MASTER THESIS

DEVELOPING AN AGILE DIGITAL TRANSFORMATION MATURITY MODEL AND ASSESSMENT INSTRUMENT

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EXECUTIVE SUMMARY

In the past decade, research has an increased focus on Digital Transformation (DT). Due to the new and rapidly increasing number of technologies, organizations cannot be on the back foot. As a result, organizations digitize information, digitalize processes, and digitally transform their organization as a whole to keep up with the digital innovations and deliver exactly what the customer wants. Practitioners and scholars have recognized the increased interest of organizations in DT and have started to establish DT maturity models to measure how mature an organization is regarding DT and to indicate how to increase its DT maturity. However, the DT maturity research is still in its early stages and current DT maturity models differ significantly.

In addition, agile is a software development methodology which has been increasing in popularity since the "Agile Manifesto" in 2021. Agile has evolved over the years and is currently scaled across complete organizations instead of just in the software development teams. Moreover, variations of DevOps are emerging to complement the agile way of working.

As both DT and agile are topics on top of mind of organizations, more and more organizations are performing DT while implementing the agile way of working. However, there does not exist a maturity model combining both DT and agile with a focus on the intersection between DT and agile. As a result, there is need for research on the topic of Agile Digital Transformation (ADT) and its maturity to assess and improve the ADT capabilities of the increasing number of organizations focusing on DT in an agile way.

Hence, this master thesis develops and evaluates the ADT maturity model, including a self-assessment instrument in the form of an application. The proposed ADT maturity model provides a framework for companies that try to improve their DT in an agile way.

The research in this thesis followed a research process implementing the Design Science Research Methodology.

The first part of this research includes a Systematic Literature Review (SLR) on existing agile maturity models concerning DT and on agile guidelines. The SLR resulted in four DT maturity models, five agile maturity models, and 24 sets of agile guidelines. After analyzing the findings, a high-level conceptual model was created, which can be used as the basis for designing a maturity model incorporating agile and DT capabilities. The second part of this research covers the multi-method development approach to design the ADT maturity model. This approach includes (i) synthesizing the four DT models into one model by systematically comparing them. Afterwards, the five agile maturity models are (ii) synthesized into one agile maturity model. Next, both synthesized models are (iii) combined to create the ADT maturity model aspects. Subsequently, (iv) expert interviews and market research has been conducted to confirm the ADT aspects and obtain information about ADT capabilities. Finally, (v) by performing the qualitative content analysis, the sub-aspects and indicators of the ADT maturity model have been selected. This resulted in the seven ADT aspects: culture, strategy, expertise, technology, internal organization, external organization and agility. In addition, 28 sub-aspects and 132 indicators were established and related to their corresponding aspect. The final part of this research contains a multi-method evaluation study. This study implemented a two-step evaluation approach consisting of (i) an expert evaluation of the elements of the ADT maturity model and (ii) observational case studies in which the ATD model and its assessment instrument was used in real-world contexts. After the first version of the ADT maturity model has been designed, it was evaluated with its expected users during expert evaluation interviews. The feedback provided by the users was used to create a final version of the ADT maturity model. In addition, evaluation criteria were rated by the experts to validate the non-functional requirements of the maturity model. Next, the assessment instrument has been created based on the second version of the ADT maturity model. The final step of the evaluation consists of applying the final ADT maturity model, through the assessment instrument, in practice. Observational case studies, where the model was applied in two organizations,

were conducted to test the functional requirements of the ADT maturity model.

To conclude, the contribution of this research is as follows:

- This thesis provided an aggregated view on the state of the art in maturity models and guidelines for DT in agile. Such a view has not been proposed until now in scientific literature. This aggregated view could serve as a lense for analysing maturity models and guidelines that might be proposed in the future and compare any future model with existing models.
- The thesis demonstrated how to use Design Science Methodology in a research context where a multi-method strategy was used both for artifact development and its empirical evaluation. The research process proposed in the thesis, could be replicated in other students'projects in which maturity models need to be developed.
- This thesis resulted in the final, novel artifact: the ADT maturity model and assessment instrument. A comprehensive two-step empirical evaluation of the newly proposed ADT maturity model and assessment instrument was done in real-world contexts. This evaluation produced indicative evidence that the ADT maturity model and assessment instrument are applicable and suitable for use.
- This research provided guidelines to practitioners at CAPE Groep B.V. on how to use the assessment instrument, how to conduct an assessment in a client organization, and on how to improve the current ADT assessment instrument.

PREFACE

This master thesis marks the end of my journey of six years at the University of Twente. During the first three and a half years, I spend my time on completing the Bachelor's degree of Business Information Technology. This Bachelor seemed suitable for me as I had always liked business oriented subjects in secondary school. Besides, information technology has always been one of my interests, even though I have not followed a subject on it during secondary school. In the end, I have been very happy with this choice and I have enjoined the courses during the Bachelor. After my Bachelor's degree, I found out that the business side of Business Information Technology appealed more to me and the computer science part was not my cup of tea. However, I really enjoyed the combination of the two and decided to pursue one of the two subsequent Master's degrees of Business Information Technology.

The Master's degree Enterprise Architecture & IT Management was a quick choice to be made. During the Bachelor, I noticed that models, project management, and IT management were the most interesting subjects to me. Thus, this Master's degree seemed a good fit to pursue my career at the University of Twente. In total, I have spent two and a half years on my Master's degree. One particular reason for the delay of half a year stems from the choice of doing a part-time board year at the student sport association T.C. Ludica. To be honest, this was one of the best choices I could have made. Next to a very fun year, I have also developed my personal skills and learned new things.

As mentioned before, I have always had an interest in models, enterprise architecture, project management and IT management. I think it is extremely interesting to observe the working of organizations and dive deeper into its structure and processes. Besides, the IT and project management of an organization allows me to obtain information on an organization's IT projects and interests. Personally, I think this partly reflects the intersection between business & IT and would be a good fit for a graduation project. Thus, I am pleased that my graduation project is in line with these topics. Creating an agile digital transformation maturity model allows me to dive deeper into IT management and an enterprise's architecture. The broad topic of digital transformation made me acknowledge many new findings on what is important about IT for organizations who want to digitally transform. Besides, it made me realize that IT is not the only important subject in digital transformation but business aspect, such as culture, are as important.

The graduation project was conducted during the Covid-19 pandemic. Currently, the pandemic is still going on and the question is if it will ever leave us. Finding an external company to conduct your research project at was extremely difficult during these times. I have contacted multiple organizations but due to Corona many organizations were anxious to employ graduation students. However, in the end, I am very happy with the company where I ended up conducting my graduation project. Whenever possible, I was happily invited to work at the office with a more than sufficient working environment. One downside of the Covid-19 pandemic is the fact that most activities take place digitally. I would have liked to interview more experts in a face-to-face way but I am pleased that the research could still continue.

I would like to thank all the great people at CAPE Groep B.V. for the great time and help during my graduation project. Many employees of CAPE Groep B.V. served as experts during my interviews and made it possible to create a nice application in Mendix. In particular, I want to thank Arthur van Leeuwen for the supervision of the graduation project. Arthur is a very insightful person and I learned many things from him.

From the University of Twente, I would like to thank Maria Iacob and Maya Daneva for the guidance during my graduation project. Without the feedback that I received from them, I would have never ended up with this great result.

I now invite you to read the thesis and I hope you enjoy reading it.

