2 RESEARCH BACKGROUND

Individuals are entering a digital revolution, where businesses, society, friends and family are engaging through digital technologies. Customers are using these digital technologies and services to decide where to go, what to do, and what to buy, at the same time businesses are going through digital transformations by exploiting the advantages of the newest technologies in order to differentiate themselves from their competitors (Berman & Bell, 2011). Although the implications of digital technologies and its impact on businesses are not new, the digital economy has entered a new age that presents new challenges and opportunities for all businesses and their CEOs (Capgemini Consulting, 2017). The digitization brings significant changes in the way *"we work, communicate and sell"*, which have triggered the digital transformation (Capgemini Consulting, 2017).

"People, not technology, are the most important piece in the digital transformation puzzle"

- Capgemini Consulting (2017)

The digital transformation do not only affect the competitive position, but affects multiple areas of an organization with many stakeholders involved e.g. people from marketing, HR, product development (Berghaus et al, 2016). These stakeholders need to develop a common culture and understanding of the activities and their prioritization in digital

transformation in order to avoid failures, reflecting above quote by Capgemini Consulting (2017). Hence, directors must constantly reconfigure the organization to ensure that the technology-enabled change leads to productivity gains and competitive advantages while considering where and how their current operations and business models can take advantages of new digital technologies (ibid).

"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change.

\- Charles Darwin in Leon C. Megginson (1964)

In order manage the technology-enabled change in the best manner requires a vision, strategic planning and implementation and to support this change the companies need to develop a viable digital transformation strategy. Hence, digital transformation is a matter of managers of the company being adaptable to the change the organization undergo due to the advantages and challenges of integrating digital technologies into the business, reflecting above quote by Darwin.

"Digital transformation strategy drives digital maturity."

-Kane et al. (2015)

The 2015 Digital Business Global Executive Study and Research Project by MIT Sloan Management Review and Deloitte (Kane et al, 2015) shows that only 15% of the companies at the early stages of what they call digital maturity, states that their company has a clear digital transformation strategy, whereas among the digitally maturing companies, more than 80% have a strategy. Therefore, the CEO's and managers might raise questions about the company's current state with regard to its digital transformation to develop a viable digital transformation strategy (Chanias & Hess, 2016). A digital maturity model can help the companies to assess and understand where their existing business lie from a digital perspective and to identify possible areas of actions in order to truly transform the company for future (Deloitte, 2015; Berghaus et al, 2016).

1.3 RESEARCH PROBLEM

A study found that what differentiates digitally mature companies from the rest is that they have developed a clear digital transformation strategy combined with leadership to drive and manage the transformation in order to become digital mature, namely a digital leader (Kane et al, 2015), if they don't do that, the term stays as a buzzword. Digital maturity models can be an essential tool to digital transformation as they give the company insights into where they are now, where can they be and what they need to do in order to get from one point to another point to become digitally mature in order to ensure that digital transformation do not become a buzzword (Turner, 2016).

Besides the practical relevance of digital transformation and digital maturity models, researches should become aware of its academic contribution and practical implications. The existence of a wide range of digital maturity models may make it difficult to select the most appropriate model according to the organizational objectives and companies thus risk selecting a maturity model that do not fit organizational needs. This is the main research problem and motivation behind this thesis, where three research gaps have been identified regarding digital transformation maturity models.

Research gap 1 - limited literature on digital transformation maturity

An initial search on digital maturity and digital transformation maturity (interrelated) do not derive articles that define the term or speak about it to an acceptable extent. However, I got hold of a management report by Chanias & Hess (2016) through my supervisors, which explores the area of digital maturity models, but taking into account that it is a management report it still reflects the gap I faced in the beginning of my research. Unlike a number of articles on digital transformation from a perspective of strategy development (Hess et al, 2016), or in relation to challenges and opportunities arising from the digitization (i.e. Henriette et al, 2015) as well as in relation to digital innovation (i.e. Yoo et al, 2010), no academic writing existed on the digital transformation in relation to maturity and maturity models. Hence, this reflects that there is no or limited conceptualization of digital transformation maturity in academia.

Research gap 2 - limited scientific knowledge on the building blocks of digital transformation

In continuation of knowledge gap 1, I acknowledge that studies from academic researches i.e. Berman, 2012; Westerman et al, 2011 states that digital transformation affects various aspects of company, however, only Henriette et al (2015) and Matt et al. (2015) studied which digital capabilities are impacted by the digital transformation. Hence, to my knowledge theories on digital transformation are lacking, which also result in a large gap in digital maturity research, as both terms are somehow interrelated, as the digital maturity (model) assess the digital transformation. I believe that the academic area need a theoretical frame and discussion on which digital capabilities contributes to digital transformation. This can move the digital maturity models out of the practical management domain and aid to a new research domain. However, it must be noted that the purpose of this thesis is not to build a theory, but instead examine how digital maturity can be defined by existing maturity models, where this thesis should be seen as a first step towards a theory building of digital transformation maturity.

Research gap 3 - no overview of digital maturity models

A initial search on digital maturity models in scientific databases in the beginning of this research process only derived two maturity models by The Institute of Information Management at the University of St.Gallen (Berghaus et al, 2016) and by MIT Sloan & Capgemini (Westerman et al, 2014). Nevertheless, in the academic literature there are attempts for assessing digital capabilities by for example the revenues created or investments related to digital technologies (Chanias & Hess, 2016). However, these indicators do not give a holistic picture of the overall digital transformation, therefore there is a need for multidimensional maturity models (ibid). A wide range of maturity models by management consultancies exist, but I could not find any overview or comparison of these models based on their capability areas and design parameters that can help users to select a maturity model that best fits their needs. This means that companies do not have an overview of existing digital maturity models, which results in practitioners may use time and effort on searching through search engines and examine each model one by one. This may further result in that practitioners in companies cannot make a well informed choice when starting their digital transformation.

1.3.1 RESEARCH QUESTION

The research question is based on the motivation behind the thesis, namely that the existence of a wide range of digital maturity models may make it difficult to select the most appropriate model and above identified three knowledge gaps; 1) a unexplored research area, 2) only two academic researches about which digital capabilities are a part of digital transformation 3) no comparison or classification of existing digital maturity models.

RQ: *How can digital transformation maturity models be defined, classified, and selected?*

Above research question is inspired by a research by Amy van Looy (2014), who conducted a comparative study on a sample of business process maturity models. The three identified knowledge gaps in this thesis show that digital maturity models are a unexplored area in academia, for which reason the research question is explorative. The main purpose is thus to gain insight into digital transformation maturity by investigating existing digital maturity models, which contributes to the academic research domain and to form a basis for further theory building by other researchers. The first part of the research question aims to answer what is measured and how digital transformation maturity is measured, this will result in a conceptual model of digital transformation maturity models in order to strengthen the foundation of these models in academia. In order to answer the second part of the research question it is first relevant to create a meaningful comparison and distinction of the sampled maturity models. Lastly, the knowledge gained from the conceptual model and the classification based on similarities will provide suggestions and a classification-tree that help practitioners to select the most appropriate maturity model.

2. METHODOLOGY

The term methodology refers to how a research should be undertaken (Saunders et al., 2009). The author of this thesis acknowledge the importance of having a understanding of the methodology to make informed choices about the research. For this reason, this section will discuss the philosophical assumption upon which the research is based and the methods adopted in order to answer the research question.

2.1 RESEARCH PHILOSOPHY AND APPROACH

In IS research one can observe a large range of discussions on research philosophies (Niehaves, 2007). A research philosophy is understood as the worldview the researcher undertakes on certain ontological and epistemological assumptions. The former is concerned with the assumptions about the researcher's view of the nature of reality and the latter is concerned with how the knowledge is acquired during the research (Lee, 1991; Weber, 2004). The emphasis has often been placed on positivism and interpretivism. The positivistic ontology believes that the world is external and that the reality is objective in any research area independent of social actors and regardless of the researcher's perspective (Saunders et al, 2009). The interpretivist ontology believes that the world around is socially constructed and that the reality is multiple and relative (ibid). The epistemology differs from the fact that positivist believes that only observable phenomena can provide credible data and facts, thus they focus on causality and law generalizations to uncover single and objective reality (ibid). Whereas, the goal of the interpretivist research is to understand and interpret the subjective meanings and social phenomena in human behavior rather than generalizing and predict causes (ibid). Nevertheless, I am critical of the positivist tradition from the point of view of this thesis since social world of maturity models in a business and management context are too complex to be theorized as definite laws in the same way as the physical science (ibid). Researches within methodology often argue that if one sympathize with such a view the research philosophy is likely to be interpretivist (ibid). However, since interpretivism advocates that the researcher needs to understand differences between humans in our role as social actors, which emphasis the difference between conducting research among people rather than objects, this research is neither seen solely from a interpretivist perspective, as this research is not studying the human role as social actors. If this research adopted an interpretivist philosophy I would have to adopt an empathetic

stance and entering the social world of for example CIO's and study how they use digital maturity models to get valuable insights in order to create actionable plans for the company, from the CIO's point of view.

The debate on research philosophies is often framed as a choice between the positivist or the interpretivist research philosophy. However, since I believe that the research question do not suggest either a positivist or interpretivist philosophy, it confirms the pragmatist's view, where one acknowledge that it is possible to work with variations in the epistemology and ontology, since the most important part of pragmatism is that the research problem and question define the research strategy and design (Saunders et al, 2009). Hence, this thesis thinks of the philosophy adopted as a continuum rather than opposite positions (Tashakkori & Teddlie, 1998).

As argued in the introduction, the scarce literature on digital transformation maturity in comparison to other types of maturity models i.e. Business Process Maturity Models, indicates an unexplored research domain in contrast to the large number of existing digital maturity models. Hence, this research is an exploratory study as the valuable means is to find out *"what is happening"* (Saunders et al,2009, p. 139) by seeking new insights into the area of digital maturity models as this field encounters three research gaps as identified in the introduction. Due to the unexplored area of digital transformation maturity in the literature an inductive approach is applied, where the purpose is to define, classify and make suggestions on how to select one, from the sample of existing digital maturity models. Hence, the purpose of applying an inductive approach is to connect the research problem to the sample of the investigated digital maturity models.

In order to answer the research question of this research through an inductive-exploratory study it is highly appropriate to adopt both qualitative and quantitative methods, which determines the adoption of a pragmatic philosophy. Furthermore, I as a researcher sees the world from different perspectives in relation to how the knowledge is acquired. The qualitative part of the research, the content analysis, takes a subjectivist epistemological stand where the quantitative approach, the classification study, takes an objectivist epistemological stand (Saunders et al., 2009). However, the research is mainly regarded in an objective ontology, as I believe that the maturity models are objective entities, since they have descriptions, design parameters, capability areas and are a part of a formal structure and the essence of the models is the same in all contexts regardless of me as a researcher.

2.1.1 RESEARCH DESIGN

The first part of the research question ask for a qualitative content analysis of the sample of digital maturity models in order to define digital transformation maturity, which will derive a set of design parameters as well as capability areas, which will be converted into a conceptual model. The second part of the research question ask for a classification of the sample of maturity models in order to investigate the similarities between these models in order to come up with suggestions on which a maturity model to select and to create step-by-step classification-trees, which call for a quantitative structured approach. Hence, since I want to conduct the content analysis on an exploratory stage in order to get insights into key elements of digital maturity models before using the quantitative analysis for a more descriptive purpose, a mixed-model research is applied (Saunders et al, 2009). By applying a mixed-model research, the qualitative data from the content analysis is quantitised and converted into numerical codes so it can be analyzed statistically (ibid).

2.2 LITERATURE SEARCH STRATEGY

According to Webster & Watson (2002, p. 13) *"a review of prior, relevant literature is an essential feature of any academic project".* Therefore, even though this research applies an inductive approach and is thus not concerned with developing hypotheses based on existing theory *(deductive)* it is still relevant to review existing literature in the beginning of the inductive research in order to help the author of this thesis to get a understanding of the domain in order to find knowledge gaps and give the reader background information (Saunders et al, 2009).

The literature review in this thesis aim to give a holistic understanding of the research domain based on existing knowledge published by other researches i.e. which concepts is related to digital transformation and how maturity is measured in IS. It must be noted that the aim of the literature in this thesis is not to test or validate the literature against the sampled digital maturity models.

In order to start the literature review a keyword search were conducted in CBS libsearch, which is set up with relevant scientific electronic databases i.e. Springerlink, ACM digital library, Business source complete, AIS and Science direct. The first keywords were "Digital maturity" and "Digital transformation maturity" with no search conditions, where the former yielded 26 results and the latter yielded 0 results. Only one out of 26 results on "Digital maturity" gave one useful source; Albanese, J., & Manning, B. (2015),

whereas one source came up with a digital readiness maturity model for manufacturing companies, which is not included in the thesis as the focus is on general and not industry specific digital maturity models.

The first keyword search indicated the scarce of literature on the concept of digital maturity in academia, hence, a keyword research were conducted on the individual concepts in the electronic databases with keywords as “digital transformation”, “digitization”, “digitalization”, “digital transformation” and “digital disruption” “digital innovation”, “digital transformation” and “business model” , “digital transformation” and “organization”, “digital transformation and framework”. In this search process sources by Westerman, G., Matt, C., & Hess, T. and the group of Henriette, E., I Boughzala and Mondher, F. gave useful insight into the area of digital transformation. Hereafter, backward searches were applied i.e. searching within the bibliographies and references of the articles produced by the second keyword search process as well as forward searches, where I searched for other papers that had cited these articles (Webster & Watson, 2002).

For the maturity concept these keywords were used: “maturity model”, “maturity model development”, “maturity model design”. During this search process it was observed that some authors appeared more frequently in the bibliographies of the first couple of articles, the mostly cited authors within the maturity model domain in IS are Becker, Mettler, Pöppelbuß and De Bruin. Here, backward and forward searches were applied as well.

In order to synthesize the literature in a concept-centric way, the derived 26 sources were applied into a concept matrix (Appendix 1), where the concepts digital transformation, digitization, maturity, digital maturity and maturity model development, determines the organizing framework of the literature review.

2.3 COLLECTION OF MATURITY MODELS

The starting point for the analysis was the collection of existing digital maturity models based on search strings in CBS libsearch, which is set up with relevant scientific electronic databases i.e. Springerlink, ACM digital library, Business source complete and Science direct and Google’s search engine were also used to find non-academic maturity models. First, the keyword “Digital” from frame 1 were linked to each of the following keywords from frame 2 “Maturity”, “Transformation” “Capability” and “Readiness”. Secondly, both frames were linked with a third frame to filter articles and discussion about

the keywords and in order to find the tools that measure at scale: “Tool”, “Model”, “Assessment” and “Index”

Frame 1 (1 keyword) x frame 2 (4 keywords) x frame 3 (4 keywords) = number of search strings (16 search processes)

The 16 search processes resulted in different digital maturity models that were concerned with digital maturity from various perspectives, however, in order to allow standardization and due to the limited space in the thesis, three selection criteria were applied.

1. I should be able to evaluate and collect data from the model, or there should be a clear description on how the data is collected i.e. examples of questions or of how the maturity is assessed in order to make a meaningful classification and similarity analysis
2. In order to be able to make a thorough content analysis of the models the language must be in English or Danish to be understandable for me
3. The maturity model must be general i.e. not domain and industry specific such as digital transformation maturity in supply chains or banking industry and so forth in order to facilitate generalization, since the questions and capability areas may be specific to that context

After adding a filter, a shortlist was derived consisting of 25 maturity models (Appendix 2). From the total number of 25 maturity models only two models can be assigned to scientific institutions, which are the models by St.Gallen University and by MIT Sloan and Capgemini Consulting and the remaining 23 models can be assigned to models by practitioners. Due to the limited number of digital maturity models in academia the difference between scientific or practitioners models will not be considered from now on.

According to the study by Lasrado et al. (2015) there is a lack of a standard vocabulary to address the diversity among maturity models, and therefore developers find it challenging in defining the parameters of comparison. Lasrado et al. (2015) identifies a standard vocabulary for maturity model description. However, a quick comparison between classical maturity models e.g. CMM and Business Process Maturity models (Lasrado et al. 2015) and digital maturity models show that even though the last mentioned use key elements of classical maturity models, there are many differences between these with regard to their design. Hence, each digital maturity model was

reviewed in Appendix 3 into the categories “general aspects of the model”, “data collection and analysis” and “data presentation” during the content analysis.

2.4 QUALITATIVE METHOD

2.4.1 CONTENT ANALYSIS

The purpose of content analysis is to provide knowledge and understanding of the 25 sampled maturity models. Content analysis is defined as a research method for the subjective interpretation of the content of text data (Hsieh & Shannon, 2005). The content analysis try to reduce the complexity of the data by relating it to a set of categories that is predefined (directed content analysis) or emerging (conventional content analysis), where the categories are called codes (ibid).

The content of the models will be analyzed through a systematic classification process of coding, identification of themes and patterns in order to define digital transformation maturity models. The content analysis will be divided into two analysis, where the first will be used to analyze *what* is measured, namely the capability areas, and the second analysis will analyze *how* it is measured, namely the design parameters. Both analyses will be summarized in a conceptual model of digital maturity models, and will be further used to classify the sampled maturity models for selection.

The conventional content analysis is applied in this thesis, which is applied when existing theory on a phenomenon that is being studied is limited (Hsieh & Shannon, 2005). Through this approach I will avoid using preconceived categories, instead I will allow the categories and names to flow from the data in line with my exploratory-inductive approach.

The data analysis start by reading all data repeatedly to obtain a sense of the whole (Tesch, 1990), hence, the initial review of the models (appendix 3) were repeatedly read. Hereafter, the analysis were divided into two separate content analyses, namely analyses of the capability areas and the design parameters.

After the initial review by reading all data repeatedly, the coding is the second step before the codes are further analyzed (Hsieh & Shannon, 2005). I first highlighted the exact capability areas from the maturity models that appears to capture the occurrence and frequency of each dimension across the 25 sampled models. All capability areas, unless there is an overlap between the capability areas, were coded as binary data to a excel-sheet (appendix 4), where I looked at the presence or absence of each dimension in

each of the 25 sampled models by applying 1 for present and 0 for absent. Hereafter, I used descriptive statistics to predict, which of the capability areas are present in the majority of the models, in order to derive a holistic definition, and to decide, which of the capability areas would be meaningful to include in the classification study. Next, I approached the text by making an initial analysis (Hsieh & Shannon, 2005). As this process continued, the labels for the codes (ibid) reflected more than one key thought, as the initial capability areas were related to one or more sub-codes, which came directly from the text analysis. Therefore, the codes were sorted into categories with sub-categories based on how different codes were related and linked (table 2) (Hsieh & Shannon, 2005). Lastly, the definitions for each code (capability area) were developed, which are expressed in the analysis. This process follows the conventional content analysis where the emergent categories are used to organize and group codes into meaningful categories, which resulted in the five capability areas of digital transformation maturity identified in the data (table 1) (Hsieh & Shannon, 2005).

The above conventional approach is also applied to the content analysis of the design parameters. After the initial analysis of the content of 25 sampled models the analysis derived 9 codes, namely 9 design parameters that express how the maturity is measured. These codes were applied to a excel-sheet (appendix 5) where each code (design parameter) were marked as present (labeled with 1) or absent (labeled with 0) in each of the 25 models. Each design parameter reflected more than one key thought and were related to one or more sub-codes that expresses the variables for maturity models, which came directly from the text analysis. Hereafter, the definitions for each design parameter were developed, which are expressed in the analysis (table 2).

With a conventional approach to content analysis, the findings should be further addressed by discussing the findings (Hsieh & Shannon, 2005). Hence, both content analyses will be used to create a conceptual model of digital transformation maturity, that will help to identify variables for classification and to create classification-trees in order to help the practitioners to select the model that best fits their needs. Lastly, a discussion of how the findings will contribute to the knowledge in the problem area will be provided.

The advantage of the conventional approach to content analysis is that I gained direct information from the collected models without imposing preconceived categories, which gave me the ability to define digital transformation maturity models grounded in the actual models. Furthermore, establishing reliability is straightforward if the researcher well-define the approach to the conducted content analysis so it can be easily replicated by

others (Hsieh & Shannon, 2005). The disadvantage of content analysis is that it is a descriptive method, which means that the analysis do not reveal the underlying objectives behind the examined phenomenon, however, the scope of this thesis is to define digital maturity models in order to contribute to the unexplored area in academia, and not to discuss why they are what they are. Lastly, the disadvantage of content analysis is that it is limited by the availability (Hsieh & Shannon, 2005) of 25 sampled maturity models.

2.5 QUANTITATIVE METHODS

2.5.1 CLUSTER ANALYSIS

The content analysis aid to create a conceptual model of digital transformation maturity models, where the derived variables from the content analysis will be further used to classify the sampled models based on their similarities. The capability areas and design parameters from the content analysis will be named variables in relation to the quantitative analysis.

Classification is frequently conducted by cluster analysis, which in this case will produce a digital maturity model classification based on the similarity between the models in relation to the variables. The purpose of the cluster analysis is to find groups in the data, such groups are called clusters, and to discover them is the purpose of cluster analysis (Kaufman & Rousseeuw, 2009). Basically, the aim is to form clusters in such a way that the cases in the same cluster are most similar to each other, whereas the cases in the other clusters are as dissimilar as possible (ibid). The cluster analysis is conducted in IBM SPSS statistics software, and will not be mentioned from now on unless it has a importance for the point that is being made.

As an exploratory classification method, any cluster analysis will produce a classification, whether the data comprise natural grouping or not (Punj & Steward,1983). This requires some caution in order to avoid clusters that are occurred by chance, where it is advised to choose the most appropriate and meaningful clustering solution (Jain et al, 1999). The hierarchical clustering method is chosen in this thesis, for which reason it is important to consider the advantages and drawbacks of choosing hierarchical clustering. First, a drawback is that one is not able to make adjustments or correction once the decision of the grouping at the early stage is made, hence, a first merging or demerging of cases will restrict the rest stages of the cluster analysis (Sisodia et al, 2012). Secondly the method is highly explorative and depended on the researcher's ability to interpret the

dendrogram based on the knowledge of the dataset, hence the results should be examined closely (ibid). Furthermore, the use of different distance methods may give different results and a large data set may give complex results in the dendrogram since no optimal number of clusters are discovered for the researcher (ibid).

Hence, all the clustering methods and measures were evaluated and compared in SPSS on my dataset in order to choose the most meaningful approach and method to classify the maturity models. The hierarchical clustering is chosen, as it builds clusters incrementally and in relation to the k-means clustering, the cases are thus not decided by the value *k*, which is the predefined number of clusters that one want to create. Furthermore, k-means clustering has not been applied as this method do not consider the type of measure, in my case binary numbers, which should be depended on the goal of the clustering, instead k-means specifically uses Euclidean distance as a distance measure. Hence, hierarchical clustering is the appropriate method for my dataset since I want to find the appropriate number of clusters based on a dendrogram and not predefine them. Furthermore, since my dataset is relatively small it gives a less complex result that are manageable. The cluster analysis will give insights into the structure of the maturity models based on their similarities and help to identify outliers. Lastly, based on the small sample and the knowledge gained from the content analysis I am able to interpret the dendrogram based on my pre-achieved knowledge of the maturity models.

The hierarchical clustering algorithm begins by assigning each case to its own cluster, and at each step, the two clusters that are most similar will be merged in a new cluster, this algorithm will continue to iteratively merge or demerge the two cases that are closest to each other until all have been merged in a cluster (Jain et al, 1999; Rafsanjani et al, 2012). To simplify, the algorithm generates a series of clusters from 1, where all cases are in one cluster to *n* clusters, where all cases are in a their individual cluster that are most similar (Jain et al, 1999). SPSS produce a dendrogram, based on the iterative clustering process, which shows how great the distance is between the cases and the clusters. The researcher can then navigate through the levels to interpret which number of clusters makes the most sense to the research (Rafsanjani et al, 2012).

2.5.1.1 METHOD AND MEASUREMENT

The cluster-method defines the procedure for combining the clusters, the method used in this thesis is the between-group linkage, which computes the smallest average distance between all the cluster pairs and combines the two clusters that are closest

(Churchill & Lacobucci, 2010). This methods begins with the number of clusters as there are cases, and on the first step the two cases with the smallest distance between them will be clustered, then the method will compute the distance once again and will combine the two clusters that are next closest (Churchill & Lacobucci, 2010; IBM, 2012c). The Ward's methods is often used in clustering, where the aim is to minimize squared deviations, and is therefore not appropriate for binary data where one want to assess the dissimilarity between two observations, instead it is appropriate for continuous variables (StackExchange, 2016; Finch, 2005).

The cluster-measure allows to specify the similarity measure to be used in clustering. The researcher should first select the type of data, between interval, counts or binary, and then select the appropriate similarity measure for that data type. Since the data for the clustering has been coded as binary values in the content analysis and shows whether a variable is present (1) or absent (0) in each maturity model, the simple matching measure has been used. Furthermore, this measurement is chosen, as whether a maturity model are similar on the present of a variable or whether they are similar on the absence of a variable are both important for the analysis. Simple-matching is the *"ratio of matches to the total number of values"* (IBM, 2012a). Explained in other words, the simple-matching coefficient is the number of paired variables, i.e. the number of instances where the maturity models both have either present or absent variables matches in the same dimension (ibid). The Jaccard measure is also often used for binary data, but is not appropriate for my data set since equal weight should be given to matches and non matches according to the presence and absence of the dimensions. Whereas the Jaccard measure consider them to be similar, creating a match, only when a variable is present in both maturity models (Gower & Ross, 1969). Simple-matching instead considers a match when a variable is either present or absent in both maturity models (ibid).

2.5.2 MULTIDIMENSIONAL SCALING

A second quantitative method used for the similarity analysis of the sampled models is multidimensional scaling (MDS). MDS is similar to clustering in the sense that both analyze cases based on their similarities, however, in MDS the groups of cases are determined a priori by the sample (Winkler, 2012; Churchill & Lacobucci, 2010). MDS is used in this thesis to provide a visualization of the pattern of dissimilarities as well as to compare the final clusters to MDS, to see if the MDS positions reflects the created clusters. The purpose of MDS is to position the cases in a low-dimensional space, (often

two or three dimensional), where the distance (the space) visualize how similar or dissimilar the cases are (Churchill & Lacobucci, 2010). MDS uses an iterative procedure as the clustering algorithm, where the cases are compared pairwise by their similarity or dissimilarity relative to their distance, if two dissimilar cases lie close to each other they will be moved apart, and if two similar cases lie close to each other they are moved closer in the space (Winkler, 2012). This process continue until the cases reflects the similarity characteristics (Winkler, 2012; Churchill & Lacobucci, 2010).

The scree plot can be used to determine the number of dimensions to retain in the multidimensional plot. First, a scree plot, which uses a loss function called stress, was created on min 1 dimension and maximum 24 dimensions (N-1) to see how many dimensions the scree plot suggested as the appropriate solution. The elbow on the scree plot indicates that the goodness of fit improves with an increase on the two dimensional mark, but do not improve when the number of dimension are increased to 3 and up to 24 (Appendix 10). Thus the two-dimensional solution is chosen since the data produce the original positions as efficiently as the three and four dimensional solution (Churchill & Lacobucci, 2010). Hereafter, the number dimensions were changed to min 2 and maximum 2 dimensions to see the common space in a two-dimensional space. The method chosen for MDS is pattern difference, that computes the similarity based on bc/(n**2), where *b* and *c* represent the diagonal cells referring to cases present in one variable but absent in the other variable, where n is the total number of cases (IBM, 2012b). The method Euclidean distance was also applied, which showed similar results as the former mentioned method.

OVERVIEW OF THE METHODOLOGICAL APPROACH

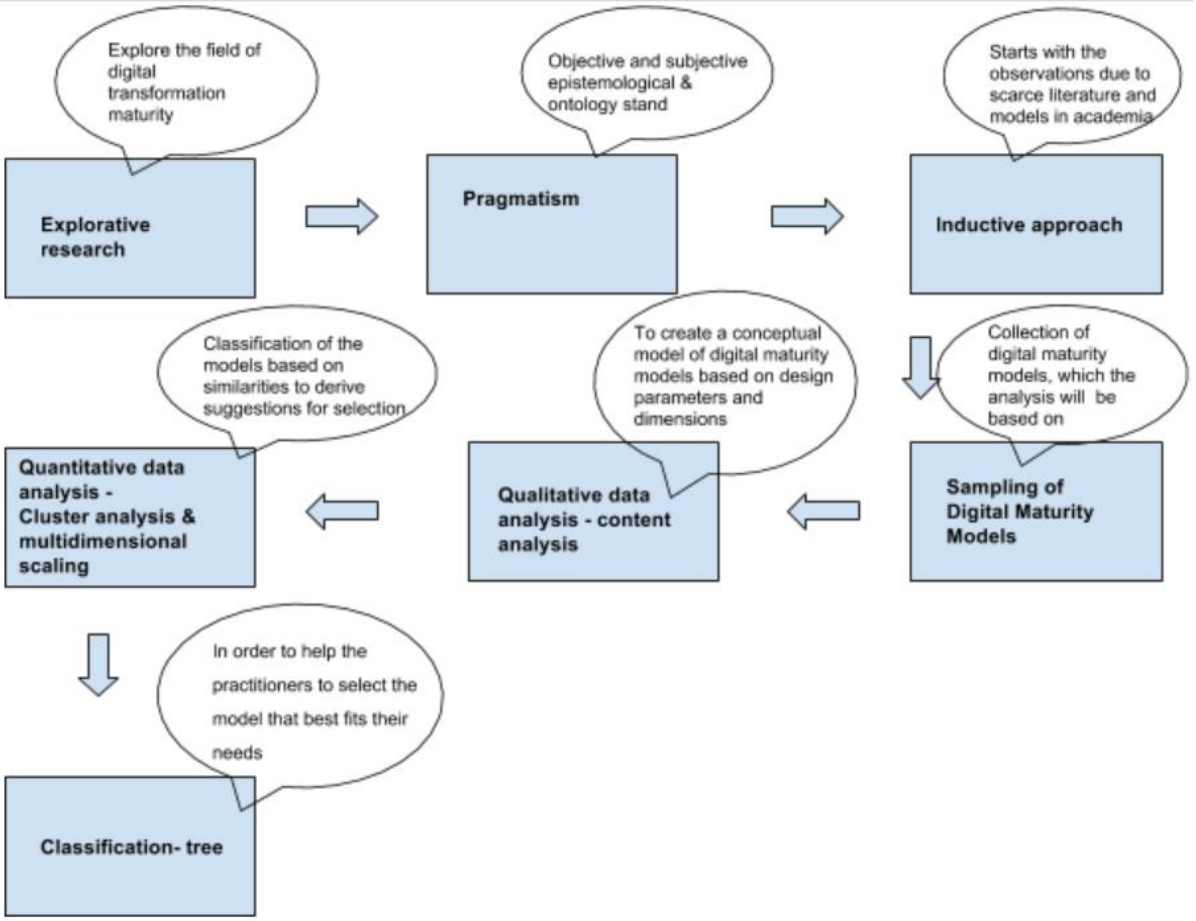


Figure 1: Overview of the methodological approach

3. LITERATURE REVIEW

Since the academic research has often been concerned with certain aspects of digital transformation and the impact of specific digital technologies on businesses, the area of digital transformation in context with maturity has not yet been studied to a fully extend. Hence, this literature will first provide an holistic view of digital transformation through the relationship between digitization, digitalization and digital transformation in order to get insights into the ongoing discussion of digital transformation. The second area is concerned with maturity in IS research, which is relevant since it provides an understanding of how to measure maturity in IS in order to derive a understanding of digital transformation in relation to maturity, which is within the scope of this thesis.

The two main areas creates the theoretical background and assures that I get an understanding of the topic in order to make sense out of the analyses of the models.