Thomas Teunissen

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LIST OF ABBREVIATIONS

ADT Agile Digital Transformation. i

ARGM Agile Requirement Generation Model. 40

ART Agile Release Train. 12

CAT Customer Acceptance Testing. 40

CEO Chief Executive Officer. 14

CMM Capability Maturity Model. 17

DAD Disciplined Agile Delivery. 12

DT Digital Transformation. i

ICT Information Communications Technology. 1

ID Identity Document. 109

ISD Information System Development. 43

IT Information Technology. 15

LeSS Large Scale Scrum. 12

MVP Minimal Viable Product. 97

PDCA Plan Do Act Check. 41

SAFe Scaled Agile Framework. 2

SLR Systematic Literature Review. i

TDD Test-Driven Development. 40

UT University of Twente. 3

UTAUT Unified Theory of Acceptance and Use of Technology. 5

1 INTRODUCTION

This chapter introduces the research. This research aims at developing an ADT maturity model and assessment instrument for CAPE Groep B.V. Currently, DT is on top of mind of many companies and increased in popularity the last five years (Bloomberg, 2018). DT has many definitions in research but for this research the definition of Bloomberg (2018) is used: ”DT is a broad term that refers to the customer-driven strategic business transformation which requires organizational change and the implementation of digital technologies.” In addition, agile is a term which increased in popularity after the ”Agile Manifesto” in 2001 (Fowler et al., 2001). Nowadays, agile is still being used, not only in software development teams but in large scale organizations as well. Agile focuses on agility and adaptability based on small iterative development cycles with the aim to improve the output with each iteration (McCormick, 2012). Finally, ADT is the intersection between, on the one hand, DT and, on the other hand, agile. This master thesis investigates what practices of DT and agile are important for ADT and develops an ADT maturity model based on these findings. The intersection has been further elaborated on in Section 1.2.3.

The remainder of this chapter is structured as follows. It starts with the description of the research context, CAPE Groep B.V., and why this context needs an ADT maturity model. Afterwards, the problem statement is described by illustrating problems, present in literature and in the research context, on agile, DT and ADT. Next, the research goal, the research methodology for this research, and the stakeholders with corresponding goals and requirements will be explained. Followed by deriving research questions from the research goal. Finally, the structure of this master thesis will be presented.

1.1 Context

This section presents the organizational, CAPE Groep B.V., and technical system, CAPE MOBY 2, of this research environment together with its problems regarding agile and DT. During this research, the perspective of CAPE Groep B.V. is taken, its stakeholders, and problems.

1.1.1 CAPE Groep B.V.

CAPE Groep B.V. is a consultancy organization that strives to deliver value to customers by innovating clients’ existing business processes by digitally transforming them. Their clients are mainly situated in the transport & logistics, supply chain, construction, finance & insurance and agri-food sectors. Nowadays, CAPE Group B.V. receives an increased number of requests from its clients about DT and agile. For instance, organizations want to digitally transform their traditional organization into an Information Communications Technology (ICT) organization (i). In addition, companies have trouble working agile even though agile practices are implemented in their way of working (ii). Finally, questions about the current company state and its functionality arise (iii). According to the next section describing the problem statement, these questions arose in literature as well. A maturity model can answer all these three questions since a maturity model helps to determine the current state of a company on a specific topic, can identify a gap between the current and desired state of a particular topic and can provide general guidelines based on the identified gap (Caiado et al., 2021). Although CAPE Groep B.V. focuses on DT and operates in an agile way of working, it currently does not own a maturity model combining, on the one hand, agility aspects, and on the other hand, DT aspects. As a result, an opportunity exists to establish an ADT maturity model and assessment instrument to operationalize the maturity model to tackle these three problems stated above.

1.1.2 CAPE MOBY 2

CAPE Groep B.V. currently owns a concept of a maturity model based on a combination of existing agile maturity models, which is called CAPE MOBY 2. CAPE MOBY 2 is still in its baby steps and contains agile maturity models retrieved via a quick search on the web. CAPE MOBY 2 exists of the following agile maturity models: management agility, business agility, business - ICT trust, governance,

agile, continuous delivery, product vision excellence, team agility, learning culture, skills of the team and DevOps implementation. The focus of the organizational system is on an agile enterprise and does not consider any DT maturity models. Although this maturity model is still in early development and does not contain DT maturity models, it can be used as a reference point when confirming agile capabilities found in the literature. In addition, it can be used to explore agile capabilities mentioned in the model but not found in the literature.

1.2 Problem Statement

This section describes the problems about agile, DT and the intersection of the two terms. In addition, it explains how these problems are related to the research goal of this master thesis.

1.2.1 Digital Transformation

Nowadays, the word DT gets an increased amount of attention and could be seen as a 'hype' (Bloomberg, 2018). It often gets confused with digitization and digitalization but covers a significantly more comprehensive range of concepts. Although DT is getting increasingly popular, the expected benefits disappoint, and the goals of DT projects are often not reached (Tabrizi et al., 2019). According to a survey of Tabrizi et al. (2019), 70% of all DT projects fail, and of the 1,3 trillion dollars spent, 900 billion dollars got wasted. This is often the consequence of a lack of the right mindset to change and organizational practices that are flawed inside an organization during their DT. As a result, DT will not lead to success but act as an amplifier to failure. In addition, large traditional companies have an even harder time executing DT projects than IT companies or start-ups. The main reasons for this are the legacy infrastructure, high amount of historical data and already established processes which are hard to change inside a sizeable traditional organization (Gerster et al., 2018). As a result of this problem, bimodal IT has been suggested as a solution to this problem (Horlach et al., 2016). Bimodal IT exist when a digital IT unit has been build next to the traditional IT unit. This allows the traditional infrastructure and processes to be in place and build a new digital IT unit to comply with the requirements to perform DT projects. However, according to Horlach et al. (2016), implementing bimodal IT might not be enough for the future, and further changes have to be adopted by large traditional companies to compete with their competitors.

1.2.2 Agile

Large traditional companies are currently adopting agile practices at a large scale to help them in their DT (Gerster et al., 2018). However, implementing agile practices inside the organization comes with challenges and problems (Denning, 2019; Fuchs and Hess, 2018). Occasionally, agile practices have been implemented but do not result in the expected benefits. In practice, this leads to questions, such as, how agile is my company or how do I become more agile? These questions can be answered by applying agile maturity models or agile guidelines. Agile maturity models support organizations in determining their maturity level based on available capabilities within the company. The more agile capabilities are in place, the higher the agile maturity level of the organization (Patel and Ramachandran, 2009). According to Patel and Ramachandran (2009), after determining the agile maturity level, guidelines are available on how to get to a certain maturity level or even a higher maturity level.

1.2.3 Agile Digital Transformation

Current agile frameworks, such as Scaled Agile Framework (SAFe), do not guide organizations through DT (Fuchs and Hess, 2018). In addition, modern agile maturity models have a lack of focus on DT (Teichert et al., 2019) and challenges for companies at different maturity levels in DT are not yet identified due to the lack of accessible cases in practice (Gerster et al., 2018). Thus, many studies have been conducted on agile maturity models and guidelines, but with no focus on DT. As a result, there is a need for research on agile maturity models and guidelines that guide substantial traditional companies through their DT. Therefore, this research aims to obtain knowledge about existing agile maturity

models and guidelines with regard to DT and to measure the gap between, on the one hand, current agile maturity models and agile guidelines and, on the other hand, DT maturity models and guidelines. In the end, the goal of this research is to develop an ADT maturity model to address these problems. To develop the ADT maturity model this research focuses on identifying the important characteristics of ADT to measure its maturity, as displayed in Figure 1. This figure displays the intersection between agile and DT.

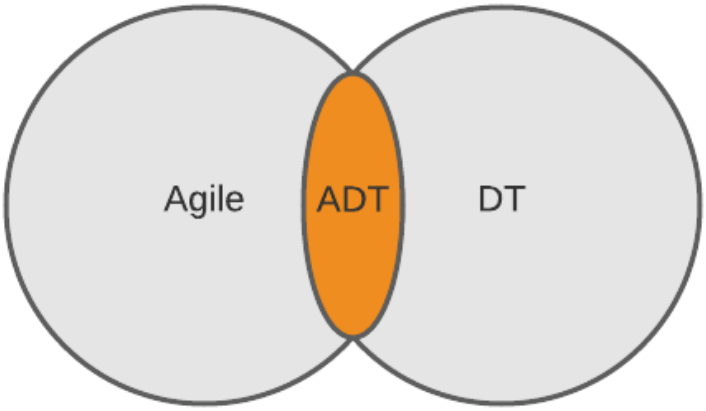


Figure 1: The ADT intersection

1.3 Research Goal

This section describes the research goal of this master thesis. First, the research goal is described by discussing the research methodology used to reach the general goal of this research. Second, the stakeholders and their goals and the requirements for the design of this research.

1.3.1 Research Methodology

This research aims to develop an agile maturity model concerning DT. To achieve this goal, the design science research methodology proposed by Hevner is followed (Hevner and Chatterjee, 2010). This research methodology has been chosen as it supports the development of artifacts in a particular environment through cycles. As a result, this methodology is a suited approach to develop an ADT maturity model, the artifact, and investigate how it interacts with its context, the environment. In addition, the design science research methodology is well accepted by researchers and determined to apply to the development of maturity models (Becker et al., 2009). Figure 2 displays a mapping of the proposed research design on the design science cycle of Hevner. The 'problems' have already been introduced in Sections 1.2.1, 1.2.2 and 1.2.3. The 'application domain' is described in Section 1.1. The 'build design' is presented in Chapter 3. The 'evaluate' is described in Chapter 4. The 'foundations' are presented in Chapters 2 and 3. Finally, the 'meta-artifacts' are described in Sections 2.4, 2.5 and 2.6.

1.3.2 Stakeholder Goals & Requirements

This section describes the stakeholders in the application domain, the stakeholder goals and the requirements based on the stakeholders and their goals, since artifact development always goes hand in hand with stakeholder goals and requirements (Hevner and Chatterjee, 2010). The application domain is depicted in Figure 2 and the stakeholders included in the application domain are: consultants, clients, the master thesis researcher, the University of Twente (UT) and CAPE Groep B.V. The master thesis researcher, the author of this paper, initiated the research by searching for a graduation project on

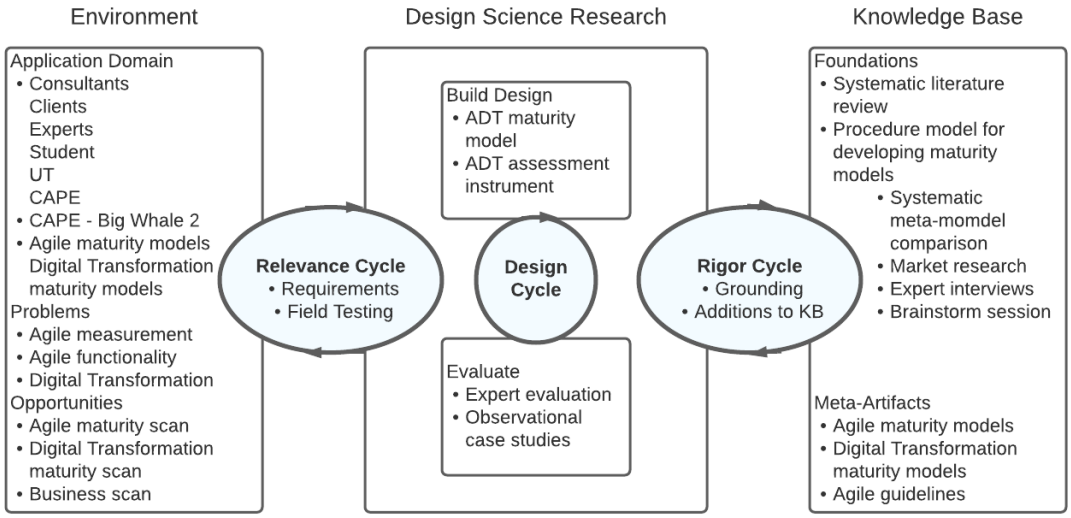


Figure 2: Design Science mapping, adapted from (Hevner and Chatterjee, 2010)

software development methodologies. CAPE Group B.V. reached out with an exciting graduation project and decided, together with the master thesis researcher, to develop a maturity model on agile concerning digital transformation. In addition to CAPE Group B.V., the UT helped supervise the master thesis researcher's graduation project and thus this research. Furthermore, the experts provided information to the master thesis researcher to develop the maturity model and assessment instrument. Finally, the consultants of CAPE Group B.V. helped to evaluate the model by using it. The stakeholders of the project have been classified using the **taxonomy of Alexander**, as the taxonomy can distinguish between human roles in system development (Alexander, 2005). All stakeholders, stakeholder classifications, stakeholder descriptions and stakeholder goals are listed in Table 1.

Based on the stakeholder goals presented in Table 1, the problems stated in Section 1 and the opportunities mentioned in Section 1, several requirements can be established. Requirements should be established to enforce the development of the artifact to be coupled to the research environment and to make sure the artifact can be evaluated afterwards (Hevner and Chatterjee, 2010). The following functional requirements are established:

1. **The maturity model needs to be able to assess the agile capabilities and practices of an organization:** One of the requirements of a maturity model, in general, is the ability to be able to assess the capabilities of a certain domain. Since this research environment is partly focused on agile, the system should be able to assess agile capabilities.
2. **The maturity model needs to be able to assess the digital transformation capabilities and practices of an organization:** One of the requirements of a maturity model, in general, is the ability to be able to assess capabilities of a specific domain. Since this research environment is partly focused on digital transformation, the system should be able to assess digital transformation capabilities.
3. **The maturity model needs to be able to appoint a maturity level:** One of the requirements of a maturity model, in general, is the ability to be able to appoint a maturity level based on the assessed capabilities of a particular domain. Therefore, this maturity model should appoint a maturity level based on Agile and Digital Transformation capabilities.
4. **The maturity model needs to be able to indicate a gap between the current and desired state of capabilities:** According to Section 1.4, the maturity model should be able to display a

Stakeholder groups	Taxonomy	Description	Goal
Researchers of the UT	Supplier	The University of Twente acts as a supplier of knowledge for the graduation student and supports the developer to finish the project.	Contribute to research and practice by supporting the graduation student.
Master thesis researcher	Developer	The graduation student develops the maturity model from scratch up until the deployment of the maturity model by performing case studies.	Develop the maturity model.
CAPE Groep B.V.	Sponsor	CAPE Group B.V. initiated the development of the artifact and discussed the scope, purpose and stakeholders with the graduation student. In addition, CAPE Group B.V. supported the student in the development of the artifact.	Develop a maturity model to solve clients issues on Agile and Digital Transformation.
Clients of CAPE Groep B.V.	Functional beneficiary	The clients of CAPE Group B.V. benefit from the results of the artifact by obtaining an overview of their Agile and Digital Transformation capabilities.	Measure and improve their Agile and Digital Transformation capabilities.
Consultants of CAPE Groep B.V.	Normal operators	The consultants of CAPE Group B.V. act as normal operators who interact with the artifact by giving commands.	Obtain a practical, easy to use and effective assessment tool to measure Agile and Digital Transformation capabilities of clients
Digital Transformation experts	Consultant	The Digital Transformation experts act as consultants and provide additional information as input for the artifact.	Provide Digital Transformation knowledge

Table 1: Stakeholders and goals

gap between the current and desired state of capabilities. Therefore, the maturity model needs to have the functionality to indicate the desired state next to scoring the current state.

5. **The maturity model needs to be able to provide improvement prioritization of capabilities:** According to Section 1.4, the maturity model should be able to guide how to improve the current state of capabilities. As a result, the maturity model needs to have the functionality to prioritize the points of improvement.