3.1 DIGITAL TRANSFORMATION

3.1.1 DIGITIZATION AND DIGITALIZATION

Even though digital transformation is one of the most used buzzwords in the business environment today, many projects within digital transformation does not reach its goals, and the reason behind this seems to be conflicting interpretation of the concept is and a uncertainty about what to put in the word transformation (Moe, 2015). In the 90s, researches made it clear that IT was going to have a profound impact on businesses, thus some associate digital transformation with business transformation, where companies create an appropriate organizational arrangement by their leverage of IT to support the business logic (Venkatraman, 1994). However, the current debate on digital transformation reveals that the changes derived from the influences of digitization on user behavior, organizations, and industries, form a new kind of transformation, which come as a result of digitalization (Matt et al., 2015; Berghaus et al., 2016; (Collin et al., 2015). Thus, in order to study digital transformation, the concept of digitalization and digitalization, which makes up the base of digital transformation, needs to be reviewed first, as the concepts describe different ideas (Chanias & Hess, 2016).

Digitization of information is the encoding of analogue information into a digital form and "*makes physical products programmable, addressable, sensible, communicable, memorable, traceable, and associable"* (Yoo et al., 2010, p. 4). Hence, digitization refers to the ability to turn existing products or services into digital products, and thus offer the advantages of tangible products with a focus on efficiency (Chanias & Hess, 2016) (Berghaus et al., 2016). If one consider the e-book example, digitization makes firms capable of engaging in digital publishing and creates a new digital business, as the non-digital product, the book, now contain digital capabilities like communication, memory, programmability, traceability, making digitization is an insufficient condition for digital innovation (Yoo et al., 2010). If digitization is the process of encoding of analogue information into a digital format then digitalization is *"the possible subsequent reconfigurations of the socio-technical context of production and consumption of products and services."* (Yoo, 2012, p. 6). The reconfiguration is the changes of existing value chains across industries and terms such as Big Data, Internet of Things, Mobile Applications to connect people are used to describe digitalization (Collin et al., 2015). Nevertheless, these digital technologies provide organizations with business improvements, such as new online sales opportunities to create new revenue streams and an improved operational efficiency due to an increased level of automation, resulting in new business models that brings increased customer value across existing industries (Collin et al., 2015). In short, digital is not just an emerging technology, but a broad business concept, namely when any technology connects people and machines with any form of information, making it is essential to every business (Albanese & Manning, 2015).

The increased proliferation of digital technologies has been an important resource for business transformation (Yoo et al., 2012), enabling organization to reshape or replace business models (Matt et al., 2015), integrating digital technologies and processes (Liu et al., 2011; Berghaus et al., 2016), leading to key business improvements (Fitzgerald et al., 2013; Berman, 2012). The term transformation refers to a *change* within the organization enabled by the digitalization, which has an impact on i.e. the strategy and operational processes of the organization (Matt et al. 2015; Berghaus et al., 2016).

This form of transformation may lead to reassessment of organizational norms and values, and such organizational transformations can have a major impact on the entire organization, hence, the transformation can become complex and chaotic (Liu & Chou, 2011). Since, digital technologies can trigger these changes and provide the foundation

for moving out of the current state towards a more competitive future, organizations should increasingly expect to incorporate these technologies into their business to improve their competitiveness (Liu & Chou, 2011). From this perspective, digital transformation can be defined as *"an organizational transformation that integrates digital technologies and business processes in a digital economy"* (Liu & Chou, 2011, p. 1730).

3.1.2 DEFINING DIGITAL TRANSFORMATION

In order to define digital transformation it is relevant to explain how the concept is perceived by the industry that are engaged in digital transformation. The MIT Center for Digital Business defines digital transformation as *"the use of technology to radically improve performance or reach of enterprises" (*Westerman et al., 2011, p. 5). From this starting point the digital transformation does not result in incremental changes, but fundamental changes due to the digital technologies, which means using a digital technology do not mean that the business undergoes digital transformation. Another definition is that digital transformation is *"the re-alignment of, or new investment in, technology and business models to more effectively engage digital consumers at every touch point in the customer experience lifecycle"* (Solis et al., 2014, p. 8). According to Accenture, digital transformation is a *"formal effort to renovate business vision, models and investments for a new digital economy"* (Afshar, 2015). While Solis et al., 2014) focus on business models and consumers and Afshar (2015) only speaks of business models, Westerman et al. (2011, p. 17) states in order to undergo a digital transformation businesses should radically *"improve performance or reach of enterprises"* around three areas; customer experience, operational performance and business models. *Customer experience* and *business models* are interrelated from Berman's (2012) point of view, as digital transformation require reshaping customer value propositions through the business model.

From the perspective of the above discussion on digitalization, putting *digital* and *transformation* together, the concept of digital transformation cover both processes with a focus on efficiency, deriving from *digitization,* and a focus on enhancing customer value through existing physical products or new products with digital capabilities, deriving from *digitalization* (Yoo et al., 2012). Companies that conduct initiatives to implement and explore digital technologies and their benefits involves transformations of business operations and affects products as well as organizational and management concepts (Matt et al., 2015). Hence, this thesis consider digital transformation in line with Berman's

(2012) definition as all changes in the way the companies conduct business including both incremental and radical changes, in contrast to Westerman et al. (2011) who refers to digital transformation as radical changes.

Hence, in order to elaborate on The MIT Center for Digital Business definition of digital transformation as *"the use of technology to radically improve performance or reach of enterprises".* The improvement of the *performance* includes operational efficiency and the *reach* includes reaching a customer segment with changes in the customer value proposition by the use of digital technologies (Fitzgerald et al., 2013; Westerman et al., 2011; Matt et al., 2015). This argument is in line with Berman (2012) definition of digital transformation, which is focused on two complementary activities: *reshaping customer value propositions* and *transforming operations* to deliver new customer value propositions effectively and in innovative ways.

Hence, the term digital transformation goes much further than digitalization and describes the process of change due to an increased use and adaption of digital technologies (Chanias & Hess, 2016). The concept reflects that digital transformation is not about implementing digital technologies into the business, but transforming the business to take advantage of the digital capabilities (Chanias & Hess, 2016; Matt et al., 2015; Westerman et al., 2011). It therefore require businesses to be centered on re-envisioning and initiating a change process of their operational processes and their business models, affecting both primary activities such as marketing and sales and its support activities, such as human resources (Berghaus et al., 2016; Chanias & Hess, 2016; Hess et al., 2016; Berman, 2012, Henriette et al., 2015). Hence, digital transformation is a change process, which is actively designed and executed by the company, and in order to do so, it is important to establish a common understanding within the company and therefore need to establish management practices to govern the transformation (Berghaus et al., 2016; Matt et al., 2015).

The research by Henriette et al (2015, p. 432) focus on four aspects of re-envisioning and initiating the organizational change process triggered by digitalization; digital capabilities, business models, operational processes and customer experience. This is in line with other studies by i.e. Westerman et al (2014), Matt et al, 2015), Hess et al, (2016) and Berman (2012). The aspects will further explained in next section based on the study by Westerman et al (2014) as this study is more comprehensive than the others.

Based on above presented perspectives, digital transformation is the change process a company undergo in order to improve performance or reach of enterprise induced by digitalization. In practice, digital transformation is concerned with the changes digital technologies bring in a business model, which result in changed *digital capabilities, business models, operational processes and customer experience,* which will be elaborated in next section (Westerman et al, 2014). Making digital transformation a management approach to govern transformative initiatives that takes advantages of the capabilities of digital technologies.

3.2.1 THE ACTIVITIES OF DIGITAL TRANSFORMATION

The above definition is holistic and do not elaborate on the specific changes in digital transformation. Therefore, this section will elaborate on digital transformation by dividing the definition into activities that the company may undertake in order to digitally transform their business.

3.2.1.1 BUILDING BLOCKS OF DIGITAL TRANSFORMATION

The research from MIT Center for Digital Business and Capgemini Consulting by Westerman et al. (2011) shows that successful businesses are digitally transforming three key areas of their businesses; *operational processes, customer experience* and *business model.* Furthermore, they state that within each of the three areas, different elements need to change in order to digitally transform the businesses, and forms a set of building blocks for digital transformation (Westerman et al., 2011, p. 17).

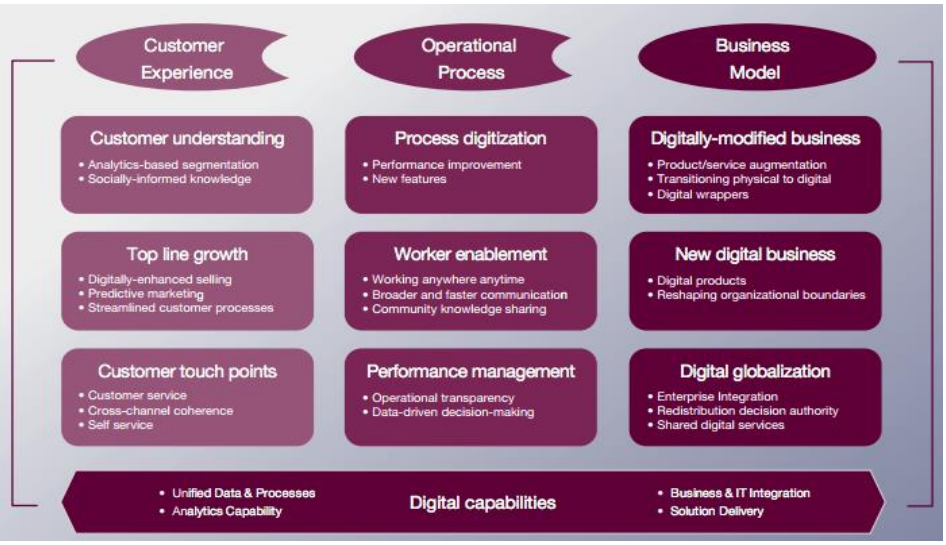


Figure 2: The three building blocks for digital transformation (Westerman et al, 2014)

Transforming customer experience

Customer experience is divided into three sub-categories; customer understanding, top line growth, and customer touch points. Berman (2012) and Henriette et al (2015) also emphasize that digital transformation should build around transforming the customer value proposition. The noteworthy sub-category is the customer touch points, as Solis (2014, p. 9) and Berman (2012) states that customer experience is not only about customer service and cross channel, but also the fact that the customer experience plays a part in the production of marketing, sales, support and everyone who is involved with the customer. However, Westerman et al. (2011) groups 'sales and marketing' with 'streamlining processes' and separates the customer understanding as a digital domain from customer service and support. Solis (2014, p. 21) also emphasizes the importance of understanding and provide solutions for the digital customer journey such as customer needs, expectations and demands develop. In phase with the customer understanding develops, the potential for streamlining the personalized customer engagement develops, by making the customer journey easier through multiple channels to create an integrated experience (Solis, 2014; Westerman et al., 2011). Furthermore, the businesses need to create a culture of customer centricity within the organization and start to take advantage of previous investment in digital technologies to get an understanding of their customer, such as specific geographies and market segments (Westerman et al., 2011; Berman, 2012). The better understanding of the customer the company gets the more will it help them to transform the sales experience, by integrating customer purchasing data to provide personalized sales and customer service or even to offer customized products (Westerman et al., 2011). Furthermore, by offering a fast and transparent problem resolution through digital initiatives the customer service can be enhanced (Westerman et al., 2011).

Transforming operational processes

Despite focusing on customer experience, organizations should benefit from digital technologies to enhance and automate internal operational processes through process digitization, worker enablement, and performance management. The digitization of the processes that automates their processes to be more efficient and scalable, automation can enable companies to refocus on more strategic task to i.e. enhance product quality. In relation to worker enablement, the company must create a virtuous cycle of knowledge sharing through digital technologies, as employees can stay connected with the office, and virtualizing the work processes from the location of the work. In a broader sense,

digital transformation can replace one way communication with broad communication channels. Furthermore, performance transparency is a key highlight in digital transformation, where executives and employees can make more informed decisions where digital systems can give them deeper insights into products, customers to make decisions based on data and not on assumptions (Westerman et al., 2011). Where Westerman et al's (2011) operational processes is mostly directed to the internal employees of the company, Berman (2012) operational model is directed towards the customer value proposition by creating new digital capabilities, leveraging information to manage across the organization, integrating and optimizing all digital and physical elements.

Transforming business models

The last area of digital transformation is business model, where digitalization enable companies to transform a new growth business through digitally-modified businesses, new digital businesses and digital globalization. Along with the technological shift, convergence of different digital technologies is changing the way of conducting business (Henriette et al, 2015). The first building block is digital modifications to the business by changing the way business is done, not only by changing how their functions work, but also redefining how the departments interact and evolving the boundaries and activities of the company through digital capabilities (Westerman et al, 2014). The second block is built around companies introduction of digital products that complement their traditional products with features and services that differentiate their brands on the basis of new types of interaction (Westerman et al., 2011; Berman, 2012). The last building block is concerned with the fact that companies should focus on transforming from multinational to truly global operations by coupling digital technology with information that allows companies to gain global synergies but at the same time remain local responsive. Hence, companies most become more centralized and decentralized at the same time (Westerman et al., 2011). Whereas Westerman et al., (2011) see the transformation of the business model more holistic, Berman (2012) focuses on products that are delivered for a better customer experience, for new revenue streams and for a radically reshaped value proposition.

Digital capabilities

Digital capabilities are the fundamental building of digital transformation, hence the companies need skills or business units to lead the digital transformation (Westerman et al., 2011). Where Westerman et al. (2011) states that digital capabilities cuts all three pillars of digital transformation, creating new digital capabilities is the first and lowest part of the transformation of the operational model according to Berman (2012). The most fundamental technology the company needs is a digital platform of *unified data and processes* in order to create a common view of and remove silos in the company. Furthermore, companies also need digital capabilities to modify their processes or build new methods onto the data and process platform (Westerman et al., 2011). *Solution delivery* requires methods and skills to define requirements for emerging digital technologies. For example, mobile platforms and social media require different approaches to learn about what will work in contrast to mature technologies (Westerman et al., 2011). Furthermore, big data activities require specific knowledge that typical IT developers do not have (Westerman et al., 2011). The company should also change their business to be led by information management and analytics by combining the unified data with powerful analysis tools in order to gain strategic advantage. Using analytics companies can reshape the customer value proposition by enhancing, extending or redefining the value of the customer experience (Berman, 2012, Henriette, 2015). Engaging in analytics can happen at different levels, the companies can begin to make better use of the data by making more informed decisions in order to react more quickly to internal changes. Lastly, digital transformation requires strong business and technology integration and through a solid IT/business relationship the company is in a great position to begin their digital transformation (Westerman et al., 2011). According to Henriette et al (2015) digital capabilities represents both the application of physical or intangible IT resources, i.e. technologies, knowledge and so forth to organizational goals.

3.2.1.2 DIGITAL TRANSFORMATION STRATEGY

The presented literature on digital transformation emphasize its strategic impact (Berman, 2012; Berghaus et al., 2016; Matt et al., 2015; Westerman et al., 2011) and as stated by Kane et al (2015) digital transformation is *"the ability to digitally reimagine the business"*. Hence, opposed focusing on single technologies, it is the ability to focus on

transforming the business as a whole that distinguishes digitally mature companies from companies that are in early stages of digital transformation (Kane et al., 2015). Hence, the strength of digital technologies does not lie in the individual technologies, rather it arise from how companies integrate them in order to transform their business (Kane et al., 2015). Since digital transformation is concerned with changes of key business operations and affects products as well as organizational and management concepts, companies need to establish a management approach to govern these transformations. An approach is to formulate a digital transformation strategy that integrates the entire coordination, prioritization and implementation of the many independent pillars of digital transformation across other business strategies while being aligned with them (Matt et al., 2015; Westerman et al., 2011)

Matt et al. (2015) proposes four dimensions of a company, which digital transformation strategy should address independent of the industry or company: *Use of technologies, changes in value creation, structural changes* and *financial aspects. The use of technology* cover both the company's attitude as well as the ability to exploit digital technologies, which refer to the strategic role of digital technology for a company and its technological ambition (Matt et al, 2015, p.4). The company needs to decide whether it wants to create their own technological standards and become market leaders, or whether they want to see digital technologies to fulfill business operations by remaining their already established standards (ibid). The *use of new technologies* leads to *changes in value creation,* where the digital transformation strategy has an impact on the company's value chain as the digitization of products and services require different adjustments to the company's business scope, since other markets and customers are addressed (Matt et al, 2015, p.4). The more the digital initiative differ from the current core business, the more opportunities arise to expand the current products and services (ibid). Using digital technologies in the value creation, *structural changes* are needed for the new operations in the value chain. The *structural changes* refers to the rearrangements in the organizational setup placing the new digital initiatives within the corporate structures and *"structural changes to accommodate changes in products, processes* (Matt et al., 2015, p. 4). These changes refer back to changes in the operational processes as stated by Westerman et al (2014). If the transformation is concerned with small changes the company may integrate the new operations into the existing corporate structures, while for more substantial changes the company may create separate departments within the company (Matt et al, 2015). However, the company should consider the *financial aspects* before the former three dimensions,

which constitutes the company's need for action owing to a struggling core business as well as its ability to finance a digital transformation endeavor (Matt et al., 2015, p. 4). It may reduce the perceived urgency to act if the company has a low financial pressure on their core business, whereas they might have a lack of external ways to finance the transformation if the company is already going through a financial pressure (ibid). Therefore, the company should timeously consider the need to conduct digital transformation while exploring their options (ibid).

In order to ensure a successful execution of the digital transformation strategy as well as fully exploiting its planned effects, it is important to align the four dimensions. The digital transformation framework shows the dependencies between the different dimensions, which support the assessment of a company's current abilities and the formulation of a digital transformation strategy (Matt et al., 2015, p. 5).

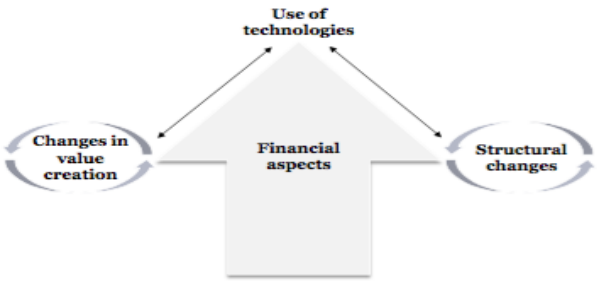


Figure 3: Digital transformation framework (Matt et al., 2015, p. 5).

3.2 THE CONCEPT OF MATURITY AND MATURITY MODELS

The term "*maturity"* is defined as *"the state of being complete, perfect or ready"* (Mettler et al., 2010, p. 334), and can be considered as a measure that allows organizations to evaluate a certain problem area (Pöppelbuß et al., 2011B). Maturity thus demonstrate an evolutionary progress of a specific ability, capability, organizational development and growth or in the accomplishment of a target from an initial to a normally occurring end stage (Pöppelbuß et al., 2011B; Becker et al. 2009).

In information systems literature the concept of maturity models has been investigated in order to understand the evolution of information systems (Lasrado et al. 2015). The literature on maturity models ranges from the progression of IT in organizations by Nolan's stage hypothesis (Pöppelbuß et al, 2011A) to the application of its stages for other IT systems, such as Intranet and ICT capability (Lasrado et al., 2015). Nolan's stage model and the capability maturity model (CMM) has been widely adopted by

academics and practitioners and led to numerous of maturity models for different problem areas based on a staged sequence of levels (Pöppelbuß et al, 2011A). Furthermore, the evolution of new technologies has served a basis for several technology specific maturity models e.g. web and social media and maturity models developed by management consultancies.

Maturity models are helpful tools to address the evolutionary progress from an assessment of status quo and indicates an anticipated, desired, or typical evolution path of objects, such as organizations or processes, to the desired target state (Becker et al. 2009; Mettler et al. 2010; Berghaus et al., 2012). Hence, maturity models determine the state of perfection or completeness (maturity) of certain capabilities through maturity stages or levels that measure the completeness of the analyzed objects through different sets of criteria (Wendler, 2012; Becker et al., 2009; Berghaus et al. 2012). The evolutionary progress implies that the object should pass through a number of stages on the way to the maturity (Becker et al. 2009). Hence, the first stage refers to the initial stage, where the organization have little capabilities in the domain that is considered, while the highest stage presents the total accomplishment of total maturity (Becker et al., 2009). The evolution path between the two extremes can be aggregated to a domain level maturity either by a continuous logic (the domain-level maturity is presented in the aggregate levels of maturity) or staged logic (certain processes need to be in place for the certain domain level) (Wulf et al., 2015, p. 5.) regarding the organization's capabilities or processes and provides criteria that are needed to reach a particular maturity level (Becker et al., 2009). The evaluation path is represented in a staged or continuous model, where the first mentioned require that all the elements of one level is achieved, whereas the continuous model allow a scoring of elements at different levels (Lasrado et al., 2015)

From the perspective of maturity models *basically* referring to tools for continuously improving capability areas, as roadmaps for guiding organizations, and blueprints for designing new entities (Pöppelbuß et al, 2011A) the purpose of maturity models can be divided into three groups depending on the purpose of use and motivation behind its development (de Bruin et al., 2005; Becker et al., 2005). The three groups are; descriptive, prescriptive and comparative maturity models (Pöppelbuß et al, 2011A).

- Descriptive: If the maturity model is applied for status quo assessment where the current capabilities of the object under consideration are assessed with respect to given criteria it serves a descriptive purpose of use (Becker et al.,2009). Hence,

the maturity model is used as a diagnostic tool and the assigned maturity level can be reported to the management (Pöppelbuß et al., 2011A).

- Prescriptive: A prescriptive maturity model indicates how to identify desirable maturity levels and provides guidelines on improvement measures (Becker et al. 2009), where specific actions are suggested (Pöppelbuß et al., 2011A).
- Comparative: The comparative maturity model serves a comparative purpose of use by benchmarking the actual situation with industry-specific best practices (Pöppelbuß et al., 2011A; Lasrado et al.,2015). The maturity levels of similar businesses can be compared given sufficient data from a large number of assessment participants (de Bruin et al., 2005).

3.2.1 DIGITAL TRANSFORMATION MATURITY

From the perspective of the former chapters on digital transformation and maturity in IS research the term digital transformation maturity can be defined in two ways. From a technological perspective it could describe to which extent a company's tasks are handled by IT, following this, a company would be fully digital transformed when performing all tasks and storing all information by the use of digital technologies (Chanias & Hess, 2016). However, digital transformation is not a matter of implementing the right technology, instead the technology has an impact on *customer experience, operational processes and business models* as mentioned earlier, therefore the transformation plan must align with the market changes where the new emerging technologies serves as an enabler to digital transformation (Solis, 2014). Therefore, digital transformation is too broad to enable a fully transformed business where all tasks are performed by the digital technologies, as the evolution paths in digitization are not linear, and it is not clear whether a company at the highest maturity stage actually performs better than its competitors (Berghaus et al. 2016). Furthermore, what is defined as a high level of digital transformation maturity in the specific moment of the company may reflect standard operations in the future, as the increasing diffusion of innovations i.e., Internet of things, will change the value of the technologies in the fast changing digital environment and in the companies that are engaged in a digital transformation (Lehmkuhl et al., 2013).

Therefore, from the point of view of this thesis the term is understood as the status of a company's digital transformation describing what the company has already achieved and transformed in terms of their transformation efforts and initiatives (Chanias & Hess, 2016;

Kane et al, 2015). The efforts and initiatives refers to the accomplished changes in *customer experience, operational processes and business mode*l regarding the mastery of the change process (Chanias & Hess, 2016). The efforts in business model relates to reshaping the existing or creating a new business model, taking into account digital capabilities (Westerman et al, 2014). The changes in operational processes refers to the rearrangements in the organizational setup placing the new digital initiatives within the corporate structures and *"structural changes to accommodate changes in products, processes or skills"* (Matt et al., 2015, p. 4). Furthermore, the company needs to create a culture of customer centricity within the organization and start to take advantage of previous investment in digital technologies to get an understanding of their customer (Berman, 2012). Hence, the highest digital maturity, or the target the company may follow in order to become digitally mature, the company need to focus on transforming the initiatives within above three areas as a whole, opposed focusing on single technologies, which distinguishes digitally mature companies from companies that are in early stages of digital transformation

The terms 'digital maturity' and 'digital transformation maturity' will both refer to the concept presented above throughout the thesis.

4. ANALYSIS

This section will first provide a content analysis of 25 sampled digital maturity models (appendix 2 for the sample N=25). First, the content analysis will define digital transformation maturity models by analyzing which capability areas are assessed and improved by digital maturity models, and secondly the content analysis will analyze the design parameters, which will be converted into variables that represents digital maturity models. Hence, the first part of the analysis aim to create a conceptual model of digital maturity models in order to answer how digital maturity models can be defined.

Hereafter, this section will conduct a cluster analysis of the 25 sampled maturity models in order to group these in a way that the models in the same group (cluster) are more similar than those models in the other groups. In order to visualize the level of similarity of the individual models, this section will provide a multidimensional scaling analysis.

Lastly, the classification of the models and the derived variables will be used to create classification-trees in order to help the companies to choose the most appropriate maturity model.

4.1 OBJECTIVES OF DIGITAL MATURITY MODELS

The group of 25 models can be divided into two focus areas. First, the capability areas of the models determines *what* is measured with the intention of improving the digital business and the second focus area, the design parameters, determines *how* the dimensions are measured to help the companies to identify priorities and to develop a digital transformation strategy for the company.

4.1.1 NUMBER AND FOCUS OF DIMENSIONS

The main purpose of maturity models is as mentioned in the literature review demonstrating an evolutionary progress of a specific capability or organizational development of a target from an initial to an end-stage (Pöppelbuß et al., 2011B). From the investigation of the 25 sampled digital maturity models it is clear that these models represents capability areas that form the basis for the maturity evaluation and determination. These capabilities represent the application of i.e. practices, knowledge, management skills, business processes and digital initiatives to further organizational goals. The number of dimensions differs from model to model, however the majority of

the models differs from 5-9 dimensions, where the model by MIT Sloan & Capgemini (Westerman et al., 2014) only has two dimensions and the model by Oracle (2017) and NBI (2017) have 11 dimensions. However, the number of dimensions is only useful for the maturity assessment from the design perspective, instead from a content perspective this section will put emphasis on the capability areas in order to describe the typical building blocks in digital transformation, which are assessed.

A part of the content analysis of the models involved looking for the presence of each dimension from one model across the rest of the models, which resulted in below table (see figure 2). One should note that the dimensions may have different names across the models, however, they have been merged into the dimension that cover the dimension regardless of the specific name in order to be able to standardize the dimensions and to reduce the complexity. For example the dimension 'Leadership' from Dt (2015) is covered in the dimension 'Transformation management' by Westerman et al (2014).

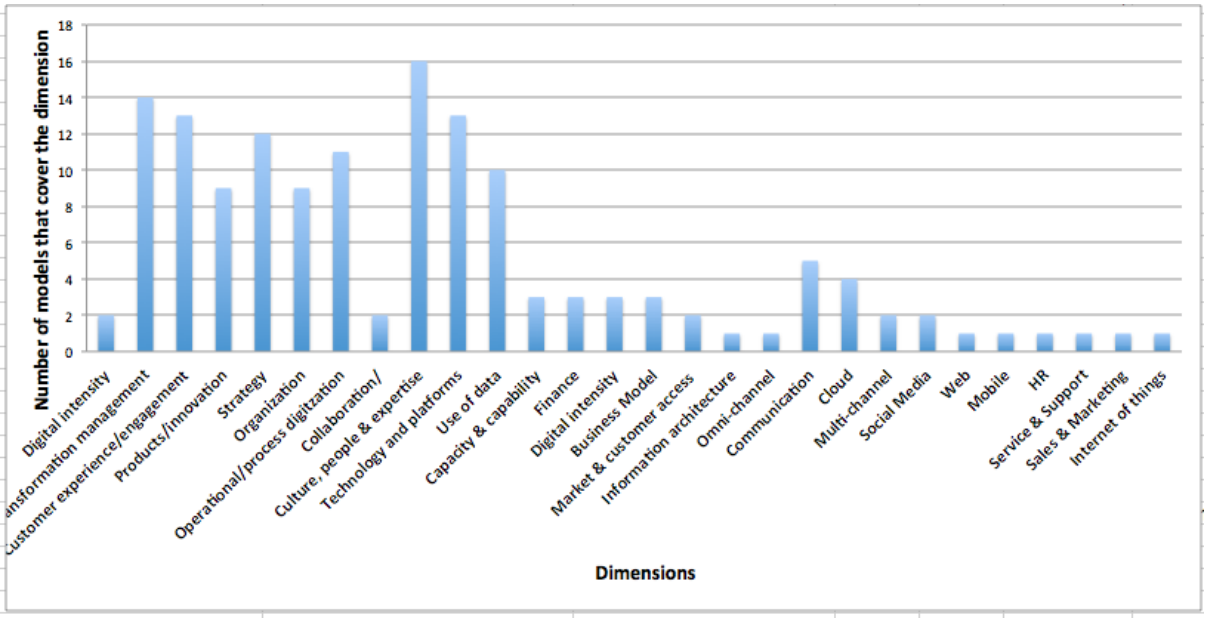


Figure 4: The sum of the dimensions across the 25 investigated models

The typical dimensions cover the aspect of culture, people and expertise, strategic transformation management and customer experience and engagement. Furthermore, they cover the use of technology and digital platforms, the existence of strategy and digitization of internal processes and operations, use of insights from data (analytics) and

lastly, the core business involving the digital products and service offering innovation. The dimensions, which the majority of the models do not cover are mainly specific technologies and business activities, such as social media, web, cloud as well as service & support and sales & marketing. These are defined as outliers as it is far below half of the models that cover these, and thus are not included in the definition nor the classification.

From above perspective it is clear that digital transformation is seen from a holistic perspective when measuring maturity. This thereby reflects the view from the literature review, that digital transformation maturity is not about whether the company implement individual digital technologies into the business in silos, but whether they transform the business to take advantage of the digital technologies (Chanias & Hess, 2016; Matt et al., 2015; Westerman et al., 2011).

The dimension ‘organization’ can be put together with the dimension ‘culture, people and expertise’ as sub-dimension. ‘Organization’ covers questions of how a company adapts its structure in order to enable digital transformation, and ‘culture, people and expertise’ looks on internal requirements for the success of a company’s digital transformation, such as risk appetite and attention to manage change from the staff’s perspective i.e. Chanias & Hess, 2016; Government of South Australia, 2016; WFA & Brilliant Noise, 2017, Berghaus et al, 2016; Deloitte, 2015. The dimension ‘Organization’ thus also refer to the dimension ‘Operational process digitization’, which is concerned with the adaption, standardization, and automation of internal processes (Berghaus et al, 2016; Chanias & Hess, 2016). This is in line with the perspective of the literature review, where it is argued that digital transformation is a change process. In order to drive the change process, the company must establish a common understanding within the company that involves management practices, the culture, and specific skills to govern the transformation (Berghaus et al., 2016; Matt et al., 2015). Dt (2015) further divide this dimension down to digital expertise, staff training and digital culture. At the lowest maturity level the digital expertise is outsourced, and the staff training is not focused on digital capabilities and the company possesses an offline cultural view (Dt, 2015). In order to master the digital transformation, the digital resources must be situated across all departments and the digital knowledge across the staff should be optimised by digital training (ibid).

According to SAP (2015) the company should have a skilled staff that is capable of handling business as a digital enterprise and lastly digital tools must be used to gather business and consumer insights, which refers to the dimension ‘organization’ (Dt, 2015).

Above capability area lead towards the dimension 'Transformation Management', which assesses whether the company are creating the necessary leadership capabilities and the top management's approach to drive the digital transformation (Westerman et al, 2014). The questions that are used to assess this dimension deals with how the company is envisioning and managing the company's move into the digital future, how well the company is governing and coordinating digital initiatives and how well the top management is helping the organization to be ready for changes i.e. Westerman et al, 2014, Berghaus et al, 2016; Deloitte, 2015; NBI, 2017; Solis, 2015). This dimension further supports the dimension 'Strategy', which assess the existence of a digital transformations strategy that should support the transformation management in leading the digital transformation. This dimension verifies the literature review, as it has been argued that the strength of digital technologies arise from how companies integrate them in their business, and since digital transformation is concerned with changes of key business operations and affects the business model, the dimension 'transformation management' also involve formulating a digital transformation strategy (Matt et al, 2015). The strategy integrates the entire coordination of the use of technologies, changes in value creation, structural changes and financial aspects (Matt et al. 2015). However, it must be noted that the financial aspects are only considered in 3 out of 25 of the investigated models (figure 2).