In addition, Hevner and Chatterjee (2010) states that acceptance criteria have to be established as well. As a result, non-functional requirements are established to evaluate the acceptance criteria of the design artifact and analyze whether the artifact improved the environment and how. The evaluation criteria are based on the Unified Theory of Acceptance and Use of Technology (UTAUT) which defines evaluation criteria for information technology (Venkatesh et al., 2003). The UTAUT has been chosen because it has been widely used in design science research and is accepted as a proper evaluation checklist. The UTAUT consists of the following evaluation criteria categories:

1. **Performance expectancy:** The degree to which an individual believes that using the system will help him or her to attain gains in job performance.

2. **Effort-expectancy:** The degree of ease associated with the use of the system.
3. **Attitude towards using technology:** An individual's overall affective reaction to using a system.
4. **Social influence:** The degree to which an individual perceives that important others believe he or she should use the new system.
5. **Facilitating conditions:** The degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system.
6. **Self-efficacy:** The degree to which an individual can operate the system without help.
7. **Anxiety:** The degree to which an individual feels fear when using the system.
8. **Behavioral intention to use the system:** The degree to which an individual wants to use the system in the future.

1.4 Research Questions

As the goal of this research is to **develop an ADT maturity model and assessment instrument**, the following main research question and research sub-questions are formulated:

Main RQ:
How to design a maturity model which allows companies to assess and improve their agile and digital transformation practices?

The following research sub-question has been established to define the agile way of working and describe how this way of working can be leveraged by companies. This research question is essential to answer since it provides a deeper understanding of agile and its important practices.

RQ1: *What is an agile way of working and how can this be leveraged by companies?*

The second research sub-question has been established to define DT and describe how its maturity can be assessed. This helps to gain a deeper understanding of DT and the concept of assessing maturity.

RQ2: *What is digital transformation and how is its maturity assessed?*

The third research sub-question has been constructed to gather insight into the state of the art on agile maturity models and guidelines with regard to digital transformation. As a result, the author gains insight in current agile and DT maturity models and is able to observe its structure and contents.

RQ3: *Which Agile maturity models and Agile guidelines with regard to digital transformation are provided in literature?*

The fourth research sub-question has been created to investigate how an ADT maturity model can be designed. This is vital knowledge because the ultimate artifact of this research consists of a maturity model which is able to assess agile and DT capabilities.

RQ4: *How to design a maturity model for companies which adopt an agile way of working and engage in digital transformation?*

The fifth research sub-question has been established with the aim to gain knowledge on how to operationalize the ADT maturity model and make it usable in practice. This research question is vital as it results in the ADT assessment instrument which can be used in practice.

RQ5: *How to operationalize the Agile Digital Transformation maturity model?*

The final research sub-question has been constructed with the aim to check the effectiveness of the artifact in practice. This research question ensures that the artifact will be evaluated in a real-world context.

RQ6: *How effective are the Agile Digital Transformation maturity model and assessment instrument in practice?*

1.5 Master Thesis Structure

The research questions proposed in Section 1.4 are answered by dividing the research into three parts: theoretical background, design & development and, evaluation & demonstration. The three parts are further detailed in Figure 3 by detailing the research activities and artifact development activities. The research activities are displayed by using a white colour and the artifact development activities are depicted with a grey colour. In addition, the research questions are attached to the research activities or artifact development iterations in the figure to visualize which parts of the paper answer which research question.

Chapter 2 includes the theoretical background of this research. This chapter fully answers **RQ1, RQ2 and RQ3** and provides the first answers to **RQ4**. First, a literature review has been conducted on software development methods, DT and maturity models in general. Second, an SLR has been performed to retrieve agile maturity models concerning DT from the literature. Third, in addition, agile guidelines have been retrieved. Finally, this SLR discusses the found maturity models and guidelines and proposes a high-level conceptual model based on the findings.

Chapter 3 covers the design & development phase of the ADT maturity model. This chapter focuses on answering **RQ4**. First, it describes how the method of Becker, based on design science, is used in the development. Afterwards, it describes the development approach used to establish the ADT maturity model. The multi-method development approach consists of a systematic meta-model comparison, expert interviews, market research, and a brainstorming session. The results of this chapter are the synthesized aspects, sub-aspects, and indicators of the ADT maturity model and the maturity levels. In addition, the results are displayed in Excel with an additional introduction and dashboard tab.

Chapter 4 consists of the evaluation & demonstration phase. This chapter concludes the answer to **RQ4** and fully answers **RQ5 and RQ6**. It starts with the description of the multi-method evaluation approach which is used. Afterwards, it covers the expert evaluation interviews, which resulted in the second version of the ADT maturity model and evaluation criteria scores. After that, the second version of the ADT maturity model is described by discussing the implemented changes. Subsequently, the ADT assessment instrument, created based on the second version of the ADT maturity model, is discussed, and design choices are stated. Finally, the observational case studies and their results are discussed. This demonstrates how the assessment instrument can be used in practice.

Chapter 5 covers the discussion of this research. A reflection on the ADT maturity model and assessment instrument, reflection on the research methodology and research limitations are given.

Chapter 6 includes the conclusion of this research. The research questions are answered, the contributions of this research are explained, and the implications & future work opportunities are discussed.

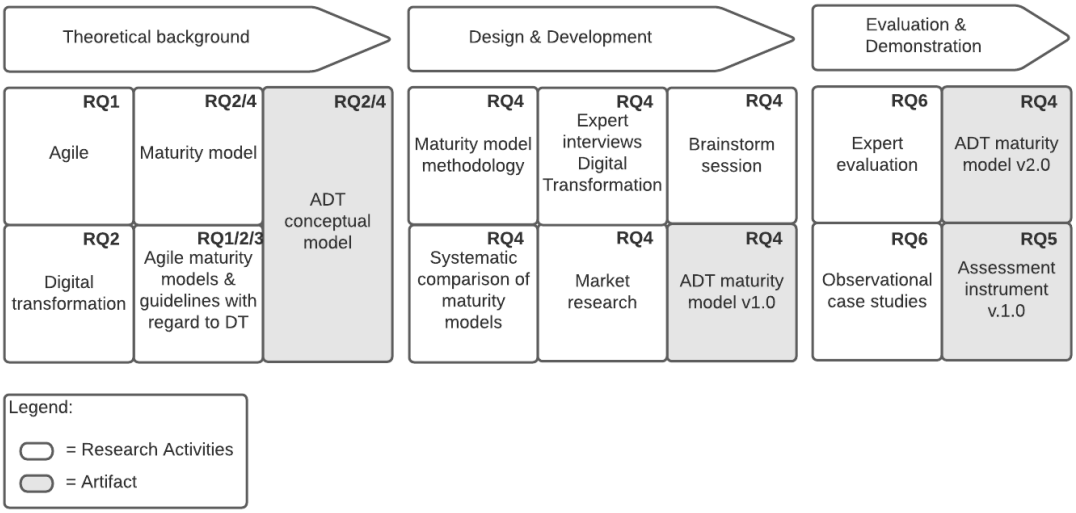


Figure 3: Research structure

2 THEORETICAL BACKGROUND

In this chapter, background information about the software development methods Waterfall, Agile and DevOps is given to understand the underlying principles of these methods. Besides, DT will be further explained by inspecting its main characteristics, phases, strategic imperatives and challenges. Finally, the concept of maturity modelling and its development over time will be examined. All this information is needed to acquire a general understanding of the terms mentioned above and better comprehend the remainder of the paper. Besides, the information on DT in Section 2.2 will be used to answer the second sub-question mentioned in Section 1.3. Afterwards, an SLR has been conducted to retrieve agile maturity models concerning DT and agile guidelines. The information retrieved from the SLR will answer the first, third and fourth sub-questions stated in Section 1.3.

2.1 Software Development Methods

Software development methods describe how to handle the development of complex software systems in practice. Over the years, several different approaches have been proposed, and many methods or parts of methods are still being used today. The first in-depth documentation of how to develop software was established in 1970 by the hands of Royce (McCormick, 2012). Afterwards, many more software development methods have been proposed, and in this section, the Waterfall, Agile, and DevOps methods will be discussed in more detail.

2.1.1 Waterfall

The first software development method ever proposed is the Waterfall method invented by Royce (McCormick, 2012). The original Waterfall method has seven stages, and each stage has to be fully completed before advancing to the next stage. This structured approach is a result of the philosophy behind the development of the Waterfall model, which is based on the hardware manufacture and construction strategies in the 1970s (McCormick, 2012). Since the Waterfall method follows a very structured approach, it has the characteristics of a waterfall in nature and is thus named after it. The Waterfall approach is best used in significant complex projects in which quality control is a considerable concern (Alshamrani and Bahattab, 2015). Figure 4 displays the Waterfall model and its seven stages.

The Waterfall model consists of the following seven stages: system requirements, software requirements, analysis, program design, coding, testing and operations, which can be simplified into five different stages (Alshamrani and Bahattab, 2015).

1. *Requirement:* the system requirements and software requirements together can be described as a major requirements phase. In this phase, information about the system and its behaviour is collected. The client mostly provides this information. In the end, the client and developer agree on a set of software specifications and features for the product.
2. *High-level design:* the analysis and program design jointly describe the high-level design stage. This stage defines a proper implementation based on the gathered information of the requirements phase. Artifacts of this stage consist of the appropriate software architecture design, algorithm design, conceptual database schema and data structure definition.
3. *Coding:* This stage deals with the coding of all the requirements and the conversion of it to the production environment.
4. *Testing:* In this phase, the coded software solutions are tested to check if it meets all requirements stated in the requirements phase. Besides, this stage is used to find bugs in the developed software and to solve them.
5. *Operation:* The operation phase deals with the monitoring of the software after it has been released to the production environment. It detects errors and bugs which occur and notifies the development team, which afterwards handles the problems.

Several issues in the Waterfall model were acknowledged in practice. For example, Van Casteren (2017) states that due to the structural approach, it is not possible to switch back to the requirements phase if it

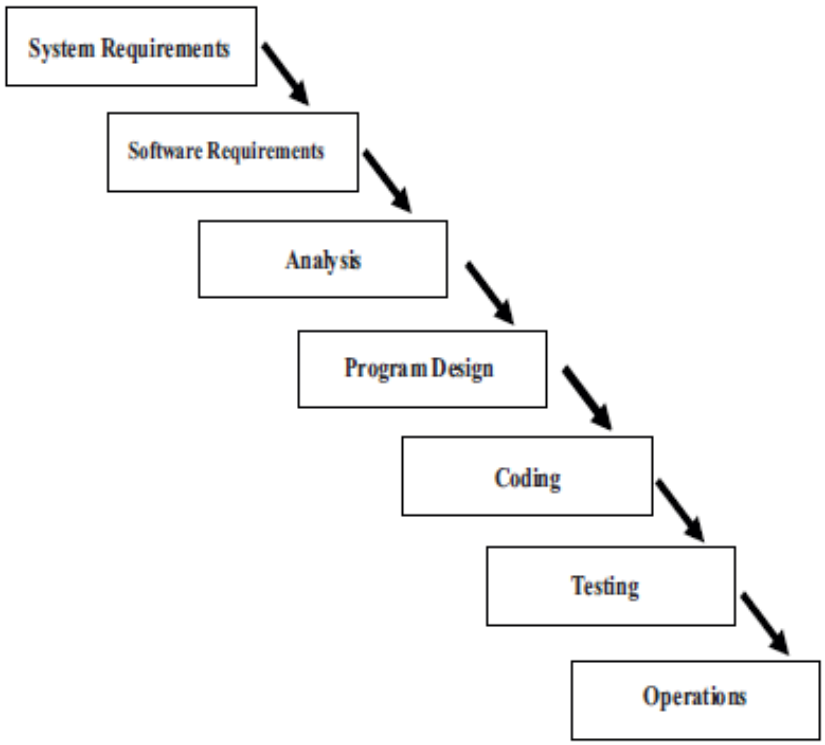


Figure 4: The Waterfall model adopted from (Van Casteren, 2017)

already has been completed. Thus, this method is unsuitable if requirements are unclear or understood and have to change later on. According to Alshamrani and Bahattab (2015), another weakness is the low customer engagement in the project. As a result, clients have little insight into the system under development, and when they can preview it, it might already be too late to make changes. Thus, there was a need for a more flexible software development method to handle software development. This is where agile comes into play.

2.1.2 Agile

Agile software development methods start to emerge in the 1990s. In these years, the methods Scrum, Crystal Clear, Extreme Programming, Adaptive Software Development and Dynamic Systems Development originated (McCormick, 2012). Compared to traditional Waterfall methods, Agile methods focus on agility and adaptability in software development instead of the step by step approach in Waterfall. As a result, the method consists of a variety of iterative development cycles which aim to improve the output with each iteration. These iteration cycles are short; one week, two weeks or a month, and after each cycle, the client discusses the output to make sure it satisfies the requirements. As described in this section, Scrum is an Agile software development method. Figure 5 acts as an example of an Agile software development method, in this case, the Scrum method.

The actual foundation of modern agile stems from the ”Agile Manifesto”, which was established in 2001 (Fowler et al., 2001). The ”Agile Manifesto” originated from a gathering of 17 people who were all Agile enthusiasts. The ”Agile Manifesto” consists of a set of purposes and principles for Agile software development. According to Fowler et al. (2001), this set should be followed when developing Agile methods and has been established to give a comprehensive overview of what an Agile method should entail. The four primary purposes mentioned in the ”Agile Manifesto” are:

- ***Individuals and interactions*** over processes and tools.
- ***Working software*** over comprehensive documentation.

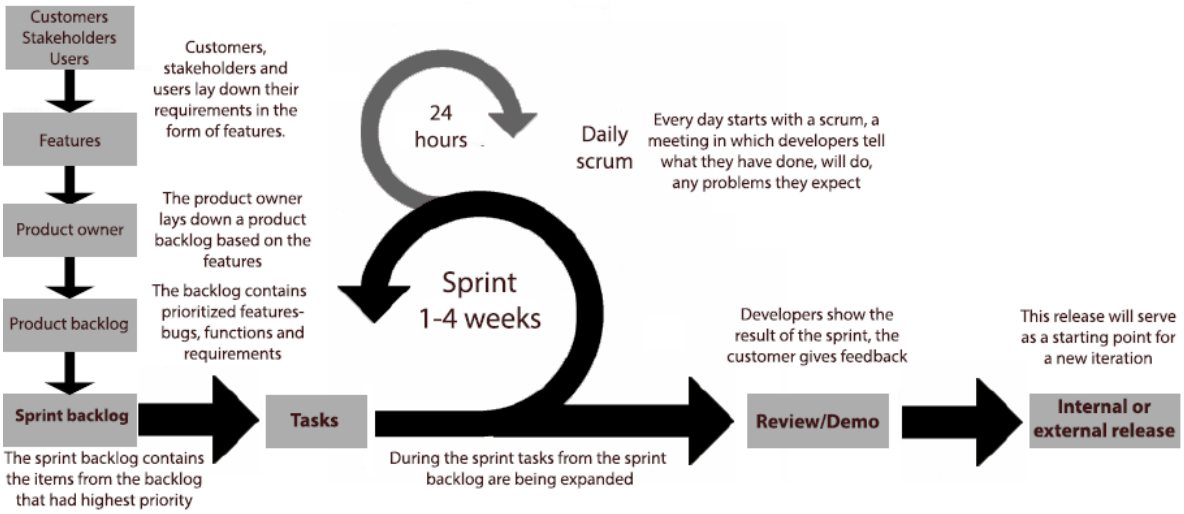


Figure 5: Agile example: Scrum overview adopted from (Van Casteren, 2017)

- ***Customer collaboration*** over contract negotiation.
- ***Responding to change*** over following a plan.