The dimension 'Product innovation' and 'Business model' are also dependent on each other, as the first mentioned assesses the aspects of the development of products and services by the use of digital technologies, where the need for business model innovation arise to support an innovative product and service portfolio i.e. PwC, 2015; Oracle, 2017; SAP, 2016. These dimensions are in line with the perspective in the literature review, as digital transformation also involve companies introduction of digital products that complement their traditional products with features and services that differentiate their brands on the basis of new types of interaction (Westerman et al., 2011; Berman, 2012). This dimension is assessed by questions such as *"Do you re-imagine your existing business models with regard to digitalization?"* (SAP, 2016). The lowest mature companies do not reimagine existing business models including their products, whereas the most mature companies constantly re-invent their business models, including their offerings (SAP, 2016; Oracle, 2017).

The dimension 'Technology and platforms' verifies that it is not a matter of the individual technologies that are implemented, but instead the dimension assesses the company's

agile project management, integrated architecture and IT expertise (Berghaus et al, 2016), and from another point of view it assess to which extend the IT architecture supports the digital services and products (PwC, 2015). The investigated models that determines this dimension agrees that the dimension assesses the company's use and adoption of technologies i.e. Government of South Australia, 2016; EY, 2017; Solis, 2015: KPMG, 2015; Gill & VanBoskirk, 2016) for example by confirming the statement in Forrester's maturity assessment *"We have a flexible, iterative, and collaborative approach to technology development"* (Gill & VanBoskirk, 2016).

The dimension 'Use of data' refers to the analytical capabilities in the company and the derived insight from the use of data i.e. Dt, 2015; Adapt2Digital, 2015; NBI, 2017; Oracle, 2017. This is also confirmed by the literature review that the company should change their business to be led by information management and analytics by combining the unified data with powerful analysis tools in order to gain strategic advantage (Westerman et al., 2014). Companies can reshape the customer value proposition by enhancing, extending or redefining the value of the customer experience by using analytics (Berman, 2012).

Leveraging insights from data to get an understanding of their customers to enhance products and services leads to the last dimension that the majority of the models agrees on, namely 'customer experience and engagement'. Customer experience assesses how well the company knows their customers for example their expectations and preferences with regard to the digitized customer journey in order to make grounded business model changes i.e. SAP, 2015; Berghaus et al, 2016; EY, 2017; Solis, 2015; Deloitte, 2015; KPMG, 2015, which refers back to the dimensions "business model' and 'product innovation'. Customer engagement measures to which extent the company has the right approach and channels to communicate with their customers in a digital environment (Deloitte, 2015). This is in line with the point of view of the literature review that companies needs to create a culture of customer centricity within the organization and take advantage of previous investment in digital technology to get an understanding of their customers, such as specific geographies and market segments (Westerman et al., 2011; Berman, 2012).

In the literature review the term digital transformation maturity is understood as the status of a company's digital transformation describing what the company has already achieved in terms of their transformation efforts (Chanias & Hess, 2016). From the perspective of maturity models in IS research, which determines the state of completeness of certain

capabilities and from the perspective of the content analysis of the dimensions of the 25 digital maturity models, higher digital transformation maturity is reached by improving the capabilities i.e. improving the transformation management capabilities including the entire coordination of the use of technologies as well as the structural changes in the organization and business model. This is needed to perform well, and thus aiding to a higher performance in digital transformation. Table 1 addresses the five capability areas that determines digital transformation maturity in the sample of the 25 maturity models.

Main capability area	**Sub capability area**
Organization Examines whether the company possess the skills and culture to redesign operational processes to support the organization in delivering the business objectives and vision	• Culture, people & expertise • Operational process digitization
Transformation Management Examines the leadership capabilities to drive the digital transformation including the entire coordination of the use of technologies as well as the structural changes in the organization and business model	• Strategy
Business Model Examines whether the company reinvent existing or develop new business models with regard to digitalization to support an innovative product and service portfolio	• Product innovation
Technology Examines the strategic role of technology and digital platforms and its integration into the organization	• Analytics
Customer Centricity Examines whether the company adapts to the digital customer behavior and expectations	• Customer engagement & Customer experience

Table 1: Five dimensions of digital transformation maturity

4.1.2 THE PURPOSE OF USE

The digital maturity models shares the same purposes of other maturity models in IS research. It has been argued in the literature review that maturity models can support self- or third-party assessment for descriptive purpose, benchmarking and to provide an action plan for organizational improvement (Pöppelbuß et al, 2011A).

7 out of 25 models (see appendix 6 for descriptive statistics) have a descriptive purpose of use, which is solely focused against maturity assessment that gives a snapshot of the company regarding its performance at the certain point in relation to the digital maturity of the company. Oracle (2017) is one example of an assessment that serves a descriptive purpose of use, which provides a graphical illustration that shows how digital mature the company is out of the maximum score of 5 with no additional information.

Figure 5: Example of a descriptive result by Oracle (2017)

In contrast the maturity model by MIT Sloan & Capgemini Consulting that also serve a descriptive purpose come up with a clear description in a book by Westerman et al., (2011) of what the determined maturity level means for the company and the description of the levels gives a clear understanding of what the differences between the maturity levels are. These maturity models are used as a diagnostic tools and the assigned maturity level can be reported to the management as a base for the development of the digital transformation strategy.

On the basis of this snapshot of the overall maturity, the results can be compared in the form of benchmarking against other companies (Lasrado et al., 2015). 9 out of 25 models serves a comparative purpose that benchmarks the actual situation with either industry specific best practices or with other companies that have conducted the same assessment. However, the limitation of these models is that there have to be enough assessments from a number of participants in order to compare the results. The model

by NBI is an example of a maturity model that serve a comparative purpose, which market the model as a benchmarking tool (NBI, 2017). The main focus of the tool is to obtain an overview of the company's digital competitiveness and the digital potential they do not take advantages of based on a comparison of other companies that shares the same size, industry and country (ibid). The tool notifies the assessor if there are not enough assessments to create a benchmark. Hence, the significance of the benchmarking depends on the availability of data from the same industry.

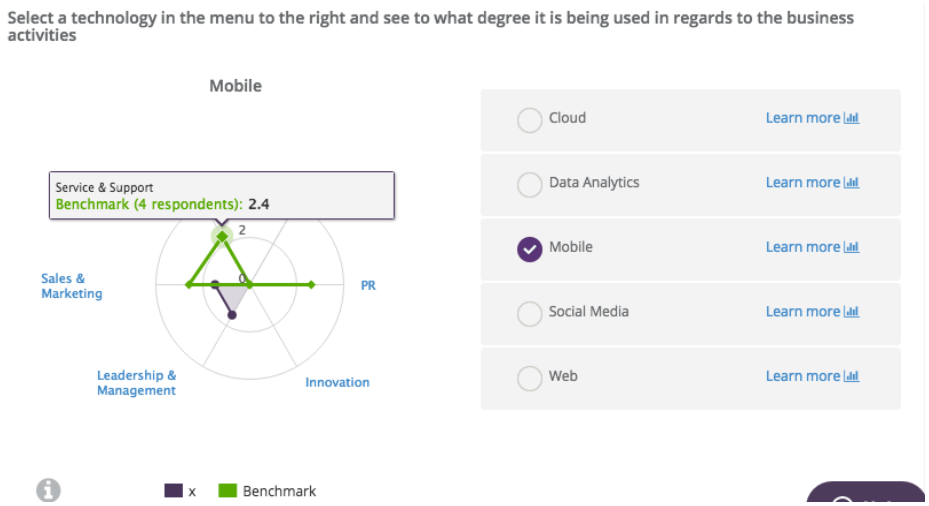


Figure 6: Example of a benchmark on the 'Service & Support' dimension (NBI, 2017).

On the basis of the descriptive snapshot 10 out of 25 investigated models (see appendix 6 descriptive statistics) also have prescriptive components that gives insight into organizational improvements by giving concrete advice to improve the digital maturity. This raises the question of whether such guidance can be provided by the tool itself or whether experts and consultants are needed instead. Deloitte (2015) is a example of an assessment that contain prescriptive components by providing guidelines on improvement measures by each identified capability gap on each dimensions according to the result of the maturity. In contrast KMPG (2015) that also contain prescriptive components are offered by experts with targeted suggestions for improvements including best practice models. The maturity assessment by KPMG (2015) is a whole package of assessments, working side-by-side with consultants and consist of descriptive, comparative and prescriptive components, creating a new category of purpose, namely a category that refers to all three purposes. The assessment involve a staff survey for the purposes of analyzing the status quo, which is benchmarked against the competitors

and industries and lastly the consultants sets milestones and prepares action plans (KMPG, 2015).

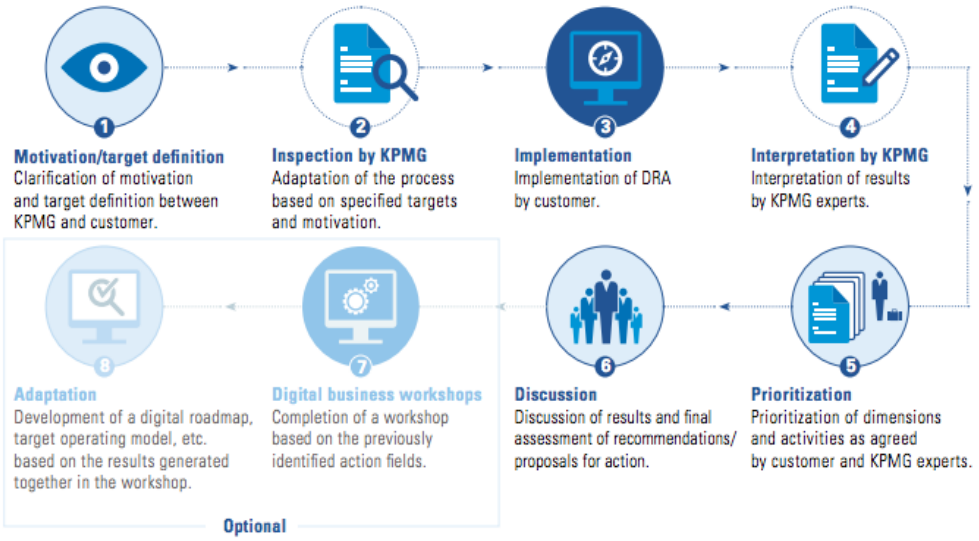


Figure 7: Process flow of KPMG's Digital Readiness Assessment (KPMG, 2015).

4.1.3 EVALUATION AND DATA COLLECTION

The majority of the investigated models allow self-evaluation, mostly by means of online questionnaires that are publicly available, where few models provides the assessment through questionnaires available in a downloadable report or by a conceptual evaluation of maturity levels through guidelines in a belonging report or research study. These models breaks down the capability areas, which are evaluated by questions or indicators. A number of lead questions are asked to be rated, mostly with a 5-point likert scale or by selecting between possible answers that reflects statements that best corresponds to the respondents view of the company. Oracle (2017) is an example of self-evaluation through an online questionnaire that collects data through qualitative statements for each capability area.

Figure 8: Example from Oracle's (2017) online questionnaire

Altimeter (Solis, 2015) is an example of a conceptual self-evaluation that do not collect data from the company instead the company place themselves on a maturity level based on the descriptions of the stages in a research report that includes case studies. The investigated self-evaluations are all available for free either being publically available or by entering company information to access the tool.

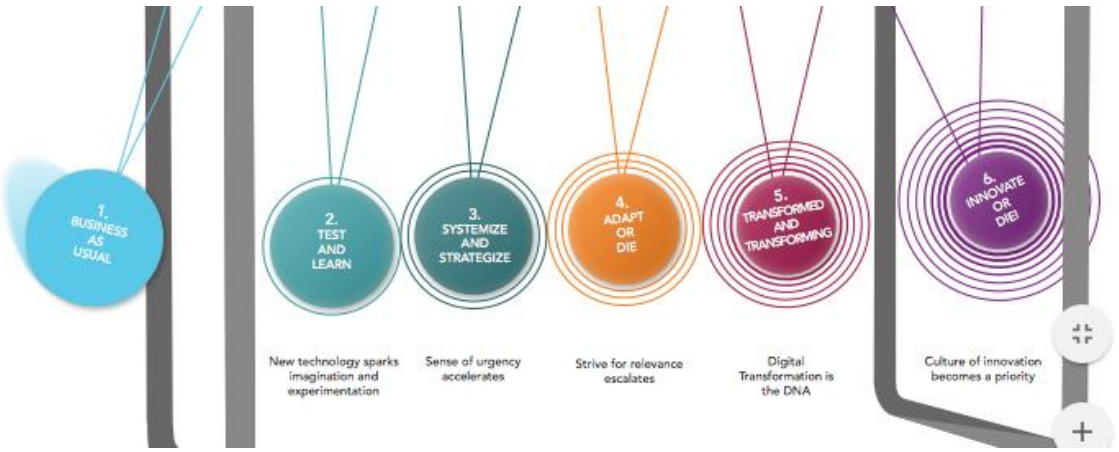


Figure 9: Maturity model from Altimeter (Solis, 2015).

5 out of the 25 investigated models (see appendix 6 descriptive statistics) are not described in full detail or are not publically available, thus there are in these cases need for an external assessor that conducts the assessment for the company. Furthermore, some of aforementioned maturity models allow an assisted self-evaluation, creating a third category of evaluation, namely self-and expert evaluation. The (self)-expert

evaluation collects data mainly from qualitative conceptual assessments in combination with questionnaires with assistance from the external consultants. KPMG (2015) and Adapt2Digital (2015) are examples of assisted self-evaluations with additional expert evaluation that creates a comprehensive analysis and report for the company on how to improve their digital maturity. BearingPoint (2015) and McKinsey (2015) are examples of an assessment that are solely conducted by the consultants. From this perspective it is clear that the consultancy companies that includes expert-evaluation use the assessment and collection of data as diagnostic tools in the beginning of a consultancy service since they are charged services. The description of the assessment can encourage the companies to buy a consultancy service in order to determine its individual requirements to achieve digital excellence and competitiveness.

4.1.4 DIGITAL MATURITY DETERMINATION AND ASSESSMENT

The majority of the 25 sampled maturity models consist of quantitative approaches in order to determine the digital maturity. The quantitative models mostly use structured questionnaires with Likert scales and with qualitative questions or statements. The determination is simple by using a summarized score for each dimension that qualifies a maturity level or score (see figure 8).

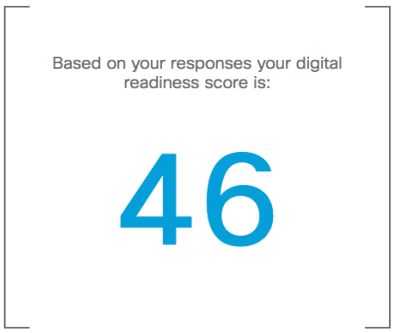


Figure 10: Maturity score out of 100 (Cisco, 2015)

The maturity model by IWI-HSG and Crosswalk (Berghaus et al., 2016) is the only model that combines mathematical-statistical score computation procedures by relying on a weighting of dimensions and its related indicators, which is aggregated to a maturity level (Chanias & Hess, 2016). The easiest indicators classifies maturity level 1 and the most difficult one as level 5. The company is rated based on its percentage that takes all the fulfilled indicators into account (Berghaus et al., 2016).

The number of questions in the questionnaires varies from 7 to 540, and the assessment duration differs in concurrently with how many questions the tool consist of. The more assessment items the longer does the assessment take. In those cases where it is not stated how long the assessment takes, I have gone through the self-evaluation and noted how long the assessment takes.

Qualitative maturity models for instance, are based on management interviews for example BearingPoint (2015), or by conceptual maturity level determination by the assessor from the company for example Dt (2015) which determine a conceptual maturity level on all capability areas. The fact that the maturity is determined on an interpretative basis is common in the qualitative models. The qualitative expert evaluations takes more than one day due to its purpose and function, and since the tool is not publically available one cannot define how many assessment questions it consist of. The qualitative conceptual self-evaluation do not consist of any questions as it is a subjective determination of maturity level based on descriptions of the levels (Dt, 2015; Solis, 2015).

The majority of the tools results in a maturity level allocation and the number of stages or levels ranges from 3-6. However, it is not the number of stages or levels that is important instead it is the path to digital transformation that is noteworthy. Formulated differently the models agrees that the lowest stage of maturity defines a company that has begun to focus on digital operations, but has no or very limited awareness of the changes that digital will bring to the business. The lowest level of maturity refers to terms as Digital Resister (IDC & SAP, 2015), Business as usual (Solis, 2015), Skeptics (Gill & VanBoskirk, 2016), Testing (Berghaus et al, 2016) and Beginners (Westerman et al., 2014). The maturity models also agree that the highest maturity level define a company that are most digitally mature by implementing the newest digital technologies and have coordinated them with a strong strategy and leadership that results in an effective value creation. The digital potential in the core activities define digitally mature companies, and refers to companies that can name them as Digital Masters (Westerman et al., 2014), Differentiators (Forrester, 2016) and Smart Digitalist (KPMG, 2015).

4.1.5 RESULT VISUALIZATION

To depict the assessed results, quantitative models use computed summarized scores that are expressed as graphical illustrations or as percentages. In some cases, the scores serve as a step to match with distinct maturity levels on a maturity model, which provides additional generic information to the overall maturity status of the company. The maturity models are distinguished between staged and continuous maturity models. The staged maturity model provides a standard sequences of improvements on each level before the next stage can be reached (Wulf et al, 2015). Furthermore, the staged maturity model provides an overview of the overall maturity i.e. for all the dimensions together and are simultaneously assessed. Below example is from IDC & SAP's staged maturity model.

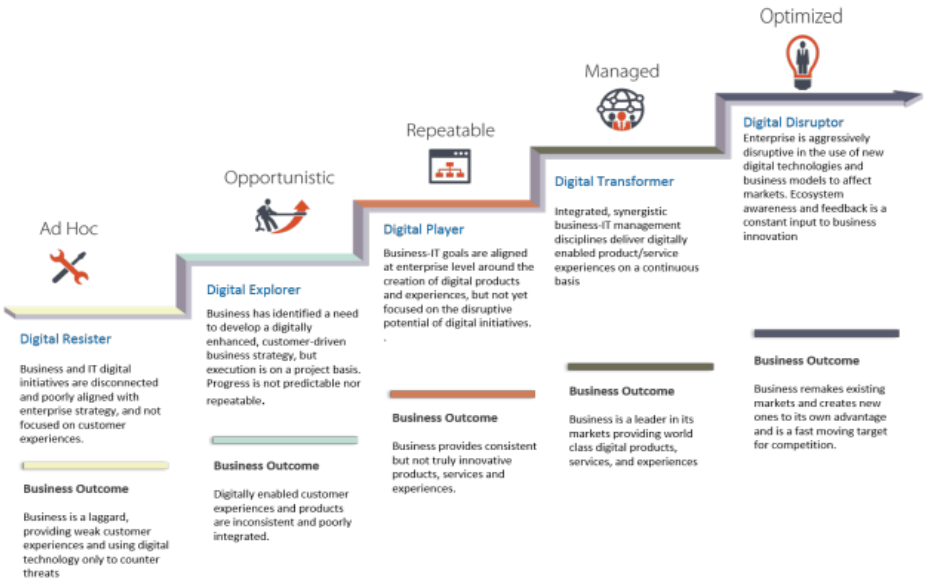


Figure 11: Staged maturity model by IDC & SAP (2015)

The continuous maturity model allows the company to focus on specific dimensions that are considered important by the assessed company. In the continuous maturity model the levels are linked to each capability area, which explain how to reach each maturity level at the respective capability area. This provide the company the opportunity to assess and improve each dimension separately, and can improve the capabilities at different maturity levels and thus limit their scope only to these capability areas. The maturity model by PwC (2015) show that the capability areas develop across four levels

of maturity and give a maturity status on each dimension that the company can target their focus on.

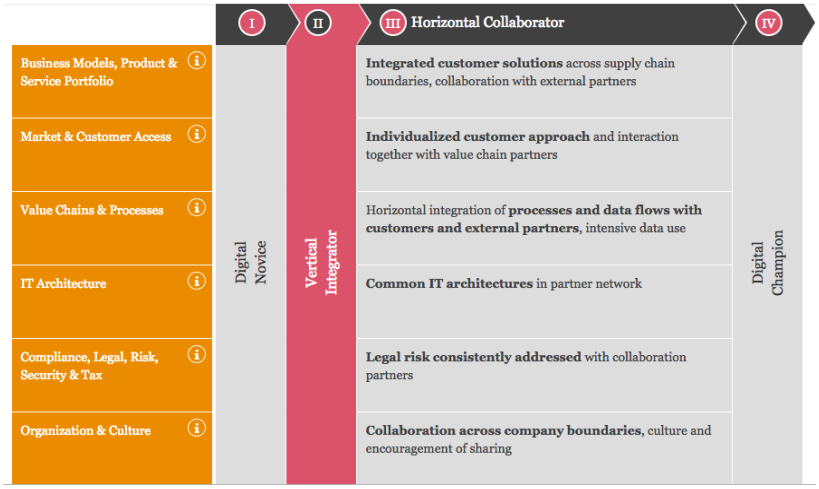


Figure 12: Continuous maturity model by PwC (2015).

Furthermore, the results can be expressed in a 2x2 matrix or in a spider diagram. The 2x2 matrix by KPMG (2015) and MIT Sloan & Capgemini (Westerman et al., 2014) is used to match the company with company archetypes based on two dimensions (axes).

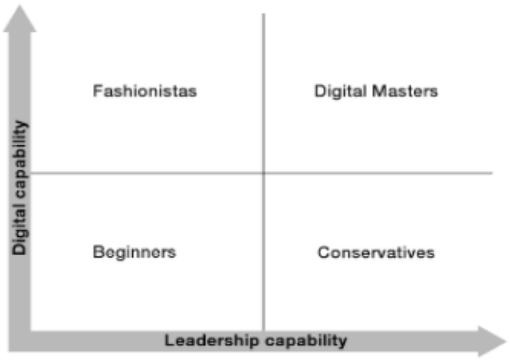


Figure 13: 2x2 maturity matrix by Westerman et al. (2014)

7 out of 25 models that visualize the results in a spider-diagram are used to show the level of maturity or the benchmarking on all capability areas. Visualizing the level of maturity in a spider-diagram gives the company the opportunity to see how mature they are in each of the assessed capability areas like the continuous maturity model. The benchmarking visualized in a spider diagram gives the company the opportunity to see the difference between the actual maturity situation and the average maturity of their competitors, to depict how well they are doing in their digital transformation. However, it is not all comparative assessments that are displaying the comparison in a spider

diagram, it can be through case studies or by standardized statements that describes the maturity in relation to other companies i.e. whether the company is below or above the mean of other assessed companies (EY, 2017).

Figure 14: Result visualization in a Spider-diagram by WFA & Brilliant Noise (2017)

4.1.6 CONCEPTUAL MODEL OF DIGITAL MATURITY MODELS

The above presented design parameters, that determines *how* digital maturity is measured and the capability area, that determines *what* is measured, define digital maturity models and are converted into a conceptual model.

Furthermore, these characteristics will be converted into variables that will be used to classify the investigated models, and potential selection criteria from which the user can choose a maturity model that best fits his specific need and context.

In table 2 the design parameters are converted into variables, by adding the different possibilities in each design parameter as a variable. However, not all design parameters might be relevant when choosing a digital maturity model, for example whether the data is collected by Likert-scales or by selecting between statements might not be relevant for the assessor, for which reason it is not included as variables. Furthermore, it must be noted that the intervals of assessment items and assessment duration are defined based on the time and number of items that have been investigated, for example since no models have between 40 and 120 assessment items it is not relevant to include it in the classification of the models.

Design parameter	Definition	Variables
Purpose	The intention for which the maturity model is applied for and whether the assessment provides the opportunity to compare the results or provides suggestions for improvements	• Descriptive - describes the status quo • Prescriptive - models that allow a gap analysis • Comparative - models that allow benchmarking against other companies • Descriptive, prescriptive and comparative
Respondents	Who is the assessor in the assessment	• Internal assessors • External assessors • Internal and external assessors
Evaluation method	Type of evaluation	• Self-evaluation • Expert-evaluation • Self- and expert evaluation
Data collection	The way data is collected during the assessment	• Online questionnaire • Questionnaire • Conceptual/qualitative
Assessment duration	The duration of the assessment	• 0-15 min. • 16-30 min. • 31-45 min. • 46-60 min. • 61-90 min. • More than one day
Number of assessment items	The number of questions that should be answered during the assessment	• 0-20 assessment items • 21-40 assessment items • 120-200 assessment items • 201-300 assessment items • Above 300 assessment items
Maturity determination	How the maturity is determined	• Score • Maturity level
Visualization	How the maturity is illustrated	• Numerical score • Staged maturity model • Continuous maturity model • 2x2 matrix with archetypes • Spiderdiagram
Cost	The costs to access the assessment	• Free • Charged

Table 2: Design parameter and variables for digital maturity model selection

The content analysis is used to derive a conceptual model of digital maturity models, see figure 13. The conceptual model of digital maturity models will create a foundation for the classification of the models in next section and answer the first part of the research question, namely how digital transformation maturity models can be defined.

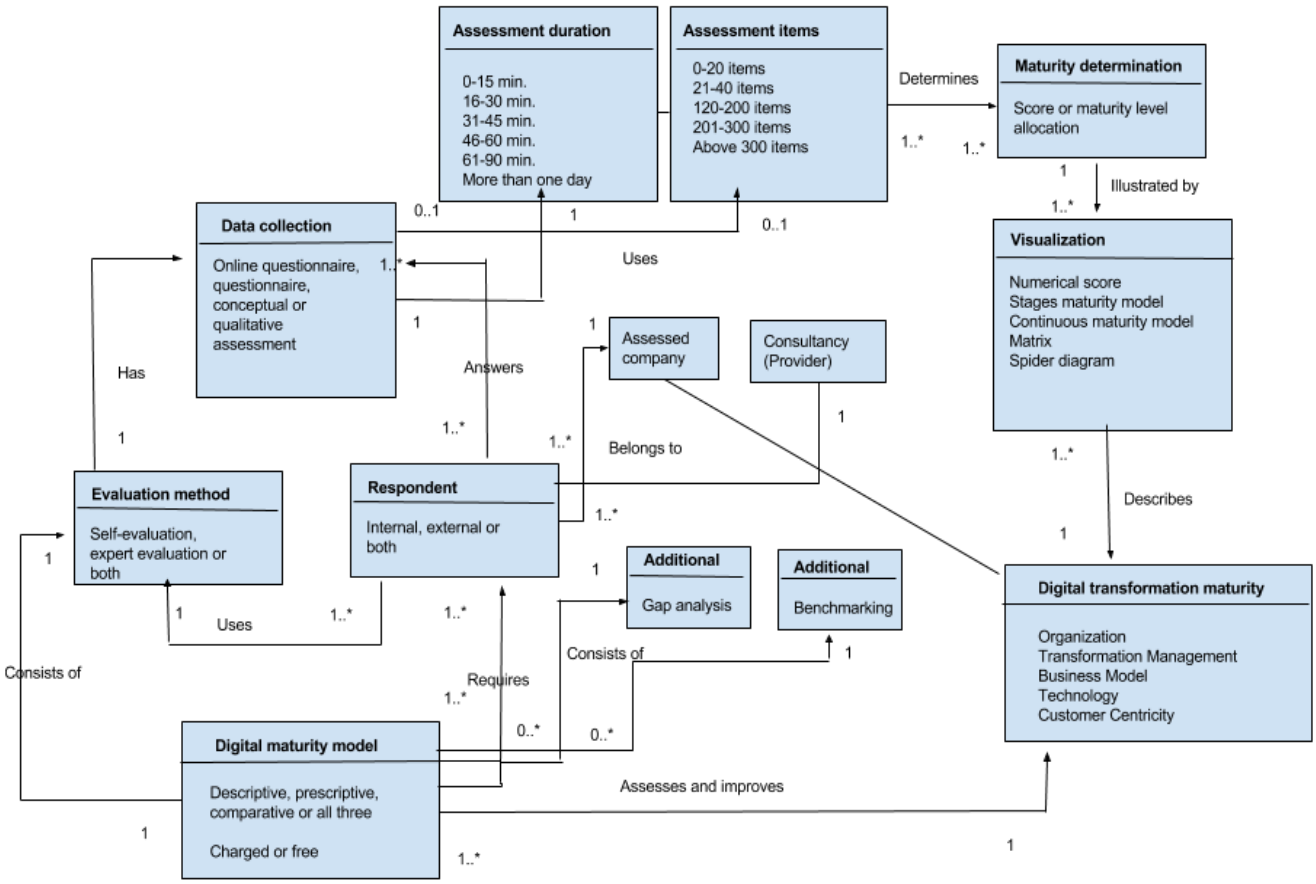


Figure 15: Conceptual model of digital maturity model

4.2 CLASSIFICATION OF DIGITAL MATURITY MODELS

Previous section has defined digital transformation maturity models and has resulted in potential selection criteria (variables) that can help the audience (academics or companies) to select a digital maturity model. However, as one see at the conceptual model, each design parameters consist of different variables (opportunities), which show that the sampled maturity models can be distinguished or classified based on respectively dissimilarities and similarities. Therefore, it is relevant to find a structure in the sample of 25 maturity models. This section will thus organize the models into clusters, where the analysis will show groups of models which are most similar between them and

are more dissimilar to the models belonging to the other groups. This will allow a classification of the models.

4.2.1 CLARIFICATION OF THE DATASET

The first part of this section will describe, which variables the classification will be based on from table 2, since all variables may not be relevant for the classification.

First, the variable '*Descriptive, prescriptive and comparative'* will not be included as an individual variable, instead the maturity models that cover this variable will be present in all three individual variables. The same applies for the variable *internal and external respondents.* Furthermore, the variable for *respondents and self-evaluation* will be merged together, as all maturity models that require internal respondents are self-evaluations and all models that require external respondents are expert-evaluations. The models that are both expert and self-evaluations will be present in both variables. The variable *qualitative assessment* defines management interviews who allocates a maturity level, whereas the variable *conceptual* defines a conceptual allocation of a maturity level by an internal assessor. These two variables are also merged into one variable as both define qualitative assessments since the variable internal and external evaluation already determines whether the qualitative assessment requires internal or external assessors.

The cluster analysis has been conducted two times, where the chi-square test showed in first round that the variables *duration of assessment* and *number of assessment items* did not have a significant importance for the grouping of the models, for which reason these are not included as variables in the final cluster solution $\chi 2$ (2, N = 25) = 0,406, p >0.05

One could assume that when a maturity model determines a maturity score the maturity is visualized as a score. This is the case in for example IBM's maturity assessment, where the maturity score is presented as a score, however, in the case of NBI, the numerical score is placed in a spider-diagram for visualization. This is the reason behind including all variables in '*maturity determination'* and '*visualization'* are included in the clustering as there is not a clear relationship between the determination and visualization type. Furthermore, the maturity model visualization is distinguished in *staged* and *continuous maturity models*, as they gives insight into whether the maturity is seen on a holistic basis or from each of the dimensions, which can be seen as an important similarity factor.

Moreover, all the capability areas that are derived from the conceptual model are included as variables for the classification, as outliers are already excluded in the definition of digital maturity models.

Lastly, the variable '*charged'* is not included as a variable for clustering, as when the maturity assessment is charged it will be coded as absent in the variable '*free'.*

This clarification defines 27 variables for clustering.

4.2.2 CREATION OF CLUSTERS

From the generated dendrogram in the cluster analysis one can observe multiple levels of clusters, and one can therefore observe how many clusters (N=25) digital maturity models creates based on their similarities across the 27 variables. The similarity is measured by number of paired present or absent variables as the simple matching measure is chosen. The maturity models are listed along the vertical axis on the dendrogram (Appendix 11), and the horizontal axis shows the distance between the clusters when they are merged. Examining the rescaled distance on the horizontal axis over the clustering steps, one can examine 4 clusters (Appendix 11). The dendrogram shows that the digital maturity models in cluster 1 are most dissimilar to the digital maturity models in cluster 4 and are less dissimilar to cluster 3 than they are to cluster 4, lastly the maturity models in cluster 1 are most similar to the maturity models in cluster 2.

Furthermore, if one look bottom-up on the dendrogram it shows that the maturity models by OpenText and IBM creates a cluster on a low distance, which means that they are most similar to each other, however, they can still be clustered in cluster 1 on a higher distance with other digital maturity models where they share similarities on some of the variables. The merging of the clusters is shown at the agglomeration schedule (appendix 7) which i.e. shows that OpenText and IBM are the first digital maturity models that are joined in a cluster with a coefficient of 0,880, which reports that the value of the distance (similarity) used to form this cluster is high and reflecting that they are quite similar on most of the variables.

Next the digital maturity models by WFA & Brilliant Noise are the next to create a cluster and at third stage the digital maturity models by NBI and Cisco creates a cluster with the same distance of similarity. At stage 11 the cluster with IBM and OpenText is merged with Deloitte's maturity model, creating a new cluster with the digital maturity models by

Arrk Group and so forth, creating cluster 1. This process continues until all maturity models are in a cluster, thus the coefficient values decrease at each stage of the cluster analysis as the level of similarity decrease until all models are in one cluster. Hence, from the coefficients and the dendrogram, I get an idea of how unlike the clusters being combined are.

However, since cluster 4 only contains 2 digital maturity models (see figure 14) and since cluster 3 is created right after cluster 4, the distance is not that significant, for which reason I set the optimal number of clusters to 3 in order to create more or less equal groups and avoid outliers such as the two digital maturity models in group 4. The dendrogram gives a good overview of the cluster solution and a starting point for further analysis. Since, the cluster analysis is decided as a 3 cluster solution, one can now specify a 3 cluster solution in SPSS.

Next step is to actually group the maturity models in their final clusters by saving a cluster membership of a single solution of 3 clusters. As one see at below table (table 3) the resulting clusters contain respectively 12, 8 and 5 digital maturity models.

	Frequency	Valid Percent	Cumulative Percent
Cluster 1	12	48,0	48,0
Cluster 2	8	32,0	80,0
Cluster 3	5	20,0	100,0
Total	25	100,0	

Table 3: Number of models in each cluster - Average Linkage (Between Groups)

4.2.3 CLUSTER ANALYSIS OF DIGITAL MATURITY MODELS

This part will analyze what the maturity models in each cluster have in common since they are grouped together by calculating their cluster means. This is done by analyzing the variance of each cluster through a One-Way ANOVA, which compares the means (variability) of the three clusters and determines whether there are any statistically significant difference between the means of the three (independent) clusters on each variable.

The aim of the cluster analysis is first to classify the N=25 maturity models (see figure 15), and hereafter describe the average maturity model in each of the 3 clusters based

on the mean values of each variable (appendix 8) and chi-square statistics to determine the significance of the relationship between the clusters and variables, which will aid to come up with three archetypes of digital maturity models. However, it must be noted that the chi-square test determines that the five capability areas do not differ significantly between the three clusters, since the p-value > 0,05[1].

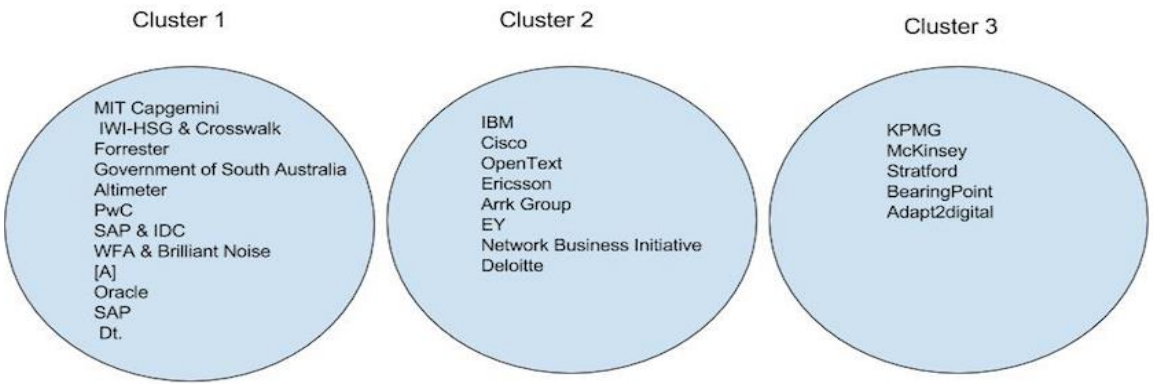


Figure 15: Cluster membership of N=25 maturity models in 3 clusters

To provide a visual interpretation of the results from the clustering I performed a multidimensional scaling of the sampled maturity models with the variables that are used for clustering as well. At below common space plot (figure 16) one can explore the multidimensional data by positioning the maturity models in a low-dimensional space based on their similarities. The common space plot confirms the three cluster solutions, since the digital maturity models in each cluster are placed near each other on the plot, which reflects that these models are most similar. Furthermore, it also confirms that cluster 2, benchmark-oriented maturity models, are more similar to the maturity models in cluster 3, consulting-oriented maturity models, since they are plotted more near to each other than the maturity models from cluster 1. This interpretation is also reflected at the dendrogram as analyzed earlier. Another interesting observation is that the maturity models from cluster 3, consulting-oriented maturity models by KPMG (VAR9) and Adapt2Digital (VAR15) are located away from the other digital maturity models in cluster 3. This confirms the cluster analysis,

[1] If p <0,05 one can on a 95% significance level refuse that the two variables are independent, and can thus make probable that there is a relationship between the two variables (Churchill & Lacobucci, 2010)

where these two models created their own cluster, but were grouped together with cluster 3 in the second three cluster solution.

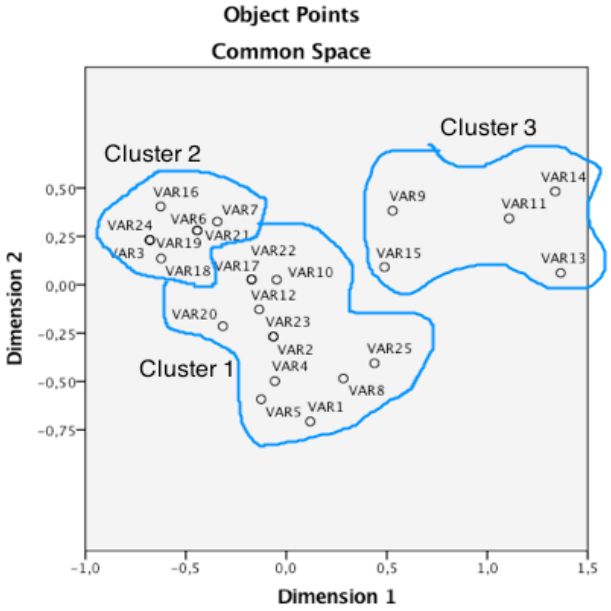


Figure 16: N=25 models in a two-dimensional space

CLUSTER 1 - BEGINNER-ORIENTED MATURITY MODELS

What characterize this cluster is that about half of the maturity models are of descriptive purpose and the remaining have a comparative purpose. Compared to the other two clusters means in the variable “descriptive” it is clear that this is the cluster that is the one that place most of the focus on the descriptive purpose ($\bar{x}$=0,42), where the chi-square test confirms that there is a significant difference between the three clusters ($\chi 2$ (2, N = 25) = 0,009, p <0.05). Hence, the objective of these digital maturity models is to provide an overall status of the current state regarding the assessed company’s maturity. It is because since the majority of the maturity models in this cluster do not provide a gap analysis and come up with recommendations for future plans. This cluster mainly uses online questionnaires ($\bar{x}$=58) ($\chi 2$ (2, N = 25) = 0,048, p <0.05) in case of self-assessments ($\bar{x}$=1,00) ($\chi 2$ (2, N = 25) = 0,001, p <0.05). What they also have in common is that all maturity assessments are determined as maturity levels ($\bar{x}$=1,00)$\chi 2$ (2, N = 25) = 0,000, p <0.05) and visualized in a staged-maturity model ($\bar{x}$=58)$\chi 2$ (2, N = 25) = 0,007, p <0.05, where none of the maturity models in the benchmark-oriented cluster are visualized as staged-maturity models and only one in the consulting-oriented cluster,

confirming that the stage-maturity model is used to provide a holistic overview without many details. The staged maturity model provides an overview of the overall maturity i.e. for all the dimensions and are simultaneously assessed, this confirms that the purpose is not more than providing insights into where the company are, and where they can and want to go. This is further reflected in the capability areas these digital maturity models have in common, which focus on the overall digital transformation, especially on the internal dimensions. The maturity models assesses foundational aspects that matter to a company's overall digital transformation, namely culture, people and skills as well as transformation management and technology, where this cluster has the highest mean in these capabilities.

Hence, the objective of the providers of the maturity models can be seen as a way of marketing themselves, since they have a broad knowledge on digital transformation or being research projects, such as Dt, MIT & Capgemini Consulting as well as the model from IWI-HSG, St. Gallen, which is a result of an academic research.

The objective of the user choosing one of the maturity models in this cluster may be for those who have not taken a maturity assessment before and want to gain insight into their current state for orientation. On top of that, the user choosing one of these maturity models may be in the beginning of their digital transformation stage, and are new to the topic of digital transformation or considering to initiate a transformation. Most of the maturity models in this cluster i.e. by MIT & Capgemini Consulting, Altimeter, Forrester and IWI-HSG consist of a report or articles giving insights into the area of digital transformation as well as case studies. Hence, this cluster can be named beginner-oriented maturity models. The assessment is simplistic in the terms of they are easily publically available as there is no need for a sign up to access the tool, this may further indicate that these digital maturity models are not time-consuming. Furthermore all the maturity models are free of charge ($\bar{x}$=1,00) $\chi 2$ (2, N = 25) = 0,000, p <0.05.

CLUSTER 2 - BENCHMARK-ORIENTED MATURITY MODELS

This cluster of maturity models can be characterized by being of a comparative purpose ($\bar{x}$=0,50), where the objective from the users perspective is to assess the current maturity state and to understand how they compare to other companies across industries and countries. The common properties in this cluster is that all maturity models assess the

maturity through self-assessed ($\bar{x}$=1,00)$\chi 2$ (2, N = 25) = 0,001, p <0.05 online questionnaires ($\bar{x}$=1,00) $\chi 2$ (2, N = 25) = 0,048, p <0.05 . This is further reflected as all of the maturity models are determined as scores depending on an online questionnaire to calculate a score ($\bar{x}$=1,00), which can be seen as a main property of the maturity models that serves a comparative purpose $\chi 2$ (2, N = 25) = 0,000, p <0.05, whereas the descriptive models are mainly determined as maturity level allocation to give a descriptive holistic view of the assessed maturity level (cluster 1).

The determined maturity scores are visualized as scores ($\bar{x}$=1.00), where the benchmarking is explained as whether the score is below or above the average competitor, or in spider diagrams ($\bar{x}$=0,38) $\chi 2$ (2, N = 25) = 0,752, p >0.05 to conduct a benchmark on all off the dimension to compare each dimension with the competitor. The chi-square test shows that there is not a significant difference between the cluster and the use of spider-diagrams, this can be explained by the fact that the comparative maturity models that have been grouped in cluster 1 and cluster 2 (where all maturity models consist of comparative components) also may use spider-diagrams for this purpose. The benchmarking-models allow the company to inform themselves according to their competitors, and determine how they perform in various capability areas. Thereby, the company can identify critical areas where they can be threaten by their peers and thus need to put in actionable plans in order to stay competitive in their industry. The benchmarking comes up with a result on all of the assessed capability areas and thus the scores gives more comprehensive insights into the assessed maturity. This gives the user the opportunity to see how mature they are in all of the assessed dimensions, which again provides a more comprehensive overview than the staged maturity models in cluster 1. Furthermore, the visualization in spider-diagrams allows the user to visualize the difference between their actual maturity state and the maturity states of their competitors. Assessing themselves can furthermore identify areas in which other companies has not succeeded in or implemented yet, which may lead to new innovative ideas for the assessed company.

The objective from the providers perspective is to gain insights into companies regarding the digital transformation as they save the data from the assessment. They may use the insights to adjust their consultancy services or to provide additional services according to the gained insights.

Hence, these clustered digital maturity models are more comprehensive than the ones in cluster 1, in the sense that it gives a detailed view of the maturity regarding their

performance in each capability area and in relation to their competitors. Hence, these models can be named benchmark-oriented maturity models. This is further reflected as the user need to register with their company information in order to access the tool, thus these models are not as easily available as the ones in cluster 1, and may in this sense be more time consuming. However, all the maturity models are free of charge ($\bar{x}$=1,00) $\chi 2$ (2, N = 25) = 0,000, p <0.05.

CLUSTER 3 - CONSULTING-ORIENTED MATURITY MODELS

The common property in this cluster is that the digital maturity assessment consist of partly or solely of assistance by external assessors from the provider (consultancy company) of the digital maturity model. The maturity is assessed solely by external consultants ($\bar{x}$=1,00) $\chi 2$ (2, N = 25) = 0,000, p <0.05 where the difference in proportions is significant between the clusters, or in collaboration with internal respondents ($\bar{x}$=0,40) $\chi 2$ (2, N = 25) = 0,001, p <0.05. In both cases the assessed company becomes a customer rather than an assessor. The data is either collected by online questionnaires ($\bar{x}$=0,40) $\chi 2$ (2, N = 25) = 0,048, p <0.05, with additional management interviews ($\bar{x}$=0,60) $\chi 2$ (2, N = 25) = 0,029, p <0.05, or only by management interviews. One must have in mind that the difference between the clusters and management interviews may be more significant than the p-value shows, as management interviews has been coded as conceptual assessments with self-assessed conceptual maturity level allocations. The first step in these maturity assessment can be an online questionnaire answered by the internal respondent (the customer) from the company that is going to be assessed, hereafter the external consultant help the customer interpreting the status of the maturity to compare with other companies in the industry and to formulate plans for becoming successful in their digital transformation. The digital maturity that are determined solely through management interviews are assessments conducted by the external consultants. Hence, these digital maturity assessment are more than giving a holistic view of the maturity (cluster 1) and more than a benchmarking (cluster 2), since expert knowledge is used to interpret and to create actionable plans. Another common property in this cluster is that all maturity determinations are maturity level allocations ($\bar{x}$=0,60) $\chi 2$ (2, N = 25) = 0,000, p <0.05 to the knowledge of mine, with additional services as a competitiveness analysis ($\bar{x}$=1,00) and gap analysis ($\bar{x}$=1,00).

Since all the maturity assessments in this clusters are charged ($\bar{x}$=1,00), which is significant different between the three clusters $\chi 2$ (2, N = 25) = 0,000, p <0.05, and

not publicity available, the objective from the provider's perspective is likely to use the assessment as entry points into larger consulting projects. Hence, the customer may be aware that the assessments might provide a biased perspective. The relation between the clusters and whether the models are charged or free is significant (0,000, p <0.05). The digital maturity models in this cluster being a part of larger consulting projects are also reflected in the assessed capability areas, as this cluster has the highest mean in the dimensions "strategy" ($\overline{x}$=0,80) and "customer centricity" ($\overline{x}$=0,80) in relation to the two other clusters, which can potentially result in two large projects for the consultancies. By assessing the company's existing or not existing digital transformation strategy, the external consultants can help the company to integrate the entire coordination of the use of technologies, changes in value creation, structural changes and structuring the financial aspects (see literature review for digital transformation strategy). Furthermore, with a focus on the customer centricity dimension, the consultancies can create and offer a marketing project by making grounded business model changes with regard to the digitized customer journey and implementing the right approach and channels to communicate with their customers.

Hence, the objective of these digital maturity models are to market and sell their consultancy services, where they use the models only as diagnostic tool in the beginning of a consultancy project or as entry point to a consultancy service.

The objective of the user selecting one of these assessments is to get professional support to develop and implement digital initiatives and to get help to create roadmaps and establish a long-term foundation for their digital transformation. Hence, this cluster can be named as consulting-oriented maturity models. The average maturity models in each cluster are summarized (table 4).

Beginner-oriented maturity models	Benchmark-oriented maturity models	Consulting-oriented maturity models
• Easily and publically available that mainly serves a descriptive purpose and assess the current state of maturity • Visualized in staged-maturity models provides an overall maturity level allocation for all capability areas that are simultaneously assessed • Assess the foundational aspects that matter to the overall digital transformation • Provider's objective is to market themselves and their broad knowledge on digital transformation - may be a branding initiative. • The user may choose these models as a diagnostic tool in order to get aware of their current state of maturity. The company may be new to the area of digital transformation.	• Need for sign up to access the tool that mainly serves a comparative purpose that compares the maturity to other companies • The maturity is score determined and visualized either as scores or in spider-diagrams that allow the user to see how mature they are on all of the dimensions - giving more comprehensive insights • The objective of the provider is to gain insights into companies and may use it to adjust their consultancy services or to develop and offer additional services upon the assessment • The objective of the user is to compare their maturity to other companies to depict how they are performing in their digital transformation compared to their competitors	• Charged service that serves a descriptive, comparative and prescriptive purpose, where the assessed company becomes a customer rather than a assessor • The data is collected by online questionnaires as well as management interviews and analyses • Online questionnaire is either answered by the customer, in addition the external consultant help the customer interpreting the result, compare them with best practices and formulate future plans for the transformation • Focus on strategy and customer centricity dimensions that can result in potential consulting projects • The objective of the provider is to market and sell their consultancy services • The objective of the user is to get professional support in developing and implementing digital initiatives, and may not have internal resources to do so

Table 4: The average maturity model in each cluster

4.2.4 SELECTION OF DIGITAL MATURITY MODELS IN A SYSTEMATIC MANNER

Previous cluster analysis may help the user to select a maturity model in a conceptual manner based on the most common characteristics of the maturity models in each cluster. After deciding which cluster to go for, the user may look in the review of the individual digital maturity model (appendix 3) to get detailed information about each model. In addition, the purpose of this section is to specify how practitioners can select a digital maturity model in a systematic manner based on the two previous analyses, step-by-step. The sample of digital maturity models will be divided into four count based classification trees that use questions, and follow a proposed sequence that is meaningful for each path until the path where there are no further questions to consider.

The classification trees for each of the purposes are created based on knowledge gained from the decision-tree algorithm in SPSS, which enables me to present categorical results. The classification-tree is used to show the selection flow to separate the dataset within each of the categories (purpose of use) into classes belonging to the response question (variables) as well as the homogeneity in the dataset.

Each classification-tree is arranged in an order where each variable narrows down the cases through the response question until there are no further response question to consider for the user or until there are single cases left. Running a decision-tree in SPSS helped me to classify the nodes that are most significant for the data-set and helped me to prune selection-criteria (the nodes) that do not have a classification power in order to reduce the complexity and to avoid overfitting in the trees. In general the importance of a variable is calculated based on the reduction of the decision tree's accuracy or in the purities of nodes when the variable is cut off (Song & Lu, 2015). Hence, the more a variable have an effect on a record the greater is the importance (ibid). Therefore, it must be noted that each question is not considered in each classification tree due to pruning i.e. the question about the respondents is not asked in the 'descriptive', 'prescriptive' and 'comparative' classification-trees since all of these models are internal self-evaluations and the question about data collection is not asked in the comparative maturity model classification-tree since all of them are online questionnaires. Furthermore, the variables related to the duration of the assessment and number of assessment

questions as well as the defined capability areas did also not have a classification power and provided less additional information for all four trees. This is also confirmed by a chi-square test that show that the p-value do not show a significant difference between the digital maturity models and these variables $\chi 2$ (2, N = 25) = 0,406, p >0.05

Following question should be considered as the first question that determines which purpose the user has with the assessment, which defines, which classification-tree should be followed in order to select a maturity model:

For which purpose are you selecting a digital maturity model?

1. "To raise awareness of my company's current state with regards to our digital transformation, so I can communicate and act on my results since I have no or little knowledge on the area of digital transformation. The maturity assessment should be a self-evaluation and free of charge".

Go for a descriptive maturity model

2. *"Beside raising awareness of my company's current maturity level I want to compare my results to best practices, my competitors or other peers that shares the same industry. The assessment should be a self-evaluation through an online questionnaire that is free of charge, but I do not mind to sign my company up in order to share our results anonymously within the community of maturity model users."*

Go for a comparative maturity model

3. *"Besides raising awareness of my company's current maturity level I want suggestions of improvements that my company can follow in order to become more digitally mature. The assessment should be a self-evaluation and free of charge."*

Go for a prescriptive maturity model

4. *"We are willing to pay for comprehensive insights into our company's digital transformation with a comparison with other peers in the industry and concrete action plans for further improvement of our digital transformation by assistance from domain experts"*

Go for a maturity assessment that consist of descriptive, comparative and prescriptive insights

After deciding which category of digital maturity model the user should choose, the user should follow the belonging classification-tree, where the number (1,2,3,4) in each node refers to the belonging question in table 5. Answering these questions while following the paths in the tree help the user to choose a maturity model that best fits his needs.

Number/Question	Answer
1. Must the assessment require an internal respondent, external respondent or a combination of both?	Internal respondent: an assessor from the assessed company who provides the information during the questionnaire, interview etc.
	External respondent: a consultant from the provider of the maturity model that conducts the assessment and/or assisting the internal assessor
2. How must the data be collected during the assessment?	Online questionnaire: the assessor should fill out an online questionnaire with a number of lead questions should be rated by a 5-point Likert scale, ratio scaling or by selecting between possible answers that reflects statements that best corresponds to the view of the company
	Questionnaire: the assessor should fill out a questionnaire with scores on how agree they are with each statement and then manually summarize the scores to determine an overall maturity level or score
	Conceptual: No statistically data are collected from the company instead on an interpretive basis the company place themselves on a maturity level based on the descriptions of the stages or by management interviews
3. How should the maturity be determined?	Score determination: The maturity level is determined by a summarized statistical score
	Maturity level determination: The maturity level is determined by a maturity level allocation with no weighting of the collected data
4. How should the maturity state be presented?	Numerical score: The maturity is presented as a numerical score i.e. between 0-100
	Staged maturity model: The maturity is presented for the overall maturity on one road map that represents all the simultaneously assessed capabilities

	Continuous maturity model: Road maps are presented for each capability area, which represents the maturity level on each capability separately. This gives the opportunity to focus and improve the capability area the company wants to focus on.
	2x2 matrix: Matches the company with four company archetypes based on two dimensions (capability area) by high and low maturity
	Spider-diagram: Presents the maturity level on each capability area in one visualization, which gives the user the opportunity to see the difference between the assessed maturity and other companies

Table 5: Questions for selection

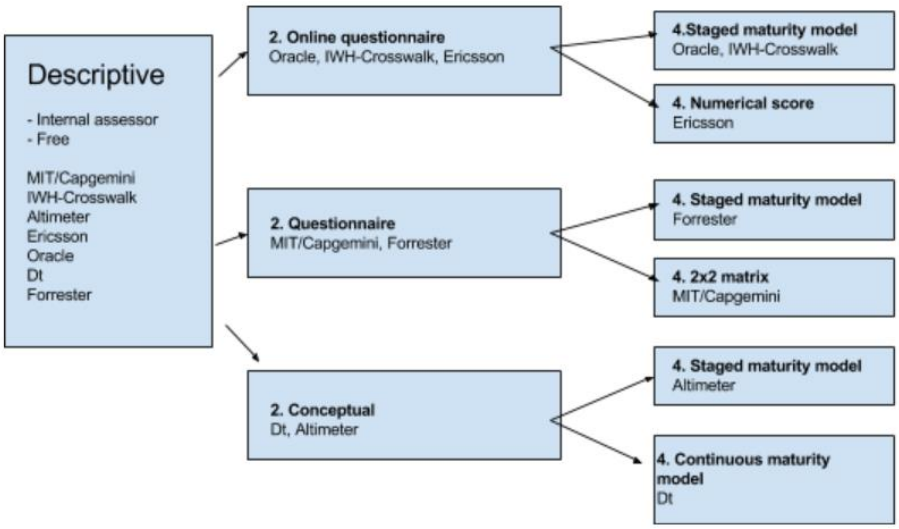


Figure 17: Classification tree for descriptive maturity models

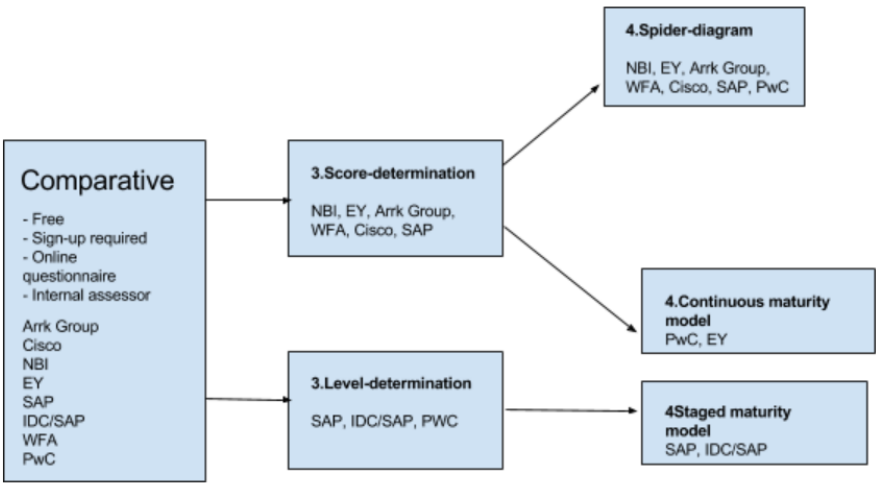


Figure 18: Classification tree for comparative maturity models

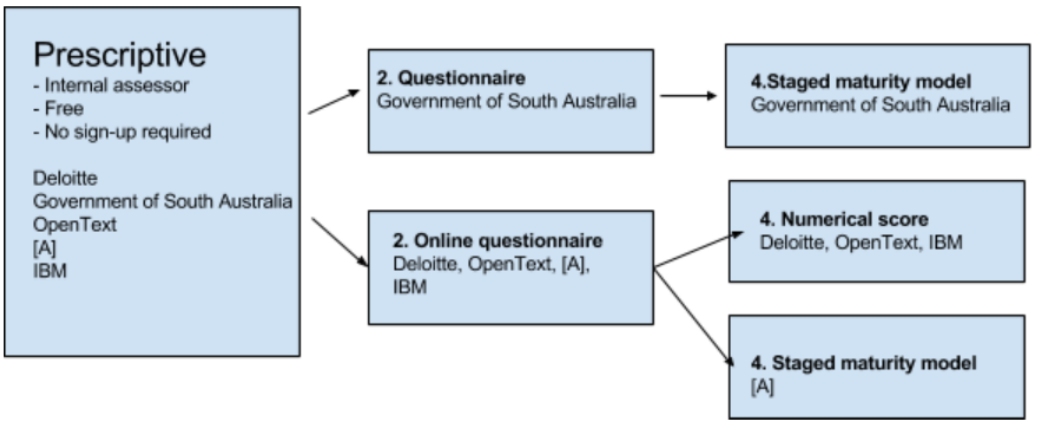


Figure 19: Classification tree for prescriptive maturity models

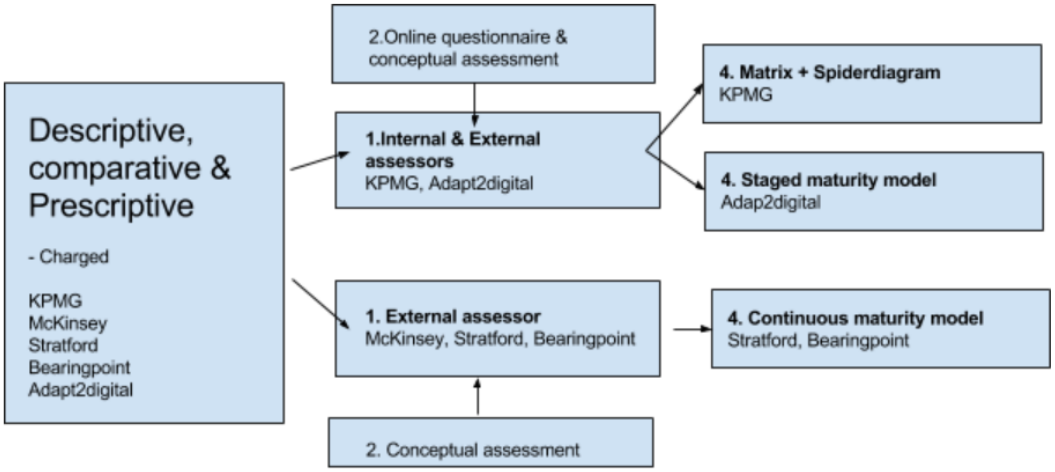


Figure 20: Classification tree for assessment that serves all purposes

5. DISCUSSION

This section completes the thesis by discussing the results and it's implications for academia and practice in relation to the research question. Furthermore, this section reflects on the research limitations and come up with suggestions on how these limitations can be addressed in further research.

5.1 TOWARDS A CONCEPTUALIZATION OF DIGITAL MATURITY MODELS

In this thesis the reader has gained insights into the concept based on a study of existing digital transformation maturity models (N=25) in order to define these to create a foundation for further conceptualization.

5.1.1 WHAT IS MEASURED?

First in order to create a conceptual model of digital transformation maturity it has been examined what the maturity models measures. From the point of view of the literature review the term is understood as the status of a company's digital transformation describing what the company has already achieved and transformed in terms of their transformation efforts and initiatives (Chanias & Hess, 2016; Kane et al, 2015). The efforts and initiatives refer to the accomplished changes in *customer experience, operational processes and business mode*l regarding the mastery of the change process (Chanias & Hess, 2016). It was examined in the analysis that the majority of the sampled digital maturity models assesses main capability areas as organization, which examines whether the company possesses the skills and culture to redesign operational processes and business models to support the organization in delivering the objectives through sub dimensions culture, people & expertise as well as operational process digitization. This is also confirmed by a chi-square test between the sampled digital maturity models and the capability area variables, where the p-value determined in all cases that there is no significant difference between the digital maturity models and the capability areas $\chi 2$ (2, N = 25) = 0,406, p >0.05.

The business model capability area assesses whether the company reinvent existing or develop new business models with regard to digitalization to support an innovative product and service portfolio including the ability to product innovate. Furthermore, most of the maturity models also assesses leadership capabilities to drive the digital transformation including the entire coordination of the use of technologies as well as the

structural changes in the organization and business model, which also examines the existence of a digital transformation strategy. The capability area 'technology', assesses the strategic role of digital technology and its use, adoption and most important the integration into the organization, where the use of analytics is used to gain insights into their customers is a common dimension across the maturity models. Lastly, customer centricity examines whether the company adapts and reacts to the digital customer behavior and expectations into the whole organization and its strategy. Hence, the conceptual model of digital transformation maturity models are consistent with the initial definition of the concept in the literature review as both cover the area of customer experience, changes in operational processes and reconfiguration of or developing new business models to take advantages of digital technologies.

However, the capability area organization and its sub-dimension culture, expertise and skills from the sampled maturity models is an interesting finding since it is not emphasized in the initial definition of the concept from the literature. The area of organization and its sub-dimension are considered as capability area in the sampled maturity models, meaning that company should have a transformation management that assures that the company possess the skills, expertise and culture to re-engineer operational processes. However, in the literature review this capability is not considered in the initial definition, but it must be noted that Westerman et al (2011) mentions it from the perspective of solution delivery i.e. social media and mobile platforms require different approaches and that the company must create a culture of customer centricity. However, from the perspective of the sampled maturity models culture, people and expertise should be an important part of the digital transformation by having internal requirements such as risk appetite and attention to the whole objective of digital transformation. This refers to the fact that it is a matter of the mindset of the people in the organization that must be changed in order to become digitally mature, and not only having a culture of customer centricity and skills to deliver a solution.

The capability area, transformation management, derived from the conceptual model of the sampled maturity models, examines the leadership capabilities to drive the digital transformation, which refers to its sub-dimension strategy that supports the goal of digital transformation. Whereas in the literature review it has been argued that the concept of digital transformation maturity is the mastery of the change process due to the changes in above presented capability areas, which requires a digital transformation strategy. Hence, even though this management capability area is not mentioned as a effort or

change in the initial definition of digital transformation maturity, it has been stated in the literature review that leadership and a transformation management is building blocks for the transformation of the above mentioned capabilities.