In addition, the principles stated in the "Agile Manifesto" are:

- Our highest priority is **satisfy the customer** through **early and continuous delivery of valuable software**.
- **Welcome changing requirements**, even in late development. Agile processes **harness change** for the customer's competitive advantage
- **Deliver working software frequently**, from a couple of weeks to a couple of months, with a preference to the short timescale.
- **Business people and developers work together** daily throughout the project.
- **Build projects around motivated individuals.** Give them the environment and support they need and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is **face-to-face conversation.**
- **Working software** is the primary measure of progress.
- Agile processes promote **sustainable development**. The sponsors, developers and users should be able to maintain a constant pace indefinitely.
- Continuous attention to **technical excellence and good design** enhances agility.
- **Simplicity**, the art of maximizing the amount of work not done, is essential.
- The best architectures, requirements and designs emerge from **self-organizing teams.**
- At regular intervals, **the team reflects on how to become more effective**, then tunes and adjusts its behaviour accordingly.

Observing the set of purposes and principles, it could be stated that there exists a significant focus on creating value for the customer at all times during the software development. An agile way of working seems to counter all the disadvantages of the Waterfall model by focusing on being agile and responding to change at all times. However, applying agile is only suited for projects which are categorized as minor. More extensive and complex projects are a danger to agile, as it is harder to judge the efforts and time required for such a project (McCormick, 2012).

These traditional agile principles and purposes were officially designed for small teams inside of an organization (Putta et al., 2018). Because of this, the benefits of agile could not be obtained by larger

organizations. Therefore, the agile methodology must first be scaled before incorporating it inside a large organization to manage this. As a result, several large-scale Agile methods emerged, such as SAFe, Large Scale Scrum (LeSS) and Disciplined Agile Delivery (DAD) (Leffingwell, 2007; Larman, 2010; Ambler and Lines, 2012). These three large-scale agile methods are the most popular, with the SAFe in the leading position. According to Putta et al. (2018), the SAFe combines practices from Kanban, Scrum, Lean and Extreme Programming. Besides, it consists of a certain amount of levels depending on the size and the needs of the organization (Leffingwell, 2018) Next to Scrum, Extreme Programming is a software development method as well. However, it differs from Scrum in following a strict priority order instead of the team determining the sequence of development. Lean practices, such as Kanban, focus on creating value for the customer with the primary objective to create as little waste as possible. Kanban utilizes this mindset by managing work by balancing demands with available capacity and resolving system-level bottlenecks. The most robust SAFe configuration is represented in Figure 6 and contains the following levels: the team level, the program level, the portfolio level and the significant solution level. This configuration should be implemented in the largest companies.

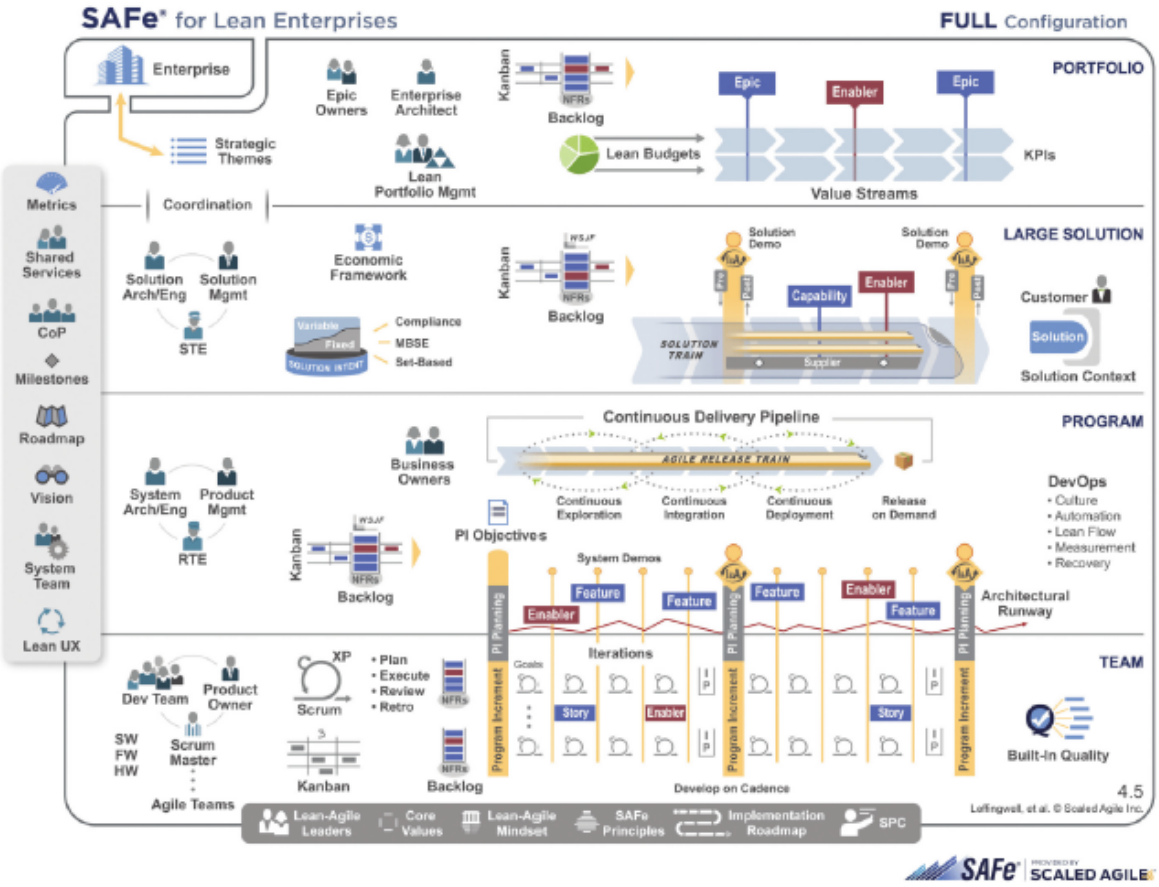


Figure 6: The SAFe, version 4.5 adopted from (Putta et al., 2018)

The team level combined with the program level describes the Essential SAFe configuration and is the basis of SAFe. The team level composes the agile teams, and the Agile Release Train (ART) scale a large number of teams and individuals together at the program level delivering through a continuous delivery pipeline. By adding the portfolio level to the Essential SAFe configuration, the Portfolio SAFe configuration is established. This configuration advances by aligning portfolio execution to the organization's strategy. For example, Lean aspects are added to determine budgets and value streams per team are generated (Leffingwell, 2018). To reach the configuration displayed in Figure 6, the large

solution level has to be incorporated. This level focuses on the largest and most complex solutions that require multiple ARTs and suppliers. Next to adding functionalities at each stage, different roles, such as the Enterprise Architect at the portfolio level, also have to be included. Although large-scale agile methods help large organizations implement Agile practices into their organization, it also comes with challenges. According to Putta et al. (2018), there arise many challenges on an organizational, cultural, roles, practices, scaling, and distribution level.

2.1.3 DevOps

DevOps, which is a combination of the words development and operations, originates from the year 2008. It has been developed to overcome the challenge of agile on the often misaligned operations function, which is responsible for the coordination of the release of the software and the development function (Hemon et al., 2020). DevOps can be seen as an extension of the Agile software development method by focusing on communication and collaboration between developers instead of tools and processes, which is typical for agile. As a result, it extends agile principles to the entire software delivery pipeline (Jabbari et al., 2016). To define DevOps, the following definition from Jabbari et al. (2016) is used, since it is built on 49 other papers mentioning definitions or characteristics of DevOps: *"DevOps is a development methodology aimed at bridging the gap between development and operations, emphasizing communication and collaboration, continuous integration, quality assurance and delivery with automated deployment utilizing a set of development practices."* Thus, the main goal of DevOps is to establish and maintain a tighter integration between the development and operations functions. The differences between the design, code, test, and deploy phases of the Waterfall, Agile and DevOps software development models are described in Figure 7. The Agile model in Figure 7 only has one deployment phase at the end of the iterations. However, iterations exist that end with a deployment phase at the end of each iteration when possible, for instance, creating functionalities on a website that deploys every iteration and changes concerning customer feedback. As can be obtained from

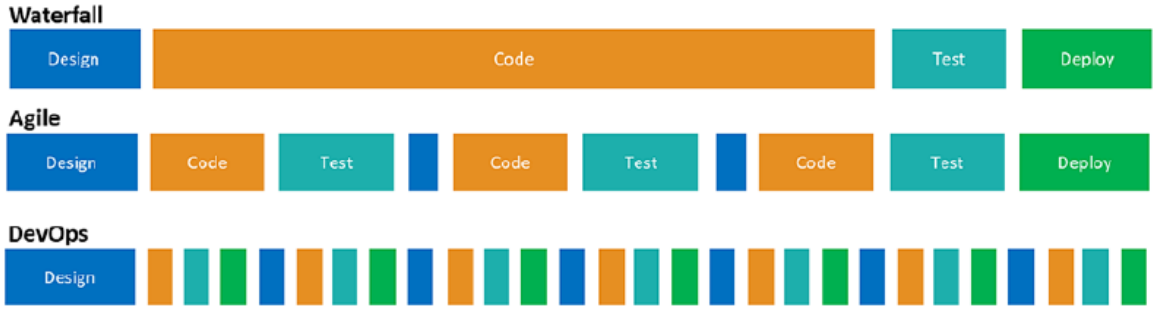


Figure 7: Software development models adopted from (Ambily, 2020)

Figure 7, DevOps has minor code and test phases compared to agile. This is a consequence of the continuous integration, continuous delivery and automated testing principles of the DevOps method (Ambily, 2020).

Over the years, many different variations of DevOps have been established with each its focus point (Ambily, 2020):

1. *BizDevOps:* In this variation, there exists an emphasis on the business people in the overall execution of the process.
2. *DevSecOps:* This variation focuses on the security aspect in the process and addresses the end-to-end security needs of the DevOps implementation. The implementation's solution technology, hosting environment, and DevOps tools are observed, and the proper security tools are implemented.

3. *CloudOps:* A variation of DevOps with a focus on cloud-based systems. It differentiates from DevOps by focusing on Saas and PaaS deployments and the implementation of infrastructure as code.
4. *MLOPs:* MLOPs implementations concentrate on machine learning model development. This variation focuses on typical machine learning processes, such as data cleaning and training the model using a sample data set.
5. *Intelligent DevOps:* This variation is the future state of DevOps and concentrates on using the collected data in the process to predict or derive new insights, for example, defect prediction.

The evolution of the DevOps methodology can be distinguished into three separate segments: DevOps 1.0, DevOps 2.0 and Intelligent DevOps. In DevOps 1.0, the focus lies on understanding the development and operations team's priority and increasing their collaboration level. Next, in DevOps 2.0, there is an additional focus on user-centric deployments incorporating users' feedback before creating the final version. Finally, Intelligent DevOps focuses on implementing intelligent software to gain meaningful insights from collected data in the process. Thus, in this segment, data has been added to the DevOps ecosystem (Ambily, 2020). Figure 8 depicts the Intelligent DevOps model. The blue circles and their explanation visualize the emphasis on gaining insights from data.

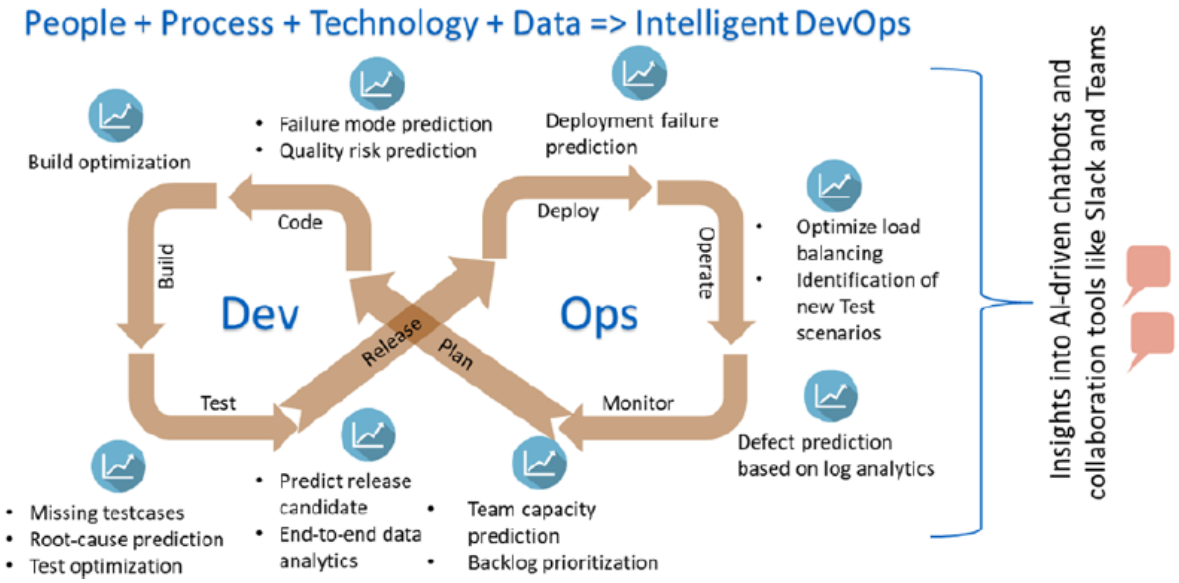


Figure 8: Intelligent DevOps adopted from (Ambily, 2020)

2.2 Digital Transformation

As already stated in the introduction, DT is a current and popular topic, both in practice and theory (Bloomberg, 2018). According to Tabrizi et al. (2019), DT risk is even the number one concern in 2019 of many directors, Chief Executive Officer (CEO) and senior executives. To repeat its definition, DT is a broad term that refers to the customer-driven strategic business transformation, which requires organizational change and the implementation of digital technologies (Bloomberg, 2018). To better comprehend DT, Figure 9 depicts a flow model of DT explaining the external drivers, phases and strategic imperatives of DT.

Figure 9 states the three phases of DT to be digitization, digitalization and eventually DT. According to Verhoef et al. (2021), you have to complete the first two stages before being able to reach the DT stage. *Digitization* covers the process of changing from analog to a digital form (Bloomberg, 2018; Verhoef et al., 2021). It is important to note that information is being digitized and not processes.