Furthermore, the capability area ‘technology’ derived from the sampled models with the sub-dimension analytics is also emphasized as a digital capability in the literature review by Westerman et al (2014). Westerman et al (2014) states that the company should change their business to be led by information management and analytics by combining the unified data with powerful analysis tools in order to gain strategic advantage. Furthermore, companies can reshape the customer value proposition by enhancing, extending or redefining the value of the customer experience by the use of insights from analytics (Berman, 2012).

The digital transformation framework presented in the literature review shows the dependencies between four different dimensions, changes in *value creation, structural changes, use of technologies and financial aspects*, which supports the assessment of a company’s current abilities and the formulation of a digital transformation strategy (Matt et al., 2015, p. 5). This framework is also consistent with the derived capability areas from the sampled maturity models, besides the financial aspects. Only 3 out of 25 of the sampled maturity models assesses the financial capabilities of the company to drive a digital transformation, for which reason they are not included in the definition. This can be explained by the fact that the company should consider the financial aspects, namely the company’s ability to finance a digital transformation endeavor before the former three dimensions as well as before entering a transformation. The changes in the value creation can be mapped up with the capability areas ‘business model’ and ‘product innovation’. Both examines the expansion of the current products and services or development of new products and services through business model change. The structural changes in the framework refers to the dimension ‘organization’, which assesses whether the company re-engineer operational processes to support the digital transformation. Lastly, the use of technology from the framework and the derived capability ‘technology’ from the sampled models finally emphasize that digital transformation is not about implementing digital technologies in silos. Instead it assesses the company’s attitude as well as the ability to exploit digital technologies, which refers to the strategic role of digital technology for a company and its technological ambition (Matt et al, 2015).

While discussing the derived dimensions from the sampled maturity models against the digital transformation framework by Matt et al (2015) and the building blocks by Westerman et al (2014) it is clear that the sampled maturity models emphasize the importance of the internal culture, skills and expertise and the leadership capabilities more than the above authors. Matt et al (2015) do not emphasize these dimensions at all, whereas Westerman et al (2014) has a different view of culture, skills and expertise than the sampled models, where the leadership capabilities are not a part of the building blocks.

5.1.2 HOW IS IT MEASURED?

Having analyzed which capability areas digital maturity assesses with regards to the company's digital transformation, it has also been examined how these models assesses these capability areas.

In the IS literature maturity models are presented as tools to address the evolutionary progress from an assessment of status quo and indicates an anticipated, desired, or typical evolution path of objects, such as capability areas organizations or processes, from an initial to a normally occurring end stage (Becker et al. 2009; Mettler et al. 2010; Berghaus et al., 2012). The sampled digital maturity models represents an evolution path of the presented capability areas. Formulated differently the models agree that the lowest stage of maturity defines a company that has begun to focus on digital operations, but has no or very limited awareness of the changes that digital will bring to the business since they do not utilize the opportunities of digital technologies. The reason behind this level of maturity can be that the company is unaware of the whole area of digital transformation, or they are skeptical by not having the internal attention to the concept or have started to use the digital technologies ineffectively (Chanias & Hess, 2016).

The tools also agree that the highest maturity level defines a company that are most digitally mature, referring to the end stage, that has integrated the newest digital technologies into the business and have coordinated them with a strong strategy, culture, skills, expertise, customer centricity and leadership. This results in an effective value creation by reinventing existing or developing new business models with regard to digitalization to support an innovative product and service portfolio. Aforementioned perspective is consistent with a survey conducted by PwC, where the respondents state that their biggest challenge in their digital transformation is not the right technology instead it is a lack of a digital culture and skills in the company (PwC, 2016).

Hence, taking advantages of the digital potential in the core activities of the company define digitally mature companies. Referring back to the initial definition of digital transformation maturity, the sampled digital maturity models assesses the status of a company's digital transformation by measuring what the company has already achieved and transformed in terms of their transformation efforts and initiatives. The efforts and initiatives refer to the accomplished changes in the five derived main and sub capability areas in the case of the sampled models. This leads to the end-stage, namely the state where the company becomes digitally mature and has gained a competitive advantages to potentially outperform other companies. This is consistent with the maturity models in IS research that determines the state of perfection or completeness of certain capabilities through maturity stages or levels that measure the completeness of the analyzed objects. Hence, the digital maturity models assesses the digital transformation maturity namely the completeness of the capabilities, where the levels or scores in the models measures the completeness of these capabilities.

5.2 DISCUSSION OF CLASSIFICATION AND SELECTION OF DIGITAL MATURITY MODELS

Having analyzed that the sampled maturity models are developed to assess a company's digital maturity through capability areas, the design parameters in terms of data collection, determination and presentation of the maturity differ largely from the perspective of the average maturity model derived from the three clusters. An important finding is that there is a connection between the purpose of the models and its methodological approach. The methodological approach i.e. data collection and visualization type represents how detailed the assessment is, which can be linked up with the purpose of use. The sampled maturity models has been coded as either descriptive, prescriptive, comparative or all three. The cluster analysis showed that the assessment of the capability areas and thus the determination of digital maturity is addressed in more detail when moving from the beginner-oriented (descriptive) to benchmark-oriented (comparative) to the most detailed namely the consulting-oriented maturity models (all three) wherein the prescriptive component is the most important offering.

The most common property of the beginner-oriented maturity models are that they assess the maturity through online or conceptual questionnaires, which is represented on staged-maturity model. This can be a selection-criteria for the user, since it gives a descriptive overview of the overall maturity based all the dimensions, where the

dimensions are simultaneously assessed. Hence, the methodological approach and the descriptive purpose of use are linked to each other. Furthermore, the majority of these maturity models consist of a belonging case study or research that explains the trends, implications and opportunities of digital transformation. This is also the reason behind these maturity models are named beginner-oriented since the emphasis in on the overall maturity based on all dimensions instead of digging down into each capability, which may not be the goal of a new-beginner in digital transformation.

The link between the purpose and methodological approach is also confirmed in the benchmark-oriented cluster, where the most common property is that most of the models offers a benchmark and assessment of each of the capabilities. These are visualized as either scores or in spider-diagrams that allow the user to see how mature they are on all of the assessed capability areas - giving more detailed insights than the aforementioned cluster. Selecting a maturity model from this cluster may be for the company that has initiated digital initiatives and has a strategy they follow, and thus want to use this assessment as a pit stop to ensure that they are on right part and are not being overtaken by their competitors.

Lastly, the methodological approach in the consulting-oriented is qualitative assessments by external consultants or combined with a questionnaire filled out by internal respondents from the assessed company. This cluster is the one where all of the maturity models are comparative and prescriptive. This means that the external consultant help the customer interpreting the status of the maturity to compare with other companies in the industry and to formulate plans for becoming more digitally mature. Hence, in this case the methodological approach and the objective of the models are also linked to each other, where the use of external consultants leads to a more comprehensive and actionable assessment than the two other clusters as it come up with action plans as well as benchmarking. The company selecting one of these maturity models may be from an industry where digital strategy, digital platforms, customer experience are not their core competences i.e. a company that is specialized in manufacturing.

Lastly, the four count-based classification trees has been created to guide the user step-by-step to select a maturity model based on five questions, which have been argued as giving most value for the selection. Due to the small sample of digital maturity models pruning has been done several times by using the SPSS decision tree results, in order to reduce the complexity and to remove variables that provide less additional information.

The ‘duration of time’ and ‘number of assessment items’ are not considered as selection criteria, since these variables provided little significance to classify the maturity models confirmed by a chi-square test. However, if one had a larger sample of digital maturity models one may assume that these would be considered as an important selection criteria for the user.

From above discussion on how digital maturity models can be classified and selected, it should be acknowledged that the needs and intentions of every company may be unique, however, standardized maturity assessment tools may help the companies to identify areas of growth and new opportunities to move towards digital maturity.

5.3 DISCUSSION OF THE METHODOLOGY

In this section the methods used in this thesis will be discussed as well as the credibility of the findings in regards to both reliability and validity.

I have applied a pragmatism philosophy in this thesis with the assumption that it is possible to work with variations in my epistemology and ontology. This assumption directed me towards a decision that a mixed-model research is appropriate for my research, where I have combined qualitative and quantitative data analyses. This approach has been useful as it allowed me to conduct a content analysis on an exploratory stage to get insights into important elements of the sampled maturity models. Hereafter, I have been able to quantitise the qualitative findings into numerical codes in order to statistically analyze the sampled maturity models and to create classification trees. Hence, the pragmatism assumptions and mixed-model approach has been used for different purposes in this thesis. However, Saunders et al (2009, p. 154) pay attention to if both quantitative and qualitative data analyses are combined then the potential of unanticipated outcome is multiplied. Me, as a researcher is mainly regarded with an objective ontology, where I believe that the maturity models are objective entities, as they have descriptions, design parameters, capability areas and are a part of a formal structure and the essence of the models are the same in all contexts. From a epistemology stand I have both integrated subjective (content analysis) and objective (cluster analysis and classification-tree) perspectives to help interpret the data. This shows that even though validity and reliability issues can be considered as minimum in this thesis they are impossible to avoid. However, several aspects assures a validity and reliability in my research. While validity refers to *“whether the findings are really about*

they appear to be about" (Saunders et al, 2009, p. 157), reliability refers to whether the chosen methods will yield consistent findings (ibid).

First, the reliability of the coding procedure in the content analysis is important as the goal is to produce relatively objective results (Neuendorf 2002, p. 141). Therefore it is recommended that more than one coder perform the coding, however, this was not possible, as this thesis only have one researcher. Nevertheless, multiple aspects guarantee intersubjectivity in this content analysis. The official maturity model documents were analyzed instead of analyzing subjective opinions of social actors, furthermore, multiple sources for the same maturity model were analyzed if possible i.e. articles and reports. Hence, the reliability of the content analysis can be considered as high, since the digital maturity models are not context dependent and the information has not been manipulated or been assigned a subjective opinion. This means that the content analysis will yield identical results when analyzing the same maturity models at different points in time, since the maturity models determines the codes and categories, and not me as a researcher.

Lastly, the validity in content analysis is concerned with the coding process, and if the process is well structured and well defined it is regarded valid (Hsieh & Shannon, 2005). The coding in the content analysis has followed a conventional analysis procedure that is well described in the methodology section. Several rules has been applied i.e. when a maturity model is either comparative, prescriptive, descriptive and if a variable is present it has been coded as 1 and 0 for absence to allow standardization. Furthermore, clear distinguishing has been added to the categories (variables) i.e. what constitutes a data collection method and a staged maturity model.

By assuring that the findings from the content analysis is valid and reliable created the basis for the classification study and classification-tree. The validity of the classification is primarily assured by choosing the most meaningful cluster solution after testing different clustering methods and by combining two diverse classification techniques. The cluster analysis has been compared to MDS to validate the final clusters, by determining if the MDS positions reflects the created clusters, which it did. Furthermore, statistically validity measures have been applied. An one-way ANOVA test was applied to determine whether there are any statistically significant differences between the means of the final clusters, which aid to the reliability of the average maturity model I came up within in each cluster. This has been combined with chi-square tests of independence between the clusters and each variable to examine if there is a significantly difference between

the groups and the variables. This aids to the validity of the final clusters and the interpretation of the beginner, benchmark and consulting oriented clusters. In this procedure the cluster analysis produced clusters based on the similarities between the variables, and to check if the clusters are statistically significant the chi-square test used the same variables. The p-value was used as a validity measure for the classification and to ensure that the clusters were not created by chance. However, it must be noted that chi-square tests the statistically difference, which highly depends on the sample size, for which reason one may look deeper into the strength of the relationship between the variables. If the relationship shows that there is a statistically significance, one may assess the relationship by chi-square-based statistics such as phi and Cramer's V (Churchill & Lacobucci, 2010). However, this is not the scope of the thesis, but is mentioned for the sake of attention.

Lastly, since the thesis examines a sample of 25 digital transformation maturity models, it has not been the aim to produce a theory that is generalizable to all research settings, instead the aim has been to examine how the sample of 25 maturity models can be defined, classified and selected. One may therefore assume that choosing a larger sample of digital maturity models beyond the examined in this thesis may have generated other findings with regards to the content analysis and the classification study.

5.4 THEORETICAL CONTRIBUTIONS

Having discussed the main findings of this thesis, this section will discuss the scientific contributions of the findings with the aim to fill a part of the identified research gaps, which the research question is based on.

The first and second research gap concerns the limited literature on digital transformation maturity and the capability areas of digital transformation compared to the existence of literature on the concept of digital transformation. Hence, the first part of the research question aim to answer how we can define digital transformation maturity models. The results of the content analysis of the existing maturity models contributes to the scientific area of digital transformation and to the area of maturity models. Based on a sample of existing digital maturity models (N = 25) this thesis has created a conceptual model of digital maturity models that specifies what and how these maturity models assess a company's digital transformation maturity, which can aid as a first step towards a theoretical framework of digital transformation maturity. Due to a lack of a common

understanding of digital maturity, the content analysis started with defining the capability areas of digital maturity models, which can aid to a digital maturity model terminology i.e. the link between maturity and the digital capability areas, namely the completeness of the capability areas, lead to a higher digital maturity. Hence, this thesis creates consensus on the capability areas for digitally mature companies. The conceptual model can be used to evaluate existing digital maturity models for example the covered capability areas, and also design of new digital maturity models.

Furthermore, the content analysis has created awareness of the implications of the methodological approaches of the maturity models. The classification study of the maturity models aid to understand that the methodological approach (design parameter) is linked with the purpose of use. A company may choose a maturity model from the basis of their current understanding and knowledge of digital transformation i.e. if a company have no or limited awareness of the concept they will go for a model from the beginner-oriented models, where most of the models consist of a belonging report about the concept, its implications and opportunities for businesses. Furthermore, the classification study shows that the methodological approach i.e. whether it is a staged maturity model or spider-diagram defines how detailed the assessment is. This knowledge contributes to the scientific area of maturity models in IS, that one standardized maturity model for i.e. digital transformation, social media etc. may not be the best solution for companies as the purpose of use requires different methodological approaches to fit the needs of the company. The criticism and focus may therefore not be turned towards the existence of a large amount of maturity models, instead the focus should be lead towards creating a conceptualization, classification and selection tools to help companies select the most appropriate models according their needs. This aid to fill research gap three, which determines the nonexistence of an overview or guidance in selecting maturity models.

Lastly, the methodological approach of this thesis can be used to define, classify and create selection suggestions of other maturity models i.e. in the upcoming years maturity models may be developed to assess the maturity of Internet of Things or Artificial Intelligence, where a similar study as this thesis may be relevant to move the domain specific maturity models out of the practical management area. Hence, this thesis can contribute with a common understanding and language of digital maturity models among academics supported by a sample of 25 maturity models.

5.5 PRACTICAL IMPLICATIONS

Having discussed the scientific contributions, this thesis also serves implications for companies. The first part of the research question aid to fill research gaps one and two, which mainly served an academic purpose. However, the definition also supports managers to discuss digital transformation with their employees and through the knowledge of which capabilities need to be assessed and improved in order to increase their digital maturity can help them to interpret their digital maturity results.

Furthermore, the classification of the models can help practitioners to understand and be aware of the differences between the maturity models from the perspective of purpose of use and the methodological approach before looking at the classification-tree and before selecting a maturity model. This implication leads forward to the answer of the last part of the research question, namely how we can select digital maturity models. The classification-tree is the most practical implication of this thesis, as the classification-trees are primarily for practical use for companies that wish to choose a digital maturity model out of a large sample of existing models. This thesis unifies the research findings from the content analysis, namely the conceptual model that consist of several capability areas and design parameters, and the cluster analysis, namely the three distinguished groups of maturity models into classification-trees. Hence, by using the classification-tree, practitioners can find the digital maturity model that best fits the needs of the company, based on rational considerations of five questions that need to be considered while following the classification-tree. Particularly, the classification-tree are for the primary decision makers for the digital transformation in a company, or an employee that is a part of the team that are concerned with the digital transformation i.e. from the marketing department, sales, HR etc. or the CEO, COO and CIO of the company that needs an overview of the current status of the overall organization with regard to the digital transformation.

The findings show that the digital maturity models agree what defines a less digitally mature and a digitally mature company, so one can assume that companies can work with any digital maturity model to assess their digital maturity. However, this thesis emphasizes the importance of the choice of a digital maturity model to its application from the perspective of the purpose of use that is linked to the methodological approach. Hence, the company may not use any maturity model without considering their purpose of use first, since this consideration defines which maturity model to choose in relation to its methodological approach. For example, the company that wants respective

improvement measures and concrete action plans to become more digitally mature may choose consulting-oriented maturity models, that use external consultants and management interviews instead of only using a standardized questionnaire, which gives a more comprehensive and actionable assessment than the beginner-oriented and benchmark-oriented maturity models. This thesis therefore aid to help practitioners in choosing the most appropriate maturity model from start to focus on the actual digital maturity assessment, so that they do not end up using a unusable maturity model for their purpose.

5.6 LIMITATIONS AND FURTHER RESEARCH

While conducting this thesis a couple of limitations was faced, which may have impacted the findings of my research. First, the research is based on a content analysis of a sample of 25 existing maturity models. The sample of digital maturity models are concerned with digital transformation and are not domain or industry specific, i.e. digital transformation in health care, in order facilitate generalization, especially in the capability areas. This can influence the right choice of a maturity model, since health cares may choose an industry specific digital maturity model instead of one of the sampled maturity models. The digital maturity model by NHS, which is targeted for health care services, and examines the use of digital technologies with focus on capabilities such as *"digital care records, transfers of care and medicines management*" (NHS England, 2017). This emphasizes that using a general digital maturity model may not be the best solution in relation to the industry type the assessed company belongs to. However, future research can start from the conceptual model of digital transformation maturity models to build a theory of digital transformation maturity.

Another limitation is that the selection criteria (variables) have been derived from the digital maturity models, where it has not been examined whether contextual and organizational factors can affect the selection of the most appropriate maturity model, which suggest for a future research. Another limitation is due to the scope of the thesis, where the capability areas that are covered by less than half of the sampled digital maturity models have not been considered as capability areas in the definition of digital maturity models and has been considered as outliers right after the coding in the content analysis.

The second limitation of this thesis is regarding the methodological approach. This thesis is conducted from a pragmatist philosophy. Hence, the derived selection criteria and the

classification-trees have not been evaluated *"via well-executed evaluation methods"* (Hevner et al, 2010, p. 12), which may make the reliability, validity and usefulness of the classification-trees in practice questionable and can thus be evaluated in a further study through a design science research (Hevner et al, 2010). One could assume that the audience of the classification-trees do not find them usability friendly or do not share the same assumption of which selection criteria are important. Hence, in a future study the evaluated selection criteria could be expanded into an online questionnaire that consist of a decision table in order to make the selection process more user friendly.

The third limitation is that the conceptual model and the decision criteria (variables) are obtained from the sampled digital maturity models. These are obtained through the websites of the companies and consisting reports, where no design documents have been available that supports the digital maturity models' approaches. Hence, the classification-trees are designed for practitioners but not by the practitioners. This can be seen as limitation of this thesis, since there is no guarantee that these are the selection-criteria that the users value most. To obtain a classification-tree with subjective selection-criteria one could in a further study consult the potential users of these maturity models and experts that are concerned with digital transformation. This could be through a Delphi study, where an expert panel is gathered and by answering a series of questionnaires in several rounds, the responses are shared with the expert panel after each round (Investopedia, 2017). Through this method there could be reached consensus around the capability areas and selection-criteria, which the expert panel found most important and useful.

Lastly, in order to put the thesis into perspective, the digital transformation is moving away from an individual-consumer-centered to an everyone-to-everyone economy (E2E) (Berman & Marshall, 2014). E2E is characterized by connecting consumers and organizations as well as a collaboration of these two parts across value chain activities, such as co-creation, co-marketing and co-funding, where disruptive innovation challenge the established structures of organizations by blurring organizational boundaries (Berman & Marshall, 2014). Hence, the existing digital maturity models may modify the capability areas of digital maturity to capability areas that assesses external influences and partnerships (ibid). As well as determining how the ecosystem of the company is coordinated and whether the company has created a structure that supports the *"symbiotic, contextual and cognitive"* relationship with its customers (Berman & Marshall, 2014, p. 14). Hence, in a further research the definition and classification approach from

this research can be extended for the area of E2E, other maturity models and other emerging concepts.

6. CONCLUSION

The problem area of this thesis is that the existence of a wide range of digital maturity models may make it difficult for companies to select the most appropriate model, where three research gaps have been identified; 1) a unexplored research area, 2) only two academic researches about which digital capabilities are a part of digital transformation 3) no overview or classification of existing maturity models. Hence, this thesis set to answer how we can define, classify and select digital transformation maturity models in order to fill part of the research gaps.

The content analysis of a sample of 25 digital maturity models has been summarized into a conceptual model of digital maturity models, which answers what is measured and how it is measured in order to define these. The main finding is that digital maturity models assesses the status of a company's digital transformation by measuring what the company has already achieved and transformed in terms of their transformation efforts and initiatives. The efforts and initiatives refer to the accomplished changes in five main capability areas; organization, transformation management, business model, technology and customer centricity, which leads to the end stage, where the company is most digitally mature. This stage refers to companies that have integrated the newest digital technologies into the organization and have coordinated them with a strong strategy, culture, skills, expertise, customer centricity and transformation management that results in an effective value creation by reinventing existing or developing new business models to support an innovative product and service portfolio. The discussion on the capability areas shows that while investing in digital technologies is important since they create the basis for the transformation, the ultimately success factor depend on people-focused factors. The company need to develop a digital culture where the employees should have a digital mindset and skills and the company must focus on customer centricity, and assure that the transformation is driven by a clear leadership and strategy.

In relation to how the maturity is measured (the methodological approach), the digital maturity models measures the completeness of the capabilities, by either internal or external assessors through online or offline questionnaires or management interviews where the levels or scores in the models measures the completeness of these

capabilities. The result can either be a maturity level allocation on a staged or continuous maturity model, 2x2 matrix, spider-diagram or as scores.

The sample of 25 maturity models have been classified in three groups; Beginner-oriented, Benchmark-oriented and Consulting-oriented maturity models. This study shows that the methodological approach and the purpose of use are linked to each other and may be an important selection criteria for companies. Based on the most common properties in each group, it can be concluded that the maturity assessment is addressed in more detail when moving from the beginner-oriented (descriptive) to benchmark-oriented (comparative) to the most detailed namely the consulting-oriented maturity models (descriptive, prescriptive, comparative) with regards to the data collection, determination and presentation.

This research suggests that a user may choose a maturity model in the Beginner-oriented cluster as a diagnostic tool in order to get insights into their current state of maturity, where the company may have no or limited knowledge of the area. Visualized in staged-maturity models, these maturity models provides an overall maturity level allocation for all capability areas that are simultaneously assessed. Furthermore, the objective of the user choosing a Benchmark-oriented maturity model is to compare their maturity to other companies to depict how they are performing in their digital transformation. The maturity is score determined and visualized either as scores or in spider-diagrams that allow the user to see how mature they are on all of the dimensions - providing comprehensive insights. Selecting a maturity model from Consulting-oriented cluster the objective of the user is to get professional support to develop and implement digital initiatives and to get help to create roadmaps and establish a long-term foundation for their digital transformation. Hence, they may not have the internal resources or skills to initiate a digital transformation. Either an online questionnaire is answered by the customer, hereafter the external consultant help the customer interpreting the result, or the external consultant creates an assessment by management interviews and compare them with best practices and formulate future plans for the transformation.

Lastly, a classification-tree has been created for each of four purpose of use, which follows a set of lead questions, to help the practitioners to select a digital maturity model in a systematic manner that best fits their needs.

7. BIBLIOGRAPHY

Albanese, J., & Manning, B. (2015). Revive: How to Transform Traditional Businesses into Digital Leaders. FT Press.

Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing maturity models for IT management. Business & Information Systems Engineering, 1(3), 213-222

Berghaus, Sabine and Back, Andrea.(2016). Stages in Digital Business Transformation: Results of an Empirical Maturity Study. MCIS 2016 Proceedings. 22

Berman, S. & Marshall, A. (2014). The next digital transformation: from an individual-centered to an everyone-to-everyone economy. Strategy & Leadership, Vol. 42 Issue: 5, pp.9-17, doi: 10.1108/SL-07-2014-0048

Berman, S. J. (2012). Digital transformation: opportunities to create new business models. Strategy & Leadership, 40(2), 16-24.

Berman, S. J., & Bell, R. (2011). Digital transformation: Creating new business models where digital meets physical. IBM Institute for Business Value, 1-17.

Bounfour, A. (2016). From IT to Digital Transformation: A Long Term Perspective. In Digital Futures, Digital Transformation (pp. 11-29). Springer International Publishing

Chanias, S. & Hess, T. (2016). How digital are we? Maturity models for the assessment of a company's status in the digital transformation. Management Reports des Instituts für Wirtschaftsinformatik und Neue Medien, LMU München, No.2/16 (Management report 2/2016.)

Churchill, G. A., & Iacobucci, D. (2010). Marketing Research: Methodological Foundations. MARKETING RESEARCH.

Collin, J., Hiekkanen, K., Korhonen, J.J., Halén, M., Itälä, T., Helenius, M., (2015). IT Leadership in Transition-The Impact of Digitalization on Finnish Organizations. Research rapport, Aalto University. Department of Computer Science.

De Bruin, T., Freeze, R., Kaulkarni, U. & Rosemann, M. (2005). Understanding the main phases of developing a maturity assessment model. Proceedings of the 13th European Conference on Information Systems, Regensburg

Finch, H. (2005). Comparison of distance measures in cluster analysis with dichotomous data. Journal of Data Science, 3(1), 85-100.

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing digital technology: A new strategic imperative. MIT sloan management review, 55(2),

Gower, J. C., & Ross, G. J. S. (1969). Minimum spanning trees and single linkage cluster analysis. Applied statistics, 54-64.

Henriette, E., Feki, M. and Boughzala, I. (2016). Digital Transformation Challenges. . MCIS 2016 Proceedings. 33.
Henriette, E., Feki, M., and Boughzala, I. (2015). The Shape of Digital Transformation: A Systematic Literature Review. MCIS 2015 Proceedings. Paper 10.

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for Formulating a Digital Transformation Strategy. MIS Quarterly Executive, 15(2).

Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. MIS Q 28(1):75–105

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. Qualitative health research, 15(9), 1277-1288.

Jain, A. K., Murty, M. N., & Flynn, P. J. (1999). Data clustering: a review. ACM computing surveys (CSUR), 31(3), 264-323.

Kaufman, L., & Rousseeuw, P. J. (2009). Finding groups in data: an introduction to cluster analysis (Vol. 344). John Wiley & Sons.

Lasrado, L. A., Vatrapu, R., & Andersen, K. N. (2015). Maturity Models Development in IS Research. In Iris Selected Papers of the Information Systems Research Seminar in Scandinavia.

Lee, A. (1991) "Integrating positivist and interpretivist approaches to organizational research," Organization Science (2) 1991, pp 342-365.

Lehmkuhl, T., Baumöl, U., & Jung, R. (2013). Towards a maturity model for the adoption of social media as a means of organizational innovation. In System Sciences (HICSS), 2013 46th Hawaii International Conference on (pp. 3067-3076). IEEE

Liu, D.-Y., Chen, S.-W. & Chou, T.-C., (2011). Resource fit in digital transformation: Lessons learned from the CBC Bank global e-banking project. Management Decision, 49(10), pp.1728–1742

Matt, C., Hess, T.; Benlian, A. (2015). Digital Transformation Strategies, Business and Information Systems Engineering, 57(5), 339–343.

Megginson, C. L. (1964). Petroleum Management, Volume 36, Number 1, Key to Competition is Management by Leon C. Megginson, Start Page 91, Quote Page 91, Petroleum Engineer Publishing Company, Dallas, Texas. Retrieved from http://quoteinvestigator.com/2014/05/04/adapt/#note-8823-3

Mettler, T., Rohner, P., & Winter, R. (2010). Towards a classification of maturity models in information systems. In Management of the interconnected world (pp. 333-340). Physica-Verlag HD.

Neuendorf, K.A. (2002). The content analysis guidebook. Sage Publications, Inc, 2002. (P. 141).

Niehaves, B. (2007). On epistemological diversity in design science: New vistas for a design-oriented IS research?. ICIS 2007 Proceedings, 133.

Punj, G., & Stewart, D. W. (1983). Cluster analysis in marketing research: Review and suggestions for application. Journal of marketing research, 134-148.
Pöppelbuß, J., & Röglinger, M. (2011A). What makes a useful maturity model? a framework of general design principles for maturity models and its demonstration in business process management. In ECIS.

Pöppelbuß,, J., Niehaves, B., Simons, A., & Becker, J. (2011B). Maturity models in information systems research: literature search and analysis. Communications of the Association for Information Systems, 29(27), 505-532.

Rafsanjani, M. K., Varzaneh, Z. A., & Chukanlo, N. E. (2012). A survey of hierarchical clustering algorithms. The Journal of Mathematics and Computer Science, 5(3), 229-240.

Saunders, M., Lewis, P., & Thornhill, A. (2009). “Research methods for business students”. Harlow [u.a.]: Pearson Education.

Sisodia, D., Singh, L., Sisodia, S., & Saxena, K. (2012). Clustering Techniques: A Brief Survey of Different Clustering Algorithms. International Journal of Latest Trends in Engineering and Technology (IJLTET), 1(3), 82-87.

Solis, B., Li, C. & Szymanski, J., 2014. Digital Transformation: Why and How Companies are Investing in New Business Models to Lead Digital Customer Experiences, s.l.: Altimeter.

Song, Y., & Lu, Y. (2015). Decision tree methods: applications for classification and prediction. Shanghai Archives of Psychiatry, 27(2), 130–135. http://doi.org/10.11919/j.issn.1002-0829.215044

Tashakkori, A. and Teddlie, C. (1998) Mixed Methodology: Combining Quantitative and Qualitative Approaches. Thousand Oaks, CA: Sage. Chapters 1 to 3 of this book provide a useful introduction to multiple methods.

Tesch, R. (1990). Qualitative research: Analysis types and software tools. Bristol, PA: Falmer.

Van Looy, A. (2014). Business process maturity: a comparative study on a sample of business process maturity models. Springer Science & Business Media.

Van Looy, A., De Backer, M., Poels, G., & Snoeck, M. (2013). Choosing the right business process maturity model. Information & Management, 50(7), 466-488.
Weber, R. (2004) "The Rhetoric of Positivism Versus Interpretivism," MIS Quarterly (28:1) pp iii-xii.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. MIS quarterly, xiii-xxiii.

Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. Information and software technology, 54(12), 1317-1339.

Westerman, G. et al., 2011. Digital Transformation: A roadmap for billion-dollar organizations, s.l.: MIT Sloan Management.

Westerman, G., Bonnet, D., and McAfee, A. (2014). Leading Digital: Turning Technology into Business Transformation. Harvard Business Review Press, Boston, Massachusetts.

Winkler, T. (2012). Information technology governance and innovation adoption in varying organizational contexts (Doctoral dissertation, Humboldt-Universität zu Berlin).

Wulf, J., Winkler, T. J., & Brenner, W. (2015). Measuring IT service management capability: Scale development and empirical validation.

Yoo, Y. (2012). Digital Materiality and the Emergence of Evolutionary Sciences of Artificial. In P.
Leonardi, B. Nardi and J. Kallinikos (Eds.), Materiality and organizing.

Yoo, Y., Henfridsson, O., and Lyytinen, K. (2010). The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. Information Systems Research 21:5 - 20th Anniversary Special Issue of Emerging Challenges.

INTERNET REFERENCES

Afshar, V., 2015. Accenture Digital: 7 Digital Business Transformation Lessons. [Online] Retrieved from http://www.huffingtonpost.com/vala-afshar/accenture-digital-7-digital-business-transformation-lessons_b_6622648.html last visited 22.02.2017

Capgemini Consulting (2017). Digital transformation. Retrieved from https://www.capgemini-consulting.com/digital-transformation last visited 27.04.2017.

IBM (2012a). Hierarchical Cluster Analysis Measures for Binary Data. Retrieved from https://www.ibm.com/support/knowledgecenter/SSLVMB_21.0.0/com.ibm.spss.statistics.help/cmd_cluster_measure_binary.htm last visited 27.04.2017

IBM (2012b). Multidimensional Scaling Dissimilarity Measures for Binary Data. Retrieved from https://www.ibm.com/support/knowledgecenter/SSLVMB_21.0.0/com.ibm.spss.statistics.help/cmd_proxscal_measure_binary.htm. last visited 27.04.2017

IBM (2012c). Hierarchical cluster analysis algorithms. Retrieved from https://www.ibm.com/support/knowledgecenter/en/SSLVMB_21.0.0/com.ibm.spss.statistics.help/alg_cluster_averagebetween.htm Last visited 27.04.2017

Investopedia (2017). Delphi method. Retrieved from http://www.investopedia.com/terms/d/delphi-method.asp . Last visited 05.05.2017

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. MIT Sloan Management Review and Deloitte

University Press, 14. Retrieved from http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/

Moe, A. (2015) I krydsfeltet mellem IT og forretning er Digital Transformation et af tidens buzzwords. Retrieved from https://www.capgeminisogeti.dk/om-os/publikationer/blogs/blog-digital-transformation/. last visited 22.02.2017

NHS England (2017). Digital maturity assessment. Retrieved from https://www.england.nhs.uk/digitaltechnology/info-revolution/maturity-index/ . Last visited 06.05.2017

PwC (2016). Industry 4.0: Building the digital enterprise. Retrieved from https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf . Last visited 25.04.2017

StackExchange (2016). Using Ward's method for clustering and Dice's similarity coefficient for binary data. Retrieved from https://stats.stackexchange.com/questions/190835/using-wards-method-for-clustering-and-dices-similarity-coefficient-for-binary last visited 27.04.2017

Turner, A (2016). How mature are you? You really need to know. Retrieved from https://inform.tmforum.org/nfv-it-transformation/2016/12/mature-really-need-know/ last visited 05.01.2017

MATURITY MODELS

[A] (2017). Digital Maturity Evaluation. Retrieved from https://simplea.com/landing/Associations/Digital-Maturity-Evaluation 26.03.2017

Adapt2Digital (2015). Digital engagement map. Retrieved from http://www.adapt2digital.com/digital-engagement-map-beta-signup/ 23.03.2017

Arrk Group (2017) Digital Maturity Assessment. Retrieved from http://www.arrkgroup.com/digital-maturity-assessment/ 24.03.2017

BearingPoint (2015) Digital Maturity Assessment. Retrieved from https://www.bearingpoint.com/files/BEDE15_0993_FC_EN_Digital_Maturity_final.pdf&download=0 23.03.2017

Berghaus, Sabine and Back, Andrea. (2016). Stages in Digital Business Transformation: Results of an Empirical Maturity Study. MCIS 2016 Proceedings. 22.

Cisco (2015). Digital Readiness Index Rapid Assessment. Retrieved from http://www.cisco.com/c/m/en_us/solutions/data-center/offers/Digital-Readiness-Assessment/index.html 25.03.2017

Deloitte (2015). How digital are you?. Retrieved from https://eu.deloittedigital.com/en/content/digital-maturity 26.03.2017

Dt (2015). Digital Maturity. Retrieved from http://thepathtodigitaltransformation.com/digital-maturity-model/ 24.03.2017

Ericsson (2017). Digital maturity assessment test. Retrieved from http://dma.live.ericsson.net/ 22.03.2017

EY (2017). Digital Maturity Check. Retrieved from https://digitalmaturitycheck.ey.com/ 27.03.2017

Gill & VanBoskirk (2016). Digital Maturity Model 4.0. Retrieved from https://forrester.nitro-digital.com/pdf/Forrester-s%20Digital%20Maturity%20Model%204.0.pdf 26.03.2017

Government of South Australia (2016). Digital maturity assessment tool. Retrieved from https://digital.sa.gov.au/sites/default/files/content_files/toolkits/Digital_Transformation_Toolkit_Guide.pdf 26.03.2017

IBM (2017). Digital Transformation Assessment. Retrieved from http://www-01.ibm.com/software/info/middleware/digital-experience/us-en/self-assessment/ 24.03.2017

IDC & SAP (2015). IDC Benchmark. Retrieved from https://sap.dx-idcmaturityscapesnapshot.com/ 24.03.2017

KPMG (2015) Digital Readiness Assessment. Retrieved from https://assets.kpmg.com/content/dam/kpmg/pdf/2016/04/digital-readiness-assessment-03-16.PDF 27.03.2017

McKinsey (2015). Digital Quotient. Retrieved from http://www.mckinsey.com/business-functions/digital-mckinsey/how-we-help-clients/digital-quotient 25,03.2017

Networked Business Initiative (2017). Networked Business Assessment Tool. Retrieved from http://www.networkedbusiness.org/benchmark%20your%20company/networkedbusiness 26.03.2017

OpenText (2017). Digital Readiness Assessment Tool. Retrieved from http://www.opentext.com/campaigns/2020-agenda/digital-readiness-assessment-tool 25.03.2017

Oracle (2017). The Oracle Digital Transformation Assessment. Retrieved from https://www.oracle.com/webfolder/s/digital-transformation-assessment/index.html 23.03.2017

PwC (2015). Industry 4.0 Self-assessment. Retrieved from https://i40-self-assessment.pwc.de/i40/landing/ 26.03.2017

SAP (2016). Digital Transformation Assessment. Retrieved from https://www.sapdigitaltransformation.com/pdf/DigitalTransformationAssessment_DimensionAnswerDefinitions_v15_FINAL.pdf and survey from https://www.sapdigitaltransformation.com/survey/1 24.03.2017

Solis, B. (2015). The six stages of digital transformation maturity. Retrieved from https://www.cognizant.com/whitepapers/the-six-stages-of-digital-transformation-maturity.pdf 27.03.2017

Stratford (2015). Digital Maturity Assessment. Retrieved from http://stratfordmanagers.com/wp-content/uploads/2015/10/Stratford-Digital-Maturity-Assessment%E2%84%A2-Result-Sample.pdf 24.03.2017

Westerman, G., Bonnet, D., & McAfee, A. (2014). Leading digital: Turning technology into business transformation. Harvard Business Press.

WFA & Brilliant Noise (2017). SONAR. Retrieved from https://brilliantnoise.typeform.com/to/wk3apC 23.03.2017

APPENDIX

Appendix 1 - Concept matrix

	Digital transformation	Digitization and digitalization	Maturity	Digital Maturity	Maturity model development
Albanese, J., & Manning, B. (2015).	x			x	
Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). .			x		x
Berghaus, Sabine and Back, Andrea (2016)	x			x	x
Berman, S. J. (2012).	x	x			
Bounfour, A. (2016).	x				
Chanias, S. & Hess, T. (2016).	x	x		x	x
Collin, J., Hiekkanen, K., Korhonen, J.J., Halén, M., Itälä, T., Helenius, M., (2015).	x	x			
De Bruin, T., Freeze, R., Kaulkarni, U. & Rosemann, M. (2005)			x		x
Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013).	x				
Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016).	x				
Henriette, Emily; Feki, Mondher; and Boughzala, Imed (2016)	x				
Henriette, Emily; Feki, Mondher; and Boughzala, Imed, (2015).	x	x			
Lasrado, L. A., Vatrapu, R., & Andersen, K. N. (2015).			x		x
Lehmkuhl, T., Baumöl, U., & Jung, R. (2013)			x		x
Liu, D.-Y., Chen, S.-W. & Chou, T.-C., (2011).	x	x			
Matt, C., Hess, T.; Benlian, A. (2015)	x				
Mettler, T., Rohner, P., & Winter, R. (2010).			x		
Pöppelbuß, J., & Röglinger, M. (2011A).					x
Pöppelbuß,, J., Niehaves, B., Simons, A., & Becker, J. (2011B).			x		x
Wendler, R. (2012).			x		x
Westerman, G. et al (2011)	x				
Westerman, G., Bonnet, D., and McAfee, A. (2014).				x	
Wulf, J., Winkler, T. J., & Brenner, W. (2015).			x		
Yoo, Y., Henfridsson, O., and Lyytinen, K. (2010).		x			
Yoo, Y. (2012).		x			

Appendix 2 - Sample of maturity models

	Institution/Name
1	MIT/Capgemini Consulting (Digital Maturity)
2	IWI-HSG and Crosswalk (Digital maturity model)
3	Deloitte (How digital are you?)
4	Forrester (Digital Maturity Model 4.0)
5	Government of South Australia (Digital maturity assessment tool)
6	Networked Business Initiative (Networked Business Assessment Tool)
7	EY (Digital Maturity Check)
8	Altimeter (Digital Transformation Maturity)
9	KPMG (Digital Readiness Assessment)
10	PwC (Industry 4.0 Self-assessment)
11	McKinsey (Digital Quotient)
12	SAP (IDC Benchmark)
13	Stratford (Digital Maturity Assessment)
14	BearingPoint (Digital Maturity Assessment)
15	Adapt2Digital (Digital engagement map)
16	Arrk Group (Digital Maturity Assessment)
17	WFA & Brilliant Noise (SONAR)
18	Ericsson (Digital maturity assessment test)
19	OpenText (Digital Readiness Assessment Tool)
20	[A] (Digital Maturity Evaluation)
21	Cisco (Digital Readiness Index Rapid Assessment)
22	SAP (Digital Transformation Assessment)
23	Oracle (The Oracle Digital Transformation Assessment)
24	IBM (Digital Transformation Assessment)
25	Dt (Digital Maturity)

Appendix 3 - Review of the sampled maturity models

Appendix 3.1 MIT Sloan & Capgemini Consulting - Digital Maturity (Westerman et al., 2014, Chanias & Hess, 2016)

General Aspects

Number and focus of dimensions:

2 dimensions: “Digital intensity” describes a combination of strategic assets, digital elements, digital capabilities and investments. “Transformation Management Intensity” assesses managerial aspects such as digital vision, governance and engagement

Purpose:

Descriptive. Creating awareness. Standardized approach to assess digital maturity in relation to the current situation. The model has been revised two times.

Data Collection and Analysis

Respondents:

Internal respondents as evaluator

Evaluation and data collection:

Self-evaluation/questionnaire with 10 lead questions for each of the two dimensions through a questionnaire, where each dimension is rated through these lead questions with a 7 point likert scale**.**

Digital maturity level determination:

Quantitative model based on a summarized score for each dimension. The value 10 represents the lowest score per dimension and the value 70 is the maximum, thus there is no weighting of the questions.

Data Presentation

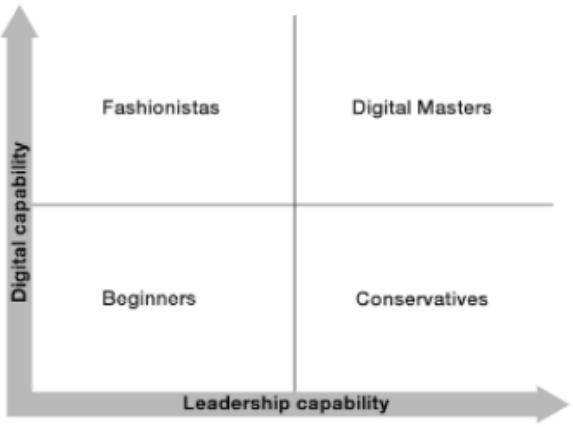
Digital maturity assessment:

The digital maturity of a company is the combination of the scores of the two dimensions. The total value of the two dimensions is assigned to a quadrant (the maturity level) The levels are:

1. Beginners are in the beginning of their digital transformation and are considered immature in both dimensions and do not utilize and exploit the opportunities of digital technologies.
2. Fashionistas have started to implement digital technologies to exploit its digital opportunities, however, the lack of management skills results in the digital technologies no not interact with each other to create an overall value.
3. Conservatives are able to manage digital technologies effectively, however, due to their conservatism they might be skeptis on new technologie and can therefore miss out chances to add value to the firm.
4. Digiratis are the most digitally mature companies by implementing the newest digital technologies and have coordinated them with a strong strategy, resulting in an effective value creation.

Result visualization:

The results is a total numeric score of each question from each of the two dimensions. The digital maturity is allocated in a 2x2 digital maturity matrix categorizing four different digital maturity levels.



From Chanias & Hess, 2016, p. 7

Benchmarking:
No
Gap analysis:
No

Appendix 3.2 IWI-HSG and Crosswalk: Digital maturity model (Berghaus et al., 2016, Chanias & Hess, 2016)

General Aspects

Number and focus of dimensions:
The model has 9 dimensions: Customer experience, product innovation, Strategy, Organization, Process digitization, Collaboration, ICT Operations & Development, Culture & Expertise and transformation management.

Purpose:
Descriptive. Creating awareness. Based on best practice indicators, and since they are revised on a regular basis to stay up to date, it has resulted in a revised model from 2016.

Data Collection and Analysis

Respondents:
Internal respondents mainly higher executive levels as the model require knowledge from different dimensions

Evaluation and data collection:
In order to assess the maturity the company has to answer an self-evaluation/online questionnaire as a part of a campaign that evaluates a number of companies during a certain period. 60 best practice indicators for each dimension through questions answered by a 5 point likert scale.

Digital maturity level determination:
Dynamic weighting of the indicators based on their degree of difficulty i.e. the more companies that go with an indicator the easier is it rated.

Data Presentation

Digital maturity assessment:
The scores are categorized into the 5 levels of maturity by a cluster analysis:

Testing, establishing, consolidating, structuring and optimizing.
The easiest indicators classifies maturity level 1 and the most difficult one as level 5. The company is rated based on its percentage viewed maturity level that takes all the fulfilled indicators into account.

Result visualization:
Numerical score and allocation on a maturity level.

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.

From from Chanias & Hess (2016) (adopted from IWI-HSG and Crosswalk 2015)

Benchmarking:
No
Gap analysis:
No

Appendix 3.3 Deloitte: How digital are you? (Deloitte, 2015)

General Aspects
Number and focus of dimensions:
5 dimensions with both internal and external focus: Strategy and leadership, customer engagement, products & services, organisation & talent and digital operations

Purpose:
Prescriptive purpose as it measures the status quo of the whole company and gives a detailed view on the results with a gap analysis.

Data Collection and Analysis
Respondents:
Internal respondents that have knowledge of the transformation as the questions does not require that much knowledge about specific processes

Evaluation and data collection:
Self-evaluation through an online questionnaire by answering 7 questions on each of the five dimensions. The evaluator assess the statements through a 5 points Likert scale, which also reflects a total percentage for each scale.

Digital maturity level determination:

The user drags a scala that represents the scales with percentage that decides, which point the user agrees on.

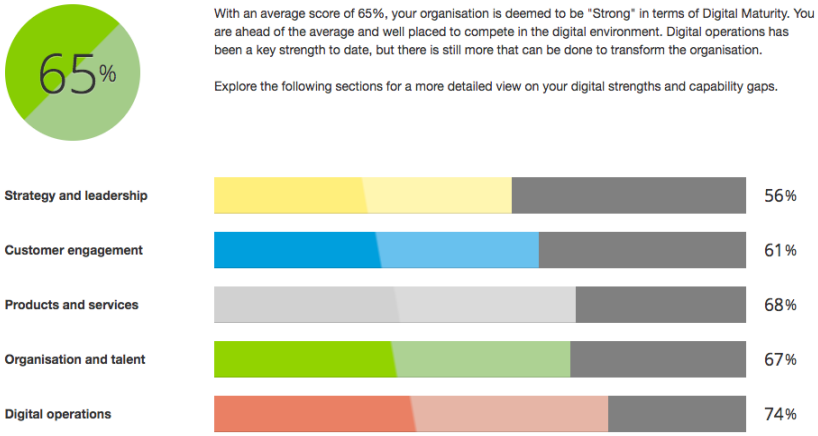
Data Presentation

Digital maturity assessment:

The scores/percentages from the online questionnaire generates an average score, which shows the digital maturity of the assessed company.

Result visualization:

The results shows the average percentage the company has achieved out of 100% on each dimension. Furthermore the company gets a break down view on the dimensions and shows the percentages on sub-dimensions the company has achieved. The results are elaborated with a description on the company's digital strengths and capability gaps. See below example from an assessment.



Benchmarking:

No

Gap analysis:

Yes - the detailed view on the results gives a gap analysis that shows the capability gaps and the company is advised to a small extend.

Appendix 3.4 Forrester: Digital Maturity Model 4.0 (Gill & VanBoskirk, 2016)

General Aspects

Number and focus of dimensions:

4 dimensions: Culture, Organization, Technology and Insights

Purpose:

Descriptive

Data Collection and Analysis

Respondents:

Internal respondents can be all kind of employees as the questions does not require that much knowledge about specific processes

Evaluation and data collection:

Self-evaluation questionnaire that can be applied to a company. The tool consist of 7 statements on each of the four dimensions and are scored through a 4 point likert scale on how much the evaluator is agree with each of the statements.There is also an interactive version of the tool, which the company can buy through Forrester.

Digital maturity level determination:

The evaluator has to add all the scores from the tool, that gives a overall score range and is putted into one of the four different maturity segments (levels).

Data Presentation

Digital maturity assessment:

Four different maturity segments that shows the level of maturity (high to low): Differentiator, Collaborator, Adopters, Skeptics. See 'result visualization' for the score ranges.

Result visualization:

A total numeric score of the 4 dimensions is allocated to a maturity level based on a score range that defines the maturity levels. The score ranges are 0-33, 34-52, 53-71 and 72-84, hence scores between 72-84 determine the highest level of maturity.

Each maturity level is explained through a characteristic behavior that come up with a standard recommendation for the strategy in order to achieve a higher maturity level.

Maturity segment	Characteristic behavior	Strategy	Score range
Differentiators	Leveraging data to drive customer obsession.	Blend the digital and physical worlds.	72-84
Collaborators	Breaking down traditional silos.	Use digital to create competitive advantage.	53-71
Adopters	Investing in skills and infrastructure.	Prioritize customer relationships over production.	34-52
Skeptics	Just beginning the digital journey.	Prompt a willing attitude.	0-33

From Forrester (2016, p. 15)

Benchmarking:

Yes - The results can be benchmarked on characteristics common to more mature companies that provides a foundation for the evaluator's ongoing plan.

Gap analysis:

No

Appendix 3.5 Government of South Australia - Digital maturity assessment tool. (Government of South Australia, 2016)

General Aspects

Number and focus of dimensions:

Governance & leadership, People & culture, Capacity & capability, innovation and technology and divides each dimension into five levels of maturity

Purpose: Prescriptive. The toolkit come up with recommendations

Data Collection and Analysis

Respondents:

Internal respondents used by the employees in an organisation that are aware of external and internal activities

Evaluation and data collection:

Self-evaluation. For each dimension on each level of maturity the evaluator tick any characteristic (5 characteristics on each of 5 maturity level across 5 dimensions:I 5*5*5 assessment items) they feel the organisation matches or exhibits across all levels of maturity.

Digital maturity level determination:

The evaluator looks at the pattern of ticks he has given across the maturity levels on each of the five dimensions and then assess a digital maturity by estimating a rating from 1-5 for each dimension. Example: If most of the ticks appears in levels 1 and 2, and looking at the characteristics of level 3 where no ticks are given, the maturity level rating is 2. or, if most ticks appear in level 3 and one tick in level 4 has such a significant weighting for the evaluator (company) the final maturity level for that dimension will be 3,5.

Data Presentation

Digital maturity assessment:

The evaluator adds the maturity ratings and then divide by 5, which will give the overall maturity rating.

Result visualization:

Numeric score. There is no description or explanation of the overall summarized maturity rating and therefore lacks an analytical approach towards the end level/rating of maturity.

Pillar	Maturity Level Rating
Governance and leadership	
People and culture	
Capacity and capability	
Innovation	
Technology	
Overall digital maturity rating (add pillars then divide by 5)	

Government of South Australia (2016)

Benchmarking:

No

Gap analysis:

Yes - The tool comes with a Digital Strategy template toolkit in order to assist companies to develop a digital strategy in line with best practises across Australia.

Appendix 3.6 Networked Business Initiative: Networked Business Assessment Tool (Networked Business Initiative, 2017)

General Aspects

Number and focus of dimensions:

Benchmarks the company's digital maturity by their use of 5 different technologies
Web,Social Media, Mobile, Cloud and Data analytics
across 7 business activities, and gives 35 dimensions
Sales & Marketing, PR & Communications, Service & Support, Innovation (R&D), Human Ressources and Leadership & Management.
The company choose, which technologies through which business activities they want to measure the results up against other companies.

Purpose:

Comparative. The tool takes the industry, size of company, country into considerations, which the evaluator choose before entering the tool. The survey is adapted according to which areas and technologies the evaluator is aware of and has knowledge about.

Data Collection and Analysis

Respondents:

Internal respondents within the chosen business activities.

Evaluation and data collection:

Self-evaluation through an online questionnaire. The amount of questions varies depending on which dimensions and technologies the evaluator has chosen. Each dimension is evaluated through each chosen technology based on questions that are both answered either with likert scales, simple questions of yes/no/don't know or possible qualitative answers.

Digital maturity level determination:

Quantitative approach based on a summarized score, which is benchmarked to the company's competitors - the ones that shares the similar industry, size and country.

Data Presentation

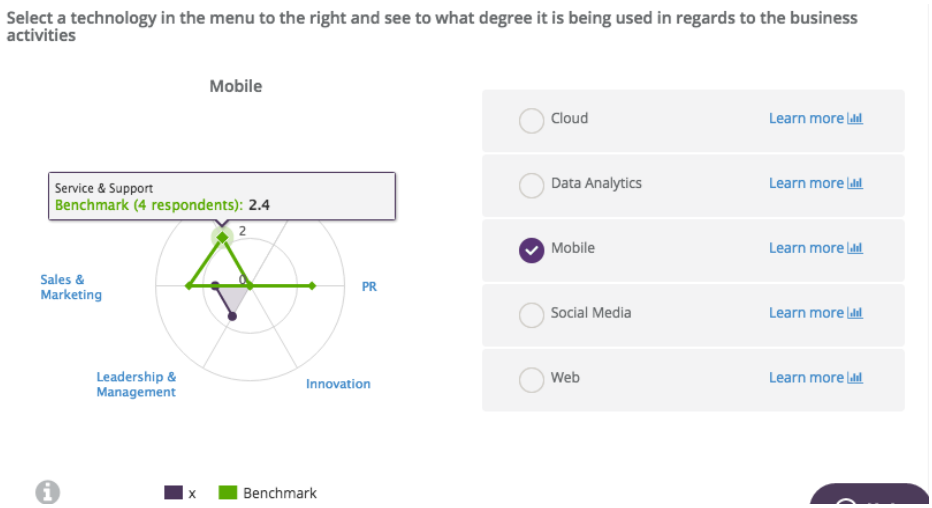
Digital maturity assessment:

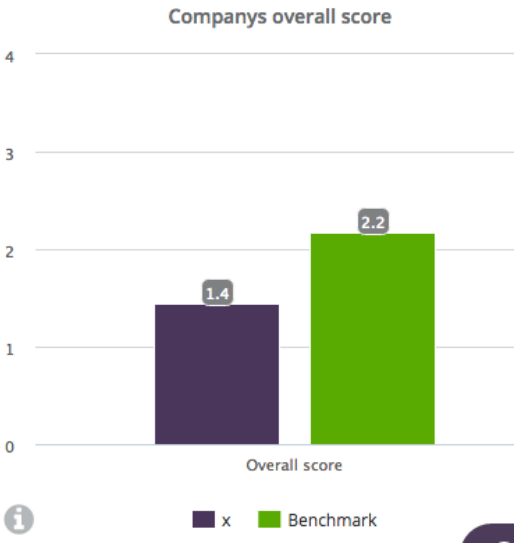
Describes internal and external (through benchmarking) the digital maturity by considering the company as a whole and by looking at the specific dimensions (business activities and technologies). The assessment is also based on a comparison between other companies that shares the same size, industry and country.

Result visualization:

Numeric score. Shows an overall result of the company's digital maturity, to what extent they utilize the chosen technologies and to what extent they utilize the chosen technologies to support the the chosen business activities on a graph from 0-4, where the benchmark is shown beside the company’s result on the graph.

The tool also consist of an interactive spider diagram, where the evaluator can select the technologies in each business activities, to see to which extent each technology supports each business activity and the other way around including benchmarking. See below example from a fictive assessment.





In all 5 different visualizations based on diagrams and graphs on each visualization including benchmarks if there are enough respondents to benchmark against.

Benchmarking:

Yes - The main focus of the tool is to obtain an overview of the company's digital competitiveness and the digital potential they do not take advantages of based on a comparison of other respondents (companies) that shares the same size, industry and country. The significance of the benchmarking depends on the availability of data from the same industry (competitors).

Gap analysis:

No

Appendix 3.7 EY: Digital Maturity Check (EY, 2016)

General Aspects

Number and focus of dimensions:

7 dimensions: Strategy, innovation and growth, Customer experience, Supply chain and operations, Finance, legal, tax and HR, Information technology, Risk and cybersecurity, People and organization.

Purpose:

Comparative, the tool assesses the current situation and benchmarks against other companies.

Data Collection and Analysis

Respondents:

Internal respondents

Evaluation and data collection:

Self-evaluation through an online questionnaire. The evaluator is presented to 14 statements, 2 for each dimension, which the evaluator has to rate.

Each statement the evaluator has to click on the 6 point scale to select how much the evaluator thinks the statement describes the company.

Digital maturity level determination:

The result is a overall maturity index score - there is no documentation available of what the ranges of scores are.

However, each dimension is given a score from 1-5 in order to elaborate on the overall score. The score on each dimension is the mean of the scores from the two statements in each dimension.

Data Presentation

Digital maturity assessment:

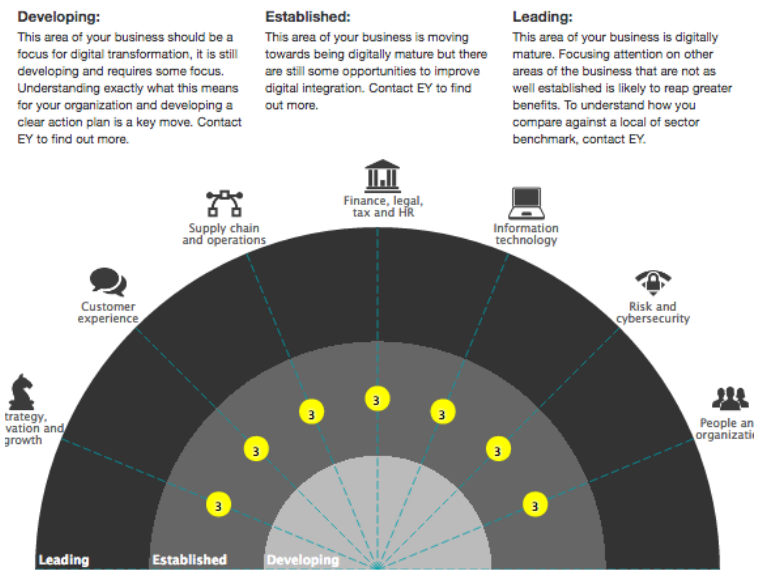
Company and industry level as the overall score is compared with the global benchmarks EY has collected through the assessment.

The scores from each dimension is placed in 3 different positions that describes how mature the company is: leading, established and developing.

The 3 areas come up with a standard description of the company's state based on the scores.

Result visualization:

Numerical scores is allocated in a graphical illustration that shows the scores in three different positions: leading, established and developing. See below example from a fictive assessment.



Benchmarking:

Yes - The overall score is compared to global benchmarks EY has collected through the assessment. The benchmarking is shown by telling the evaluator if the company is below, in line or above the average organization.

Gap analysis:
Yes - paid service/consultancy it is stated that the evaluator has to contact EY for more information and advice on the results.

Appendix 3.8 Altimeter - Digital Transformation Maturity (Solis, 2015)

General Aspects

Number and focus of dimensions:
6 dimensions within the organization that must undergo a transformation: Analytics, Customer Experience, Governance and Leadership, People and Operations, Technology Integration, Digital Literacy

Purpose:
Descriptive - Describes the company's current maturity level

Data Collection and Analysis

Respondents:
Internal respondents can be any kind of respondents as the model is conceptual and do not ask for specific questions

Evaluation and data collection:
The evaluation is conceptual as the evaluator do not collect data as such, they place themselves based on the descriptions of the stages.

Digital maturity level determination:
The level is determined by the descriptions of the stages and available case studies Altimeter presents.

Data Presentation

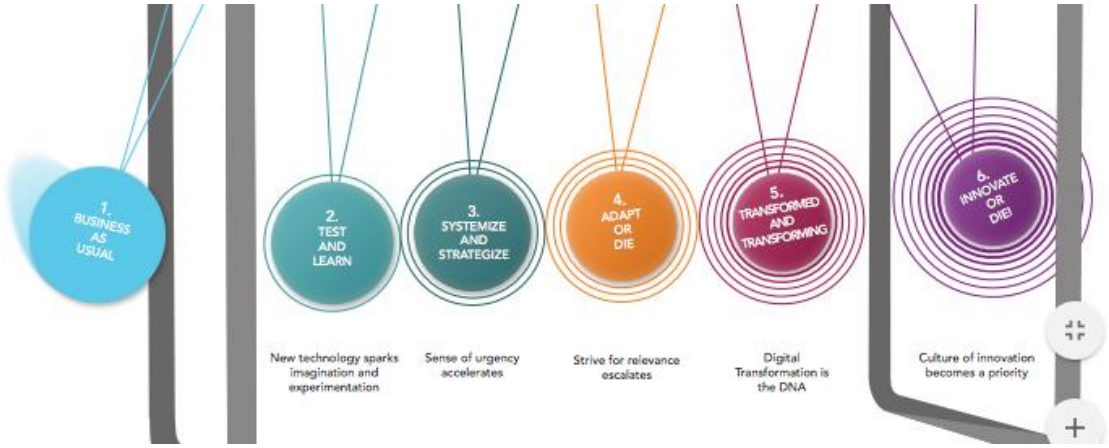
Digital maturity assessment:

The assessment is based on 6 stages:

Stage 1: Business as usual – The company has begun to focus on digital operations, but only to the extent that the company has begun to invest in platforms ad becoming technology-enabled(Solis, 2015)
Stage 2: Test and learn. At this stage the company is in a test and learn phase as they are aware of the disruption. The company still operate in silos and changes are not well organized, the company and the executives begin to come out of their comfort zones.(Solis, 2015)
Stage 3: Systemize and strategize. The company starts to invest strategically in people, processes and technology. Digital literacy is at this stage the primary focus to help the stakeholders to be aware of the digital technologies and how they operate with them.(Solis, 2015)
Stage 4: Adapt or die –The company has now accepted the journey toward transformation. The activities and efforts are planned with clearer intentions, and the company is in a better position to clarify both short and long-term goals.(Solis, 2015)
Stage 5: Transformed and transforming - Digital transformation is the DNA of the company at this stage and the company is continually developing new initiatives such as products and services to create value and the leadership is a part of the transformation journey.(Solis, 2015)
Stage 6: Innovate or die –In the final maturity stage the focus moves from transformation and technology toward innovation and disruption (Solis, 2015)

Result visualization:

Conceptual allocation on a maturity level



From Solis (2015)

Benchmarking:

No - As Altimeter does not collect data from the assessment there are no benchmarking available.

Gap analysis:

No

Appendix 3.9 KPMG - Digital Readiness Assessment (KPMG, 2015)

General Aspects

Number and focus of dimensions:

7 dimensions Digital strategy, Digital Governance, Digital Culture, Digital Customers, Digital Organization and Process, Technology Management and Digital People and Capabilities.

Purpose:

Descriptive, prescriptive and comparative: Describes the status quo by allocation to a readiness Matrix, benchmarking and advice from KPMG's consultants.

Data Collection and Analysis

Respondents:

Internal respondents answers a questionnaire. External respondents assess and interprets the results and provides an action plan

Evaluation and data collection:

Self-evaluation through a questionnaire with help from KMPG consultants and is interpreted by KMPG consultants

Digital maturity level determination:

Overall maturity score from 0-100% on transformation intensity and operational effectiveness which allocated in a 2x2 matrix

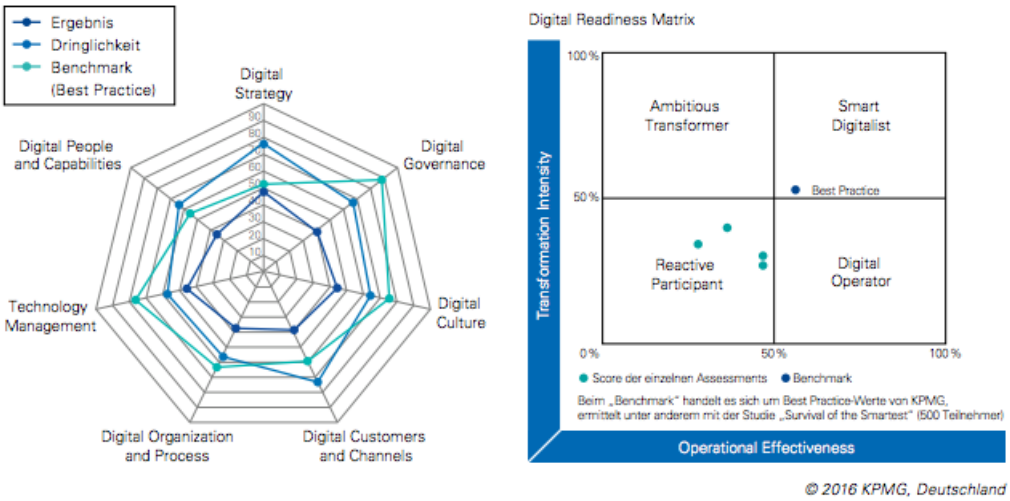
Data Presentation

Digital maturity assessment:

4 levels on two dimensions transformation intensity and operational effectiveness reactive participant, digital operator, ambitious transformer and smart digitalist

Result visualization:

Numerical score that are allocated in a 2x2 maturity matrix



(KPMG, 2016).

Benchmarking:

Yes - against the company's competitors, other industries and digital pioneers

Gap analysis:

Yes - KMPG consultants provides suggestions for improvement including
best practice models and implementation aids paid service/consultancy

Appendix 3.10 PwC - Industry 4.0 Self-assessment (PwC, 2015)

<u>General Aspects</u>

Number and focus of dimensions:

6 dimensions:

Mandatory:

Business Models, Product & Service Portfolio

Market & Customer Access

Value Chains & Processes

Optional:

IT Architecture

Compliance, Legal, Risk, Security & Tax

Organization & Culture

Purpose:

Comparative

<u>Data Collection and Analysis</u>

Respondents:

Internal respondents senior executives

Evaluation and data collection:

Self-evaluation through an online questionnaire by rating 33 questions across the 6 dimensions.

The statements are rated by 5-point likert scale with a scale for the actual situation and a scale for the target situation.

Scale 1 and 5 are described for each questions to help the evaluator to rate

Digital maturity level determination:

Maturity level allocation with a standardized description of the level

<u>Data Presentation</u>

Digital maturity assessment:

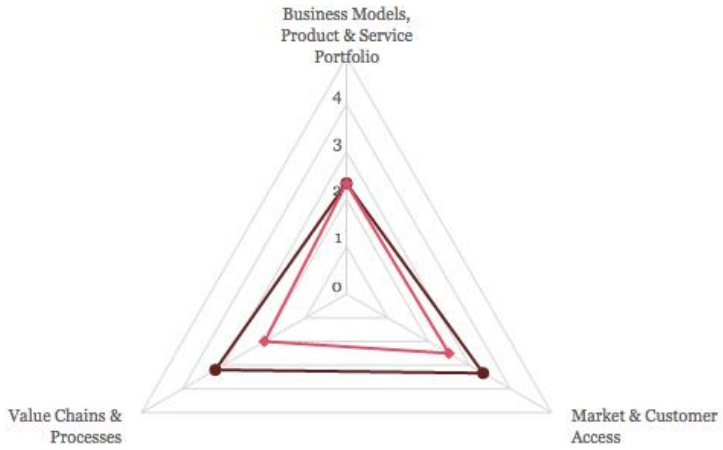
4 levels: digital novice, vertical integrator, horizontal collaborator and digital champion.

Result visualization:

Maturity level allocation. “Spider diagram” that shows numerical scores/maturity on each dimensions and showing the gap between the current maturity and the target

	1 Digital novice	2 Vertical integrator	3 Horisontal collaborator	4 Digital champion
Digital business models and customer access	First digital solutions and isolated applications	Digital product and service portfolio with software, network (M2M) and data as key differentiator	Integrated customer solutions across supply chain boundaries, collaboration with external partners	Development of new disruptive business models with innovative product and service portfolio, lot size 1
Digitisation of product and service offerings	Online presence is separated from offline channels, product focus instead of customer focus	Multi-channel distribution with integrated use of online and offline channels; data analytics deployed, e. g. for personalisation	Individualised customer approach and interaction together with value-chain partners. Shared, integrated interfaces.	Integrated Customer Journey Management across all digital marketing and sales channels with customer empathy and CRM
Digitisation and integration of vertical and horisontal value chains	Digitised and automated sub processes. Partial integration including production or with internal and external partners. Standard processes for collaboration partly in place	Vertical digitisation and standardised and harmonised internal processes and data flows within the company; limited integration with external partners	Horizontal integration of processes and data flows with customers and external partners, intensive data use through full integration across the network.	Fully digitised, integrated partner ecosystem with self-optimised, virtualised processes, focus on core competency; decentralised autonomy. Near real-time access to extended set of operative information
Data & Analytics as core capability	Analytical capabilities mainly based on semi-manual data extracts; Selected monitoring and data processing, no event management	Analytical capabilities supported by central business intelligence (BI) system Isolated, not standardised decision support systems	Central BI system consolidating all relevant internal and external information sources, some predictive analytics Specific decision support and event management systems	Central use of predictive analytics for real-time optimisation and automated event handling with intelligent database and self-learning algorithm enabling impact analysis and decision support
Agile IT architecture	Fragmented IT architecture in-house.	Homogeneous IT architecture in-house. Connection between different data cubes developing.	Common IT architectures in partner network. Interconnected single data lake with high-performance architecture	Single data lake with external data integration functionalities and flexible organisation. Partner service bus, secure data exchange
Compliance, security, legal & tax	Traditional structures, digitisation not in focus	Digital challenges recognised but not comprehensively addressed	Legal risk consistently addressed with collaboration partners,	Optimising the value-chain network for compliance, security, legal and tax
Organisation, employees and digital culture	Functional focus in “silos”	Cross-functional collaboration but not structured and consistently performed	Collaboration across company boundaries, culture and encouragement of sharing	Collaboration as a key value driver

From PwC (2015).



Example from a fictive assessment

Benchmarking:
Yes - by contacting PwC paid service/consultancy
Gap analysis:
No

Appendix 3.11 McKinsey - Digital Quotient (McKinsey, 2015)

General Aspects
Number and focus of dimensions:
4 dimensions: Strategy, Culture, Organization and Capabilities

Purpose:
Descriptive, prescriptive and comparative. McKinsey consultants provides a description of the results, action plan and a benchmarking against competitors.

Data Collection and Analysis
Respondents:
External respondents - Consultants creates the assessment of the company

Evaluation and data collection:
Expert evaluation

Digital maturity level determination:
N/A

Data Presentation

Digital maturity assessment:
N/A

Result visualization:
Comprehensive report includes an evaluation of the results against competitors and best practices.

Benchmarking:

Yes - paid service/consultancy

Gap analysis:
Yes - paid service/consultancy

Appendix 3.12 SAP/IDC - IDC Benchmark (IDC & SAP, 2015)

General Aspects

Number and focus of dimensions:
5 dimensions
leadership, information, operating models, the omni-channel experience, and the working world.

Purpose:
Comparative - SAP creates a company specific report based on the answers from the questionnaire and the overall result is benchmarked against other companies

Data Collection and Analysis

Respondents:
Internal respondents from all levels in the organization answers the questionnaire and external respondents provides the gap analysis/action plan

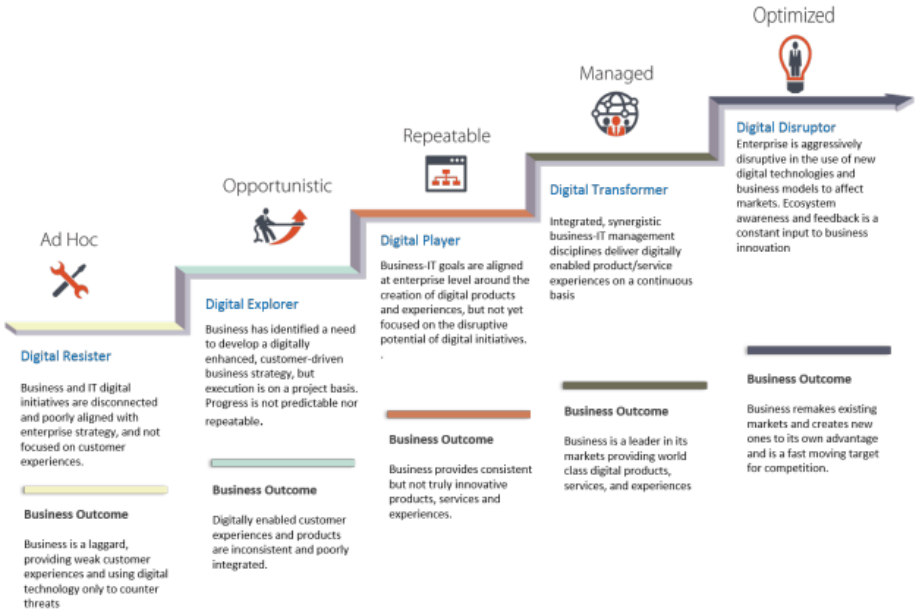
Evaluation and data collection:
Self-evaluation through an online questionnaire through 7 qualitative questions. 2 questions about performance and 1 question for each of the 5 dimensions. The questions are answered with possible answers, thus there are no scales

Digital maturity level determination:
Maturity level allocation on a staged maturity model

Data Presentation

Digital maturity assessment:
5 stages: Digital Resister, Digital Explorer, Digital Player, Digital Transformer, Digital Disruptor

Result visualization:
Maturity level allocation and a report that explains the results



From IDC & SAP (2015)

Benchmarking:

Yes - on each dimension and level

Gap analysis:

No

Appendix 3.13 Stratford - Digital Maturity Assessment (Stratford, 2015)

<u>General Aspects</u>

Number and focus of dimensions:

5 dimensions: Strategy, Customer experience, Data and technology, Operational processes and People and culture

Purpose:

Descriptive, prescriptive and comparative Stratford consultants provide a description of the results, action plan and a benchmarking against competitors

<u>Data Collection and Analysis</u>

Respondents:

External respondents - Consultants creates the assessment of the company

Evaluation and data collection:

Expert evaluation - Scores are placed on a maturity level on each assessment item

Digital maturity level determination:

Expert evaluation - Scores are placed on a maturity level on each assessment item

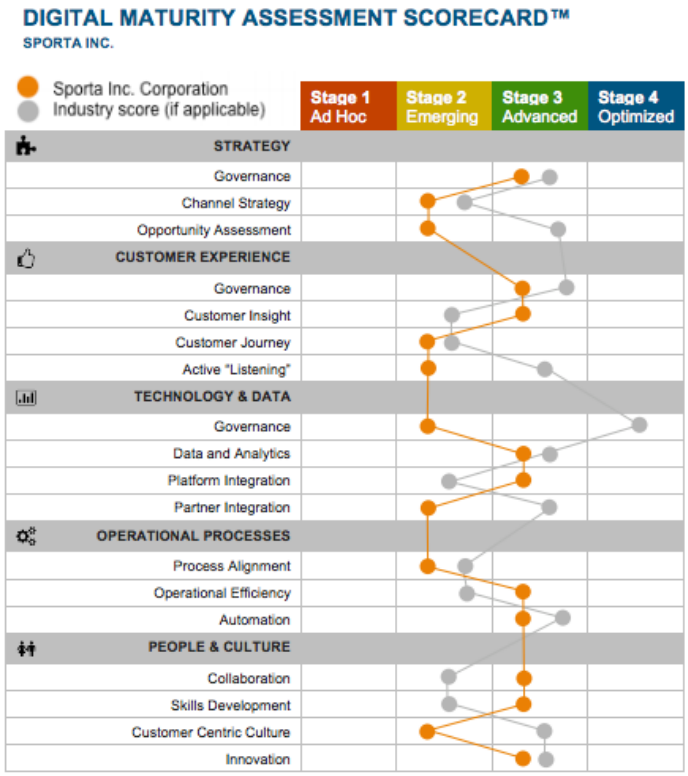
<u>Data Presentation</u>

Digital maturity assessment:

4 stages Stage 1: Ad Hoc, Stage 2: Emerging, Stage 3: Advanced, Stage 4: Optimized

Result visualization:

Digital maturity assessment scorecard that shows an maturity allocation on each of the dimensions



From Stratford (2015, p. 1)

Benchmarking: Yes - on each dimension and level

Gap analysis: Yes - the consultants creates and facilitate a strategy and roadmap. paid service/consultancy

Appendix 3.14 BearingPoint - Digital Maturity Assessment (BearingPoint, 2015)

General Aspects

Number and focus of dimensions:

6 dimensions: Strategy, Process, Technology, Customer, People, Product

Purpose:

Descriptive, prescriptive and comparative

Assessment of digital readiness, Benchmarking and Process optimization.

Data Collection and Analysis

Respondents:

External respondents - Consultants creates the assessment of the company

Evaluation and data collection:

Expert evaluation - qualitative interviews and maturity assessment

Digital maturity level determination:
Maturity level allocation - non-weighted average of the results from the qualitative interviews make up the respective maturity level.

Data Presentation

Digital maturity assessment:
N/A

Result visualization:
Digital maturity is determined on an individual basis for each functional area i.e sales, marketing, logistics and based on the 6 dimensions

From BearingPoint, 2015, p. 1

Benchmarking: Yes - paid service/consultancy

Gap analysis: Yes - paid service/consultancy

Appendix 3.15 Adapt2Digital - Digital engagement map (Adapt2Digital, 2015)

General Aspects
Number and focus of dimensions:
9 dimensions around people and business
Business: Technology, Data & Insights, Metrics, Framework & Governance, Futurology

People:Digital leadership, Audience, Collaboration & Integration, Communication

Purpose:
Descriptive, prescriptive, comparative. Description of the results, the company gets a report containing commentary against each dimension and actionable suggestions, the results are benchmarked against competitors

Data Collection and Analysis
Respondents: internal respondents answers an online questionnaire and External respondents creates an report with actionable suggestions.

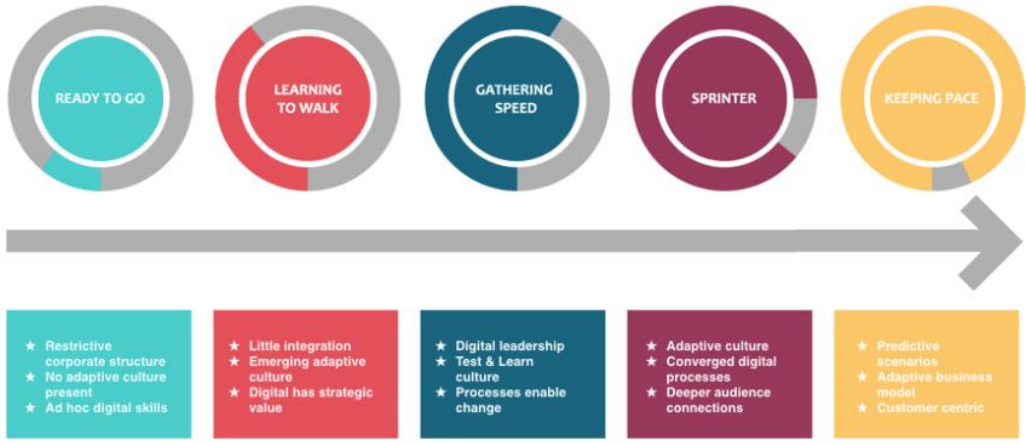
Evaluation and data collection: Self-evaluation through an online questionnaire by providing answers against the 9 dimensions Expert evaluation provides and analysis and suggestions

Digital maturity level determination: Maturity level allocation on a staged maturity model based on the answers - no documentation of how they determine the maturity level.

Data Presentation

Digital maturity assessment:
5 stages
Ready to go - ad hoc digital skills
Learning to walk- digital has strategic value
Gathering speed - digital leadership and processes enables change
Sprinter - Converged digital processes
Keeping pace - adaptive business model and customer centric

Result visualization: Maturity level allocation on a staged maturity model with description of the scores on each pillar and commentary against each dimensions with actionable recommendations



From Adapt2digital (2015)

Benchmarking: Yes - paid service

Gap analysis: Yes - paid service

Appendix 3.16 Arrk Group - Digital Maturity Assessment (Arrk Group, 2017)

General Aspects

Number and focus of dimensions:
5 dimensions: Leadership and strategy, Execution and delivery, Organisation & Culture, Digital Platform, Customer experience

Purpose:
Comparative. The purpose is to compare to the company's peers across the dimensions.

Data Collection and Analysis

Respondents:

Internal respondents on all levels that are involved in the digital enterprise answers an online questionnaire

Evaluation and data collection:
Self-evaluation through an online questionnaire by answering 12 qualitative questions across the five dimensions

Digital maturity level determination:
Numerical score for each of the dimensions - no documentation of how it is assessed

Data Presentation

Digital maturity assessment:
Numerical score - no documentation of how it is assessed

Result visualization:
Numerical score

Benchmarking: Yes with those who share same industry type

Gap analysis: No

Appendix 3.17 WFA & Brilliant Noise - SONAR (WFA & Brilliant Noise, 2017)

General Aspects
Number and focus of dimensions:
7 dimensions
strategy, customer insight, operations, tech platforms, leadership and culture, marketing communications, and performance.

Purpose: Comparative. Describes the current situation and compares the results against other respondents/companies

Data Collection and Analysis
Respondents: Internal respondents: Executive, managerial director, department head, senior manager, mid level and junior

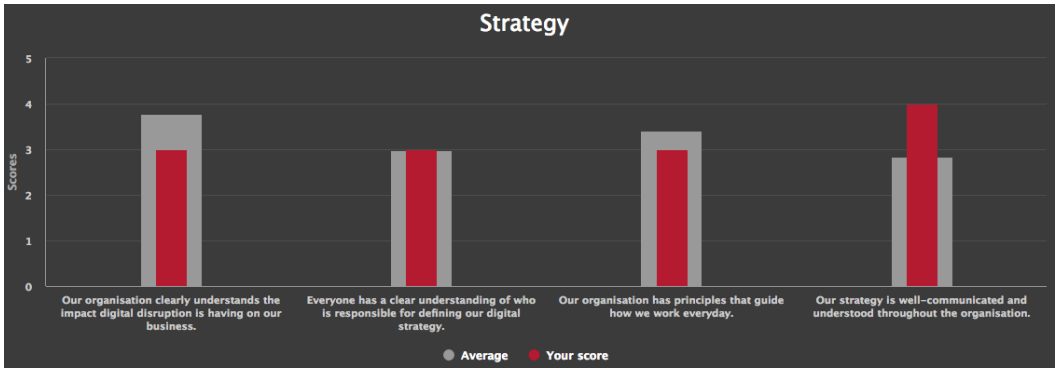
Evaluation and data collection: Self-evaluation through an online questionnaire with 37 quantitative questions across the dimensions by ranking the answers by a 5 point likert scale

Digital maturity level determination: Numerical score that is placed on a maturity level - there is no documentation of how the numerical score is counted

Data Presentation

Digital maturity assessment: 3 maturity levels: Pioneers, Integrators, Connecteds.

Result visualization: Numerical score that are places on a maturity level with a description of the level
Spider-diagram that shows the maturity on each dimension against other respondents and the average
Graph that shows the score on the y axe and each question of each dimension on the x axe beside the average scores that WFA has collected. See below examples from a fictive assessment.



Benchmarking: Yes - shows the average scores and the scores of other respondents

Gap analysis: No

Appendix 3.18 Ericsson - Digital maturity assessment test (Ericsson, 2017)

General Aspects

Number and focus of dimensions: 7 dimensions

Strategy, Organization, Customer, Ecosystem, Innovation, Operations and Technology

Purpose: Descriptive - the purpose is a description of how digitally mature the company is

Data Collection and Analysis

Respondents: Internal respondents can be from all levels as it is superficial questions and is based on the individual respondents view on the business

Evaluation and data collection: Self-evaluation through an online questionnaire with 7 statements where the evaluator has to select a qualitative statement that best corresponds to their view of the business.

Digital maturity level determination:
Through scores between 1-100

Data Presentation

Digital maturity assessment:
Through scores between 1-100

Result visualization:
Scores

Benchmarking: No

Gap analysis: No

Appendix 3.19 OpenText - Digital Readiness Assessment Tool (OpenText, 2017)

General Aspects
Number and focus of dimensions:
5 dimensions: Content Management, Customer Experience, Business Processes, Cloud, Analytics

Purpose: Prescriptive - the purpose is to give an overview of the overall maturity and to provide recommendations for the gaps.

Data Collection and Analysis
Respondents: Internal respondents of all lines of business

Evaluation and data collection: Self-evaluation through an online questionnaire through 19 statements that are rated by a 5 point likert scale

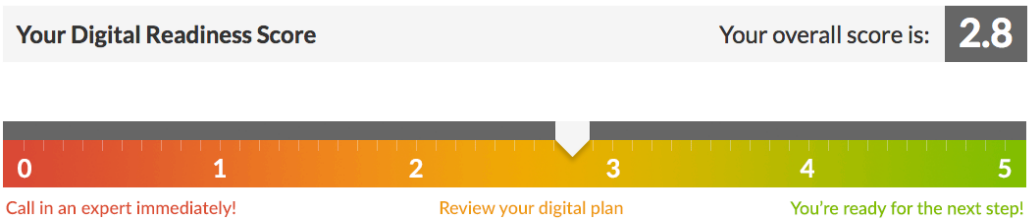
Digital maturity level determination: Numerical score that shows the company's overall digital readiness score and a score of how mature the company is on each dimension

Data Presentation

Digital maturity assessment: A scale from 1-5 - no documentation how the score is calculated

Result visualization:
Overall numerical maturity score that is placed on a scale
A scale from 1-5 with 3 points:
Lowest point 1: call an expert
Mid point: 2,5: review your digital plan
Highest point 5: You are ready for the next step

See below example from a fictive assessment.



Benchmarking: No

Gap analysis: Yes - provides a gap analysis across the five dimensions

Appendix 3.20 [A] - Digital Maturity Evaluation (A, 2017)

General Aspects

Number and focus of dimensions:

5 dimensions: Technology, Multichannel, Member Experience, Content Engineering and Optimization

Purpose: Prescriptive - considers the state of digital maturity within the company and provides a gap analysis

Data Collection and Analysis

Respondents: Internal respondents

Evaluation and data collection: Self-evaluation through an online questionnaire through 25 statements that are marked as true/false

5 questions for each of the five dimensions

Digital maturity level determination:

How many percentages out of 100 the company scores on each dimension that is places on a maturity level

Score is 0-20 is placed at level 1

Score 20-40 is placed at level 2

Score 40-60 is placed at level 3

Score 60-80 is placed at level 4

Score 80-100 is placed at level 5

Data Presentation

Digital maturity assessment:

5 maturity levels

1; Initiated

2: Challenged

3: Developed

4: Optimized

5: Engaged

Result visualization:

Scores for each dimension that is shown in a spider diagram that shows how mature the organization is and the scores for each dimension is allocated on a staged maturity model.

From [A], 2017.

Benchmarking: No

Gap analysis: Yes - provides a gap analysis across five dimensions

Appendix 3.21 Cisco - Digital Readiness Index Rapid Assessment (Cisco, 2015)

General Aspects

Number and focus of dimensions:

7 dimensions: Automation and orchestration, Service catalog, Cloud readiness, Financials and cost management, Security and Compliance, Platform and data and Self-service IT

Purpose: Comparative

Data Collection and Analysis

Respondents: Internal respondents on all levels that are involved in the digital enterprise answers an online questionnaire

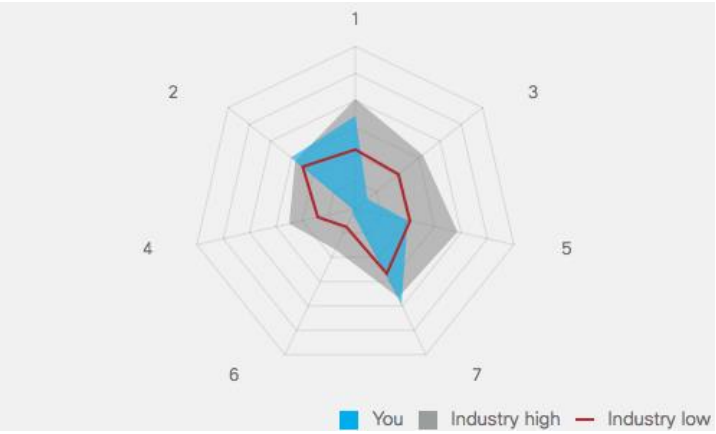
Evaluation and data collection: Self-evaluation through an online questionnaire by answering 10 qualitative questions by choosing between possible answers

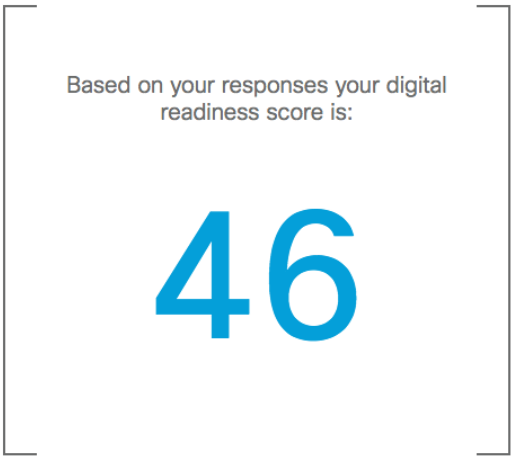
Digital maturity level determination: Numerical overall score for each dimension each possible answer (indicator) has its own weighting and the sum up of the indicators and its weighting determines the overall maturity score

Data Presentation

Digital maturity assessment: Numerical score between 0-100

Result visualization: The scores for each dimension is shown in a spider diagram versus existing competitors with high and low scores. See below example from a fictive assessment.





Benchmarking: Yes - The results are benchmarked against country and industry for comparison and insights

Gap analysis: No

Appendix 3.22 SAP - Digital Transformation Assessment (SAP, 2016)

General Aspects

Number and focus of dimensions:

8 dimensions: Leadership & Strategy, Business models, Customer Centricity, Culture
Technology foundation, Processes and Structure & Governance

Purpose: Comparative

Data Collection and Analysis

Respondents: Internal respondents on all levels that are involved in the digital enterprise answers an online questionnaire

Evaluation and data collection:

Self-evaluation through an online questionnaire by answering 28 questions by selecting a maturity level for each statement/question in each dimension. Each question in every maturity level across all dimensions has its own definition/answer

Digital maturity level determination: Scale that represents the current and desired maturity level. For each dimension, a marker represent the current level on each dimension. The evaluator drags the other marker to the desired level. An explanation will be shown once the evaluator click on the desired level marker

Data Presentation

Digital maturity assessment: 5 maturity scale levels are determined for each dimension, so no overall maturity score

Level 1: Digital Resister

Level 2: Digital Explorer

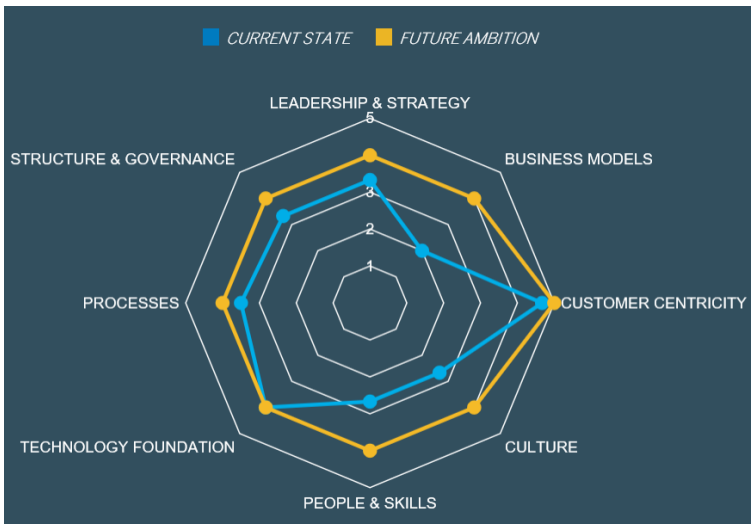
Level 3: Digital Player

Level 4: Digital Transformer

Level 5: Digital Disruptor

Result visualization: A graphical representation (spider diagram) of the current and desired digital maturity is mapped against each dimension assessed

An industry benchmarking on the maturity scale that shows the company's score, lower industry quartile and upper industry quartile.



Benchmarking: Yes - the results are benchmarked against other companies and shows how the company compare to their industry peers based on their input

Gap analysis: No

Appendix 3.23 Oracle - The Oracle Digital Transformation Assessment (Oracle, 2017)

General Aspects

Number and focus of dimensions:

11 dimensions. Cloud uptake Cloud goals Data Analytics Mobility Agility IT budget breakdown Business Model Leadership

Purpose: Descriptive

Data Collection and Analysis

Respondents: Internal respondents on all levels that are involved in the digital enterprise answers an online questionnaire

Evaluation and data collection: Self-evaluation through 11 qualitative questions for each of the11 dimension by choosing between 4 possible answers for each question

Digital maturity level determination: Graphical illustration of how well they are doing in each dimension

Data Presentation

Digital maturity assessment: 3 possible levels: Fair, good and great.

Result visualization: A graphical representation of each dimension whether it is fair, good or great. See below example from a fictive assessment.

Benchmarking: No

Gap analysis: No

Appendix 3.24 IBM - Digital Transformation Assessment (IBM, 2017)

General Aspects

Number and focus of dimensions:

No focus of dimensions

Purpose: Prescriptive- describes the current situation and come up with recommendations of improvement.

Data Collection and Analysis

Respondents: Internal respondents. Chief Information Officer or equivalent position. Director or equivalent position. Team Leader or equivalent position. Professional or equivalent position

Evaluation and data collection:

Self-evaluation through 11 qualitative questions by choosing between 4 possible answers for each question

Digital maturity level determination:

Numerical score in percentage that shows the company's overall maturity out of 100%

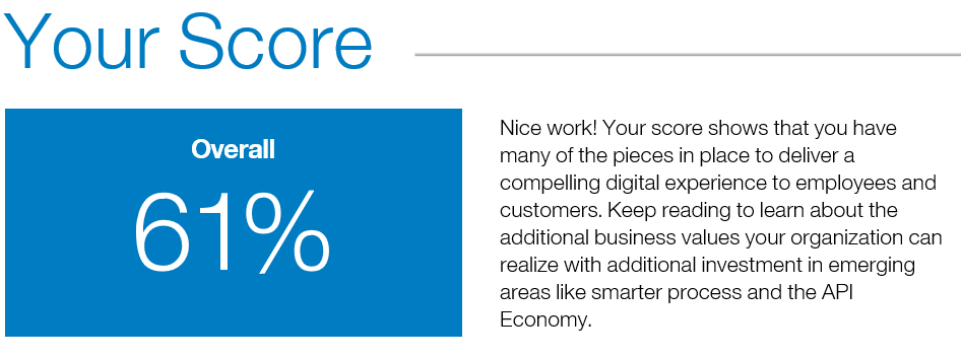
Data Presentation

Digital maturity assessment:

Numerical score between 0-100

Result visualization:

Shows a percentage that represents the overall maturity with a short description what the score means in relation to their transformation. See below example from a fictive assessment.



Benchmarking:

No

Gap analysis:

Yes - beside the overall maturity score the respondent gets suggestions on how the company can continue to improve.

Appendix 3.25 Dt - Digital Maturity (Dt, 2015)

Number and focus of dimensions:

8 dimensions:Leadership, Business strategy, People, teams & culture, Data & Metrics, Cross-channel Integration, Customer value proposition, Customer experience and Growth

Purpose: Descriptive

Data Collection and Analysis

Respondents:

Internal respondents

Evaluation and data collection:

The evaluation is conceptual as the evaluator do not collect data as such, they place themselves based on the descriptions of the stages.

Digital maturity level determination:
The level is determined by the descriptions of the stages for each dimension

Data Presentation

Digital maturity assessment:
5 stages for each of the dimensions
Stage 1: Initial State
Stage 2: Defined
Stage 3: Repeatable
Stage 4: Managed
Stage 5: Optimised

Result visualization:
Staged maturity model for each dimensions based on its sub-categories i.e agility under the dimension 'growth' with descriptions. See below maturity model for the dimension 'Leadership'

Leadership

	Low Maturity				*High Maturity*
	Stage 1 Initial State	**Stage 2 Defined**	**Stage 3 Repeatable**	**Stage 4 Managed**	**Stage 5 Optimised**
Board-level buy-in	Board are not persuaded of merits of digital investment	Board are convinced of the importance of digital	Board are engaged and involved	Digital is fully adopted and understood by the board	The board plays an active role in digital initiatives
Digital Direction & Vision	Digital direction & vision is undefined by leadership	Leaders are active in defining the digital direction & vision	Leaders communicate digital direction & vision	Employees are educated in the digital direction & vision	Digital direction & vision is adopted and optimised
Digital Decision Making	Digital is not an active part of business decisions	Leaders are active in how digital can aid business decisions	Leaders promote digital thinking as part of decision making	Digital thinking is integrated part of wider decision making	Digital decision making is optimised

From Dt (2015)
Benchmarking: No
Gap analysis: No

Appendix 4 - Coding of capability areas

	Digital intensity/literacy (operations, customer business models)	Transformation management/governance	Customer experience/ engagement	Product innovation /innovation	Strategy	Organization	Operational Process digitzation	Collaboration/teamwork	Culture, people & expertise	Technology and platforms
MIT/Gap-gemini Consulting: IWI-HSG and Crosswalk	1	1	0	0	0	0	0	0	0	0
Deloitte	0	1	1	1	1	1	1	1	1	1
Forrester	0	1	1	1	1	1	0	0	1	0
Government of South Australia Networked	0	0	0	0	0	1	0	0	1	1
Business Initiative	0	1	0	1	0	0	0	0	1	1
EY	0	1	0	1	0	0	0	0	0	0
Altimeter	0	0	1	1	1	1	0	0	0	1
KPMG	1	1	1	0	0	0	0	0	1	1
PwC	0	1	1	0	1	1	1	0	1	0
McKinsey	0	0	0	1	0	1	1	0	1	1
SAP & IDC	0	0	0	0	1	1	0	0	1	0
Stratford	0	1	0	0		0	1	0	1	0
BearingPoint	0	0	1	0	1	0	0	0	1	1
Adapt2Digital	0	0	1	1	1	0	1	0	1	1
Arrk Group	0	1	1	0	0	0	0	1	0	1
WFA & Brilliant Noise	0	1	1	0	1	1	1	0	1	0
Ericsson	0	1	0	0	1	0	1	0	1	1
OpenText	0	0	1	1	1	1	1	0	0	1
[A]	0	0	1	0	0	0	1	0	0	0
Cisco	0	0	0	1	0	0	0	0	0	1
SAP	0	0	0	0	0	0	1	0	0	0
Oracle	0	1	1		1	0	1	0	1	1
IBM	0	1	0	0	0	0	0	0	1	0
Dt	0	0	0	0	0	0	0	0	0	0
	0	1	1	0	1	0	0	0	1	0

	Insights/analytics/use of data	Capacity & capability	Finance	Risk & Cybersecurity	Business Model	Market & customer access (channels etc.)	Information architecture	Omni-channel	Communication/content management	Cloud
MIT/Gap-gemini Consulting: IWI-HSG and Crosswalk	0	0	0	0	0	0	0	0	0	0
Deloitte	0	0	0	0	0	0	0	0	0	0
Forrester	0	0	0	0	0	0	0	0	0	0
Government of South Australia Networked	1	0	0	0	0	0	0	0	0	0
Business Initiative	0	0	0	0	0	0	0	0	1	1
EY	0	1	1	1	0	0	0	0	0	0
Altimeter	1	0	0	0	0	0	0	0	0	0
KPMG	0	1	0	0	0	0	0	0	0	0
PwC	0	0	0	1	1	1	0	0	0	0
McKinsey	0	1	0	0	0	0	0	0	0	0
SAP & IDC	0	0	0	0	0	0	1	1	0	0
Stratford	1	0	0	0	0	0	0	0	0	0
BearingPoint	0	0	0	0	0	0	0	0	0	0
Adapt2Digital	1	0	0	0	0	0	0	0	1	0
Arrk Group	0	0	0	0	0	1	0	0	0	0
WFA & Brilliant Noise	1	0	0	0	0	0	0	0	1	0
Ericsson	0	0	0	0	0	0	0	0	0	0
OpenText	1	0	0	0	0	0	0	0	1	1
[A]	0	0	0	0	0	0	0	0	1	0
Cisco	1	0	1	1	0	0	0	0	0	1
SAP	0	0	0	0	1	0	0	0	0	0
Oracle	1	0	1	0	1	0	0	0	0	1
IBM	0	0	0	0	0	0	0	0	0	0
Dt	1	0	0	0	0	0	0	0	0	0

	Multi-channel	Social Media	Web	Mobile	Human resource	Service & Support	Sales & Marketing
MIT/Gap-gemini Consulting:	0	0	0	0	0	0	0
IWI-HSG and Crosswalk	0	0	0	0	0	0	0
Deloitte	0	0	0	0	0	0	0
Forrester	0	0	0	0	0	0	0
Government of South Australia	0	0	0	0	0	0	0
Networked Business Initiative	0	1	1	1	1	1	1
EY	0	0	0	0	0	0	0
Altimeter	0	0	0	0	0	0	0
KPMG	0	0	0	0	0	0	0
PwC	0	0	0	0	0	0	0
McKinsey	0	0	0	0	0	0	0
SAP & IDC	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
BearingPoint	0	0	0	0	0	0	0
Adapt2Digital	0	0	0	0	0	0	0
Arrk Group	0	0	0	0	0	0	0
WFA & Brilliant Noise	0	0	0	0	0	0	0
Ericsson	0	0	0	0	0	0	0
OpenText	0	0	0	0	0	0	0
[A]	1	0	0	0	0	0	0
Cisco	0	0	0	0	0	0	0
SAP	0	0	0	0	0	0	0
Oracle	0	1	0	0	0	0	0
IBM	0	0	0	0	0	0	0
Dt	1	0	0	0	0	0	0

	Internet of things
MIT/Gap-gemini Consulting:	0
IWI-HSG and Crosswalk	0
Deloitte	0
Forrester	0
Government of South Australia	0
Networked Business Initiative	0
EY	0
Altimeter	0
KPMG	0
PwC	0
McKinsey	0
SAP & IDC	0
Stratford	0
BearingPoint	0
Adapt2Digital	0
Arrk Group	0
WFA & Brilliant Noise	0
Ericsson	0
OpenText	0
[A]	0
Cisco	0
SAP	0
Oracle	1
IBM	0
Dt	0

Appendix 5 - Coding of the design parameters

Model	Descriptive	Prescriptive	Comparative	Descriptive, prescriptive and comparative	Internal respondents	External respondents	Internal and external
MIT/Gap-	1	0	0	0	1	0	0
IWI-HSG and Crosswalk	1	0	0	0	1	0	0
Deloitte (How digital are you?)	0	1	0	0	1	0	0
Forrester (Digital Maturity	1	0	0	0	1	0	0
Government of South	0	1	0	0	1	0	0
Networked Business Initiative	0	0	1	0	1	0	0
EY (Digital Maturity Check)	0	0	1	0	1	0	0
Altimeter (Digital	1	0	0	0	1	0	0
KPMG (Digital Readiness	0	0	0	1	0	0	1
PwC (Industry 4.0 Self-	0	0	1	0	1	0	0
McKinsey (Digital Quotient)	0	0	0	1	0	1	0
SAP & IDC (IDC Benchmark)	0	0	1	0	1	0	0
Stratford (Digital Maturity	0	0	0	1	0	1	0
BearingPoint (Digital maturity	0	0	0	1	0	1	0
Adapt2Digital (Digital	0	0	0	1	0	0	1
Arrk Group (Digital Maturity	0	0	1	0	1	0	0
WFA & Brilliant Noise	0	0	1	0	1	0	0
Ericsson (Digital maturity	1	0	0	0	1	0	0
OpenText (Digital Readiness	0	1	0	0	1	0	0
[A] (Digital Maturity	0	1	0	0	1	0	0
Cisco (Digital Readiness	0	0	1	0	1	0	0
SAP (Digital Transformation	0	0	1	0	1	0	0
Oracle (The Oracle Digital	1	0	0	0	1	0	0
IBM (Digital	0	1	0	0	1	0	0
Dt (Digital Maturity)	1	0	0	0	1	0	0

Model	Self-evaluatio	Expert-evaluation	Self-evaluation and expert-evaluation	Online questi	Questionnaire	Conceptual
MIT/Gap-	1	0	0	0	1	0
IWI-HSG and Crosswalk	1	0	0	1	0	0
Deloitte (How digital are you?)	1	0	0	1	0	0
Forrester (Digital Maturity	1	0	0	0	1	0
Government of South	1	0	0	0	1	0
Networked Business Initiative	1	0	0	1	0	0
EY (Digital Maturity Check)	1	0	0	1	0	0
Altimeter (Digital	1	0	0	0	0	1
KPMG (Digital Readiness	0	0	1	1	0	0
PwC (Industry 4.0 Self-	1	0	0	1	0	0
McKinsey (Digital Quotient)	0	1	0	0	0	0
SAP & IDC (IDC Benchmark)	1	0	0	1	0	0
Stratford (Digital Maturity	0	1	0	0	0	0
BearingPoint (Digital maturity	0	1	0	0	0	0
Adapt2Digital (Digital	0	0	1	1	0	0
Arrk Group (Digital Maturity	1	0	0	1	0	0
WFA & Brilliant Noise	1	0	0	1	0	0
Ericsson (Digital maturity	1	0	0	1	0	0
OpenText (Digital Readiness	1	0	0	1	0	0
[A] (Digital Maturity	1	0	0	1	0	0
Cisco (Digital Readiness	1	0	0	1	0	0
SAP (Digital Transformation	1	0	0	1	0	0
Oracle (The Oracle Digital	1	0	0	1	0	0
IBM (Digital	1	0	0	1	0	0
Dt (Digital Maturity)	1	0	0	0	0	1

Model	Qualitative interview/assessment	0-15 min duration	16-30 min duration	31-45 min duration	46-60 min duration	61-90 min duration	More than 1 day
MIT/Gap-	0	0	1	0	0	0	0
IWI-HSG and Crosswalk	0	0	0	0	0	0	0
Deloitte (How digital are you?)	0	0	0	1	0	0	0
Forrester (Digital Maturity	0	0	1	0	0	0	0
Government of South	0	0	0	0	1	0	0
Networked Business Initiative	0	0	1	0	0	1	0
EY (Digital Maturity Check)	0	0	1	0	0	0	0
Altimeter (Digital	0	0	0	1	0	0	0
KPMG (Digital Readiness	0	0	0	0	0	0	1
PwC (Industry 4.0 Self-	0	0	0	0	1	0	0
McKinsey (Digital Quotient)	1	0	0	0	0	0	1
SAP & IDC (IDC Benchmark)	0	1	0	0	0	0	0
Stratford (Digital Maturity	1	0	0	0	0	0	1
BearingPoint (Digital maturity	1	0	0	0	0	0	1
Adapt2Digital (Digital	0	0	0	0	0	0	1
Arrk Group (Digital Maturity	0	1	0	0	0	0	0
WFA & Brilliant Noise	0	0	1	0	0	0	0
Ericsson (Digital maturity	0	1	0	0	0	0	0
OpenText (Digital Readiness	0	1	0	0	0	0	0
[A] (Digital Maturity	0	1	0	0	0	0	0
Cisco (Digital Readiness	0	1	0	0	0	0	0
SAP (Digital Transformation	0	0	1	0	0	0	0
Oracle (The Oracle Digital	0	1	0	0	0	0	0
IBM (Digital	0	1	0	0	0	0	0
Dt (Digital Maturity)	0	0	0	1	0	0	0

Model	0-20 assessment items	21-40 assessment items	120-200 assessment items	201-300 assessment items	Above 300 assessment items	Marturity determination: Score 1-100
MIT/Gap-	1	0	0	0	0	0
IWI-HSG and Crosswalk	0	0	0	0	1	0
Deloitte (How digital are you?)	0	1	0	0	0	1
Forrester (Digital Maturity	0	1	0	0	0	0
Government of South	0	0	1	0	0	0
Networked Business Initiative	0	0	0	0	0	1
EY (Digital Maturity Check)	1	0	0	0	0	1
Altimeter (Digital	0	0	0	0	0	0
KPMG (Digital Readiness	0	0	0	0	0	0
PwC (Industry 4.0 Self-	0	1	0	0	0	0
McKinsey (Digital Quotient)	0	0	0	0	0	0
SAP & IDC (IDC Benchmark)	1	0	0	0	0	0
Stratford (Digital Maturity	1	0	0	0	0	0
BearingPoint (Digital maturity	0	0	0	1	0	0
Adapt2Digital (Digital	0	0	0	0	0	0
Arrk Group (Digital Maturity	1	0	0	0	0	1
WFA & Brilliant Noise	0	1	0	0	0	0
Ericsson (Digital maturity	1	0	0	0	0	1
OpenText (Digital Readiness	1	0	0	0	0	1
[A] (Digital Maturity	0	1	0	0	0	0
Cisco (Digital Readiness	1	0	0	0	0	1
SAP (Digital Transformation	0	1	0	0	0	0
Oracle (The Oracle Digital	1	0	0	0	0	0
IBM (Digital	1	0	0	0	0	1
Dt (Digital Maturity)	0	0	0	0	0	0

Model	Marturity determination: Maturity level	Visualization: Numerical score	Visualization: Staged Maturity model	Visualization: Continuous Maturity model	Visualization: Matrix	Visualization: Spiderdiagram	Benchmarking
MIT/Gap-	1	0	0	0	1	0	0
IWI-HSG and Crosswalk	1	0	1	0	0	0	1
Deloitte (How digital are you?)	0	1	0	0	0	0	0
Forrester (Digital Maturity	1	0	1	0	0	0	1
Government of South	1	0	1	0	0	0	0
Networked Business Initiative	0	0	0	0	0	1	1
EY (Digital Maturity Check)	0	1	0	0	0	0	1
Altimeter (Digital	1	0	1	0	0	0	0
KPMG (Digital Readiness	1	0	0	0	1	0	1
PwC (Industry 4.0 Self-	1	0	0	1	0	0	1
McKinsey (Digital Quotient)	0	0	0	0	0	0	1
SAP & IDC (IDC Benchmark)	1	0	1	0	0	0	1
Stratford (Digital Maturity	1	0	0	1	0	0	1
BearingPoint (Digital maturity	0	0	0	1	0	0	1
Adapt2Digital (Digital	1	0	1	0	0	0	1
Arrk Group (Digital Maturity	0	0	0	0	0	1	0
WFA & Brilliant Noise	1	0	0	0	0	1	1
Ericsson (Digital maturity	0	1	0	0	0	0	0
OpenText (Digital Readiness	0	1	0	0	0	0	0
[A] (Digital Maturity	1	0	1	0	0	1	0
Cisco (Digital Readiness	0	0	0	0	0	1	1
SAP (Digital Transformation	1	0	0	0	0	1	1
Oracle (The Oracle Digital	1	1	0	0	0	0	0
IBM (Digital	0	1	0	0	0	0	0
Dt (Digital Maturity)	1	0	0	1	0	0	0

Model	Gap analysi	Free	Charged
MIT/Gap-	0	1	0
IWI-HSG and Crosswalk	0	1	0
Deloitte (How digital are you?)	1	1	0
Forrester (Digital Maturity	1	1	0
Government of South	1	1	0
Networked Business Initiative	0	1	0
EY (Digital Maturity Check)	1	1	0
Altimeter (Digital	0	1	0
KPMG (Digital Readiness	1	0	1
PwC (Industry 4.0 Self-	0	1	0
McKinsey (Digital Quotient)	1	1	0
SAP & IDC (IDC Benchmark)	1	1	0
Stratford (Digital Maturity	1	0	1
BearingPoint (Digital maturity	1	0	1
Adapt2Digital (Digital	1	0	1
Arrk Group (Digital Maturity	1	1	0
WFA & Brilliant Noise	0	1	0
Ericsson (Digital maturity	0	1	0
OpenText (Digital Readiness	1	1	0
[A] (Digital Maturity	1	1	0
Cisco (Digital Readiness	0	1	0
SAP (Digital Transformation	0	1	0
Oracle (The Oracle Digital	0	1	0
IBM (Digital	1	1	0
Dt (Digital Maturity)	0	1	0

Appendix 6 - Descriptive statistics: Frequency tables

Descriptive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	13	1,3	52,0	52,0
	1	12	1,2	48,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Comparative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	12	1,2	48,0	48,0
	1	13	1,3	52,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Prescriptive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	15	1,5	60,0	60,0
	1	10	1,0	40,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Internal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	,3	12,0	12,0
	1	22	2,2	88,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

External

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	20	2,0	80,0	80,0
	1	5	,5	20,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Questionnaire

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	22	2,2	88,0	88,0
	1	3	,3	12,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

OnlineQuestionnaire

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	8	,8	32,0	32,0
	1	17	1,7	68,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Conceptual

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	20	2,0	80,0	80,0
	1	5	,5	20,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

ScoreDetermination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	17	1,7	68,0	68,0
	1	8	,8	32,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

NumericalScoreVisualization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	20	2,0	80,0	80,0
	1	5	,5	20,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

MaturityLevelDetermination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	10	1,0	40,0	40,0
	1	15	1,5	60,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

StagedMaturityModelVisualization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	16	1,6	64,0	64,0
	1	9	,9	36,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

ContinuousMaturityModelVisualization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	20	2,0	80,0	80,0
	1	5	,5	20,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

SpiderdiagramVisualization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	18	1,8	72,0	72,0
	1	7	,7	28,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

MatrixVisualization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	23	2,3	92,0	92,0
	1	2	,2	8,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Free

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	5	,5	20,0	20,0
	1	20	2,0	80,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

OperationalProcesDigitization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	14	1,4	56,0	56,0
	1	11	1,1	44,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Strategy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	13	1,3	52,0	52,0
	1	12	1,2	48,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

TransformationManagement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	11	1,1	44,0	44,0
	1	14	1,4	56,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

BusinessModel

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	22	2,2	88,0	88,0
	1	3	,3	12,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Analytics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	15	1,5	60,0	60,0
	1	10	1,0	40,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

ProductInnovation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	16	1,6	64,0	64,0
	1	9	,9	36,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Org

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	16	1,6	64,0	64,0
	1	9	,9	36,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	12	1,2	48,0	48,0
	1	13	1,3	52,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

CustomerCentricity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	12	1,2	48,0	48,0
	1	13	1,3	52,0	100,0
	Total	25	2,5	100,0	
Missing	System	976	97,5		
Total		1001	100,0		

Appendix 7 - Agglomeration schedule

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	19	24	,880	0	0	11
2	17	22	,880	0	0	12
3	6	21	,880	0	0	17
4	8	25	,840	0	0	19
5	13	14	,840	0	0	10
6	12	23	,800	0	0	13
7	5	20	,800	0	0	16
8	7	18	,800	0	0	15
9	3	16	,800	0	0	11
10	11	13	,800	0	5	22
11	3	19	,740	9	1	15
12	2	17	,740	0	2	14
13	4	12	,740	0	6	16
14	2	10	,720	12	0	20
15	3	7	,710	11	8	17
16	4	5	,700	13	7	20
17	3	6	,693	15	3	23
18	9	15	,680	0	0	22
19	1	8	,680	0	4	21
20	2	4	,674	14	16	21
21	1	2	,631	19	20	23
22	9	11	,600	18	10	24
23	1	3	,570	21	17	24
24	1	9	,497	23	22	0

Appendix 8 - One-Way Anova (Mean values)

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Descriptive	1	12	,42	,515	,149	,09	,74	0	1
	2	8	,13	,354	,125	-,17	,42	0	1
	3	5	1,00	,000	,000	1,00	1,00	1	1
	Total	25	,44	,507	,101	,23	,65	0	1
Prescriptive	1	12	,17	,389	,112	-,08	,41	0	1
	2	8	,38	,518	,183	-,06	,81	0	1
	3	5	1,00	,000	,000	1,00	1,00	1	1
	Total	25	,40	,500	,100	,19	,61	0	1
Comparative	1	12	,42	,515	,149	,09	,74	0	1
	2	8	,50	,535	,189	,05	,95	0	1
	3	5	1,00	,000	,000	1,00	1,00	1	1
	Total	25	,56	,507	,101	,35	,77	0	1
Internal	1	12	1,00	,000	,000	1,00	1,00	1	1
	2	8	1,00	,000	,000	1,00	1,00	1	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,88	,332	,066	,74	1,02	0	1
External	1	12	,00	,000	,000	,00	,00	0	0
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	1,00	,000	,000	1,00	1,00	1	1
	Total	25	,20	,408	,082	,03	,37	0	1
OnlineQuestionnaire	1	12	,58	,515	,149	,26	,91	0	1
	2	8	1,00	,000	,000	1,00	1,00	1	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,68	,476	,095	,48	,88	0	1
Questionnaire	1	12	,25	,452	,131	-,04	,54	0	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,00	,000	,000	,00	,00	0	0
	Total	25	,12	,332	,066	-,02	,26	0	1
Conceptual	1	12	,17	,389	,112	-,08	,41	0	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,60	,548	,245	-,08	1,28	0	1
	Total	25	,20	,408	,082	,03	,37	0	1
ScoreDetermination	1	12	,00	,000	,000	,00	,00	0	0
	2	8	1,00	,000	,000	1,00	1,00	1	1
	3	5	,00	,000	,000	,00	,00	0	0
	Total	25	,32	,476	,095	,12	,52	0	1

MaturityLevelDetermination	1	12	1,00	,000	,000	1,00	1,00	1	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,60	,548	,245	-,08	1,28	0	1
	Total	25	,60	,500	,100	,39	,81	0	1
NumericalScoreVisualization	1	12	,00	,000	,000	,00	,00	0	0
	2	8	,63	,518	,183	,19	1,06	0	1

	3	5	,00	,000	,000	,00	,00	0	0
	Total	25	,20	,408	,082	,03	,37	0	1
StagedMaturityModelVisualization	1	12	,58	,515	,149	,26	,91	0	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,20	,447	,200	-,36	,76	0	1
	Total	25	,32	,476	,095	,12	,52	0	1
ContinuousMaturityModelVisualization	1	12	,17	,389	,112	-,08	,41	0	1
	2	8	,13	,354	,125	-,17	,42	0	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,20	,408	,082	,03	,37	0	1
MatrixVisualization	1	12	,08	,289	,083	-,10	,27	0	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,20	,447	,200	-,36	,76	0	1
	Total	25	,08	,277	,055	-,03	,19	0	1
SpiderdiagramVisualization	1	12	,25	,452	,131	-,04	,54	0	1
	2	8	,38	,518	,183	-,06	,81	0	1
	3	5	,20	,447	,200	-,36	,76	0	1
	Total	25	,28	,458	,092	,09	,47	0	1
Free	1	12	1,00	,000	,000	1,00	1,00	1	1
	2	8	1,00	,000	,000	1,00	1,00	1	1
	3	5	,00	,000	,000	,00	,00	0	0
	Total	25	,80	,408	,082	,63	,97	0	1

Culture	1	12	,83	,389	,112	,59	1,08	0	1
	2	8	,25	,463	,164	-,14	,64	0	1
	3	5	,80	,447	,200	,24	1,36	0	1
	Total	25	,64	,490	,098	,44	,84	0	1
OperationalProcesDigitization	1	12	,42	,515	,149	,09	,74	0	1
	2	8	,50	,535	,189	,05	,95	0	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,44	,507	,101	,23	,65	0	1

TransformationManagement	1	12	,75	,452	,131	,46	1,04	0	1
	2	8	,38	,518	,183	-,06	,81	0	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,56	,507	,101	,35	,77	0	1
Strategy	1	12	,33	,492	,142	,02	,65	0	1
	2	8	,50	,535	,189	,05	,95	0	1
	3	5	,80	,447	,200	,24	1,36	0	1

BusinessModel	1	12	,25	,452	,131	-,04	,54	0	1
	2	8	,00	,000	,000	,00	,00	0	0
	3	5	,00	,000	,000	,00	,00	0	0
	Total	25	,12	,332	,066	-,02	,26	0	1
ProductInnovation	1	12	,33	,492	,142	,02	,65	0	1
	2	8	,50	,535	,189	,05	,95	0	1
	3	5	,20	,447	,200	-,36	,76	0	1
	Total	25	,36	,490	,098	,16	,56	0	1
Technology	1	12	,67	,492	,142	,35	,98	0	1
	2	8	,25	,463	,164	-,14	,64	0	1
	3	5	,60	,548	,245	-,08	1,28	0	1
	Total	25	,52	,510	,102	,31	,73	0	1
Analytics	1	12	,42	,515	,149	,09	,74	0	1
	2	8	,38	,518	,183	-,06	,81	0	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,40	,500	,100	,19	,61	0	1

CustomerCentricity	1	12	,33	,492	,142	,02	,65	0	1
	2	8	,63	,518	,183	,19	1,06	0	1
	3	5	,80	,447	,200	,24	1,36	0	1
	Total	25	,52	,510	,102	,31	,73	0	1
Organization	1	12	,25	,452	,131	-,04	,54	0	1
	2	8	,38	,518	,183	-,06	,81	0	1
	3	5	,40	,548	,245	-,28	1,08	0	1
	Total	25	,32	,476	,095	,12	,52	0	1

Appendix 9 - Crosstables of the cluster solution

Descriptive * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Descriptive	0	7	7	0	14
	1	5	1	5	11
Total		12	8	5	25

Prescriptive * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Prescriptive	0	10	5	0	15
	1	2	3	5	10
Total		12	8	5	25

Comparative * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Comparative	0	7	4	0	11
	1	5	4	5	14
Total		12	8	5	25

Internal * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Internal	0	0	0	3	3
	1	12	8	2	22
Total		12	8	5	25

External * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
External	0	12	8	0	20
	1	0	0	5	5
Total		12	8	5	25

OnlineQuestionnaire * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
OnlineQuestionnaire	0	5	0	3	8
	1	7	8	2	17
Total		12	8	5	25

Questionnaire * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Questionnaire	0	9	8	5	22
	1	3	0	0	3
Total		12	8	5	25

Conceptual * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Conceptual	0	10	8	2	20
	1	2	0	3	5
Total		12	8	5	25

ScoreDetermination * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
ScoreDetermination	0	12	0	5	17
	1	0	8	0	8
Total		12	8	5	25

MaturityLevelDetermination * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
MaturityLevelDetermination	0	0	8	2	10
	1	12	0	3	15
Total		12	8	5	25

NumericalScoreVisualization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
NumericalScoreVisualization	0	12	3	5	20
	1	0	5	0	5
Total		12	8	5	25

StagedMaturityModelVisualization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
StagedMaturityModelVisualization	0	5	8	4	17
	1	7	0	1	8
Total		12	8	5	25

ContinuousMaturityModelVisualization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
ContinuousMaturityModelVisualization	0	10	7	3	20
	1	2	1	2	5
Total		12	8	5	25

MatrixVisualization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
MatrixVisualization	0	11	8	4	23
	1	1	0	1	2
Total		12	8	5	25

SpiderdiagramVisualization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
SpiderdiagramVisualization	0	9	5	4	18
	1	3	3	1	7
Total		12	8	5	25

Free * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Free	0	0	0	5	5
	1	12	8	0	20
Total		12	8	5	25

Culture * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Culture	0	2	6	1	9
	1	10	2	4	16
Total		12	8	5	25

OperationalProcesDigitization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
OperationalProcesDigitizati on	0	7	4	3	14
	1	5	4	2	11
Total		12	8	5	25

TransformationManagement * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
TransformationManageme nt	0	3	5	3	11
	1	9	3	2	14
Total		12	8	5	25

Strategy * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Strategy	0	8	4	1	13
	1	4	4	4	12
Total		12	8	5	25

BusinessModel * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
BusinessModel	0	9	8	5	22
	1	3	0	0	3
Total		12	8	5	25

ProductInnovation * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
ProductInnovation	0	8	4	4	16
	1	4	4	1	9
Total		12	8	5	25

Technology * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Technology	0	4	6	2	12
	1	8	2	3	13
Total		12	8	5	25

Analytics * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Analytics	0	7	5	3	15
	1	5	3	2	10
Total		12	8	5	25

CustomerCentricity * Average Linkage (Between Groups) Crosstabulation

Count

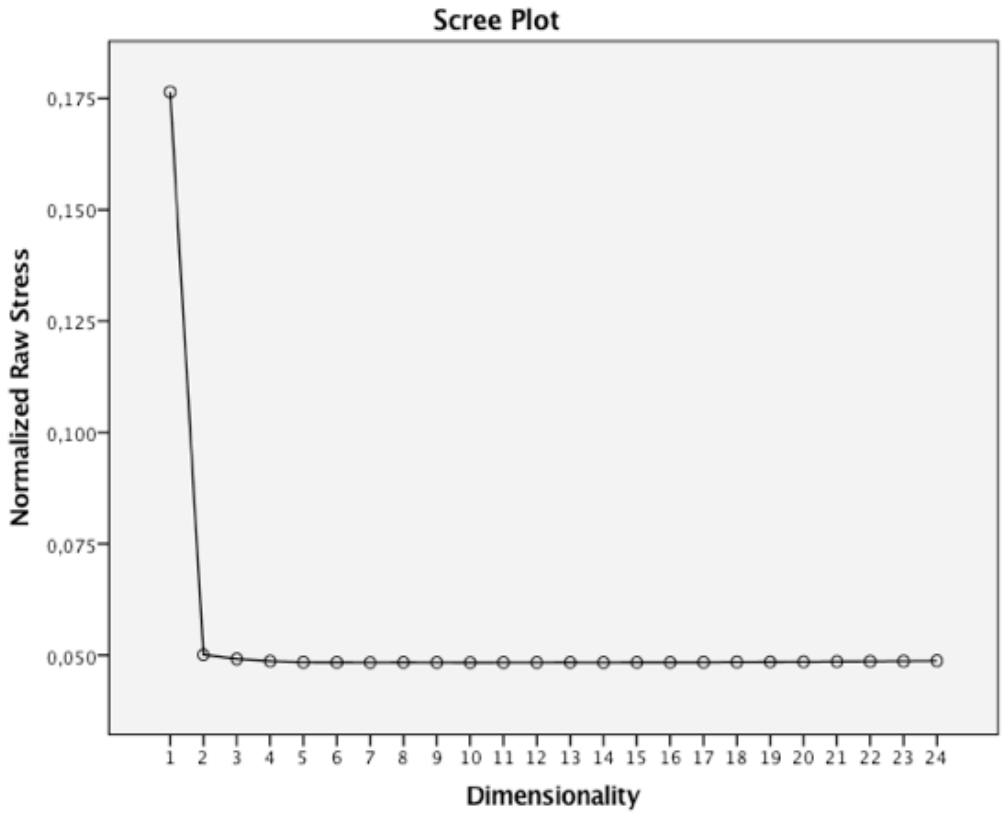
		Average Linkage (Between Groups) 1	2	3	Total
CustomerCentricity	0	8	3	1	12
	1	4	5	4	13
Total		12	8	5	25

Organization * Average Linkage (Between Groups) Crosstabulation

Count

		Average Linkage (Between Groups) 1	2	3	Total
Organization	0	9	5	3	17
	1	3	3	2	8
Total		12	8	5	25

Appendix 10 - Scree plot



Appendix 11 - Dendrogram from the cluster analysis