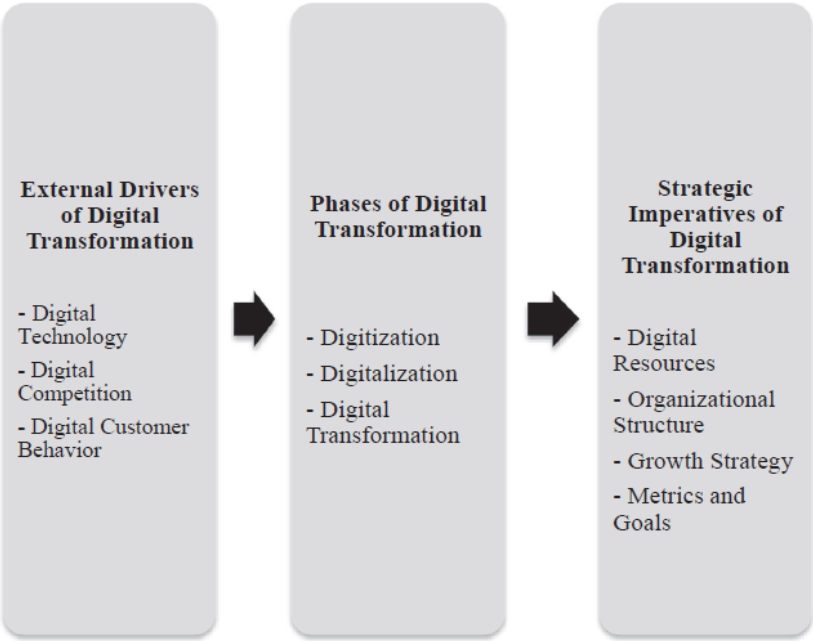


Figure 9: Flow model of digital transformation (Verhoef et al., 2021)

Take, for example, paper-based processes in the administration of an organization. In this case, the information is digitized by converting it to a digital form instead of being on paper. *Digitalization* includes transforming or optimizing existing business processes by utilizing digital technologies or Information Technology (IT) (Bloomberg, 2018; Verhoef et al., 2021). This is often reached by automating processes and adding an artificial intelligence component to the business process. If we look at the earlier example, digitalization of the paper-based process arises when the staff does not fill in the digital form manually but when it happens automatically by using digital technology. *Digital transformation* goes beyond digitalization and focuses not only on processes but on the whole company and its business model (Bloomberg, 2018; Verhoef et al., 2021). As a result, DT leads to new business models that are changed through digital technology. It disrupts the competitive environment and leads to new innovative business models aimed at creating value for the customer (Vial, 2019). To compare the three phases of DT, the first two are reliant on technology, whereas the final DT phase is focused on the customer (Bloomberg, 2018). Regarding the example, the organization should focus on the customer's expectations, needs, and preferences in the DT phase instead of solely worrying about digitizing information or digitalizing processes.

According to the most right box of Figure 9, there are particular necessities that have to be considered when performing a DT. First, *Digital resources* have to be considered to make sure the right assets and capabilities are in place on a digital level. For example, big data analytic capabilities have to be accessible to gain insights into the available data. Furthermore, *Organization structure* is a crucial aspect to consider since the organization has to manage digital change on an organizational structure level. As a result, an agile organizational form is recommended, and traditional organization schemes are insufficient. Moreover, *Growth strategy* is vital to consider, as DT opens new opportunities to grow, and parts of the growth strategy are the fundamental building blocks for the new business model. Finally, *metrics and goals* measure the performance improvements of the DT and indicate whether the DT is successful or impeded in a certain way.

Figure 10 illustrates an ADT roadmap adopted from (Bloomberg, 2018). Observing the figure, DT seems to be a complex phenomenon consisting of different components, such as agile architecture,

DevOps, and customer experience, which leads to DT when all components are implemented. Besides, DT is considered a novel term, and the theory and practice base is still scarce (Vial, 2019; Verhoef et al., 2021). As a result, significant challenges occur when organizations perform the DT process and to overcome these challenges, further research has to be conducted. According to Verhoef et al. (2021), there exists a need for further research on the measurement of DT phases and readiness.

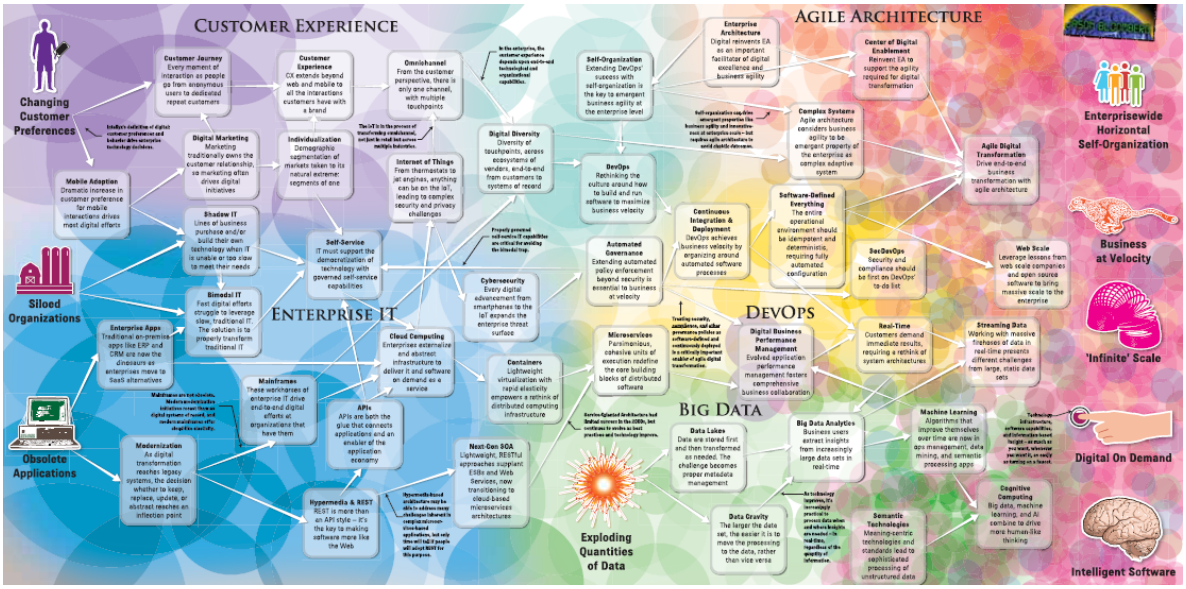


Figure 10: Agile digital transformation roadmap adopted from (Bloomberg, 2018)

2.3 Maturity Models

To get an understanding of maturity models, it is helpful first to state a definition. There are many definitions of maturity models in practice, and a standard definition is missing (Wendler, 2012), but the definition of Becker et al. (2009) is used in this paper since it is one of the most general definitions: *"A maturity model consists of a sequence of maturity levels for a class of objects. It represents an anticipated, desired, or typical evolution path of these objects shaped as discrete stages. Typically, these objects are organizations or processes."* Using a maturity model is desirable when an organization wants to know how mature they are on a specific concept. Besides, when the maturity level is determined, the organization knows how to obtain a higher level of maturity if it is not already on the highest maturity level. On the other hand, organizations could use maturity models to determine a maturity level, which is desired to be reached when there has been no focus on this concept yet. Since the capabilities per maturity level are described, the organization knows what to focus on to reach a specific maturity level. Each maturity model has a different structure. However, most maturity models consist of the characteristics displayed in Figure 11.

In this model, two parts are described in observing the structure of maturity models (Lasrado et al., 2015). Part one covers the design structure of maturity models, and part two concentrates on the measurement instruments used in maturity models. According to Lasrado et al. (2015), the general design pattern of a maturity model exists of the number of levels on one axis and the different dimensions on the other axis, which can be described as a path to maturity. Each level includes a detailed description of the level itself and criteria on how to reach this level. Furthermore, the measurement instruments are described by four concepts: maturity score or level, dimensions sub-categories and assessment questions. *Maturity score or level* covers the number of maturity levels of the maturity model. Together the maturity levels describe the path to full maturity and complete

capability on a specific topic. *Dimensions*, also referred to as capabilities, describe the capabilities which are needed to accomplish a concept. For instance, 'people' might be a dimension when the maturity of agile is determined. *Sub-categories* are explained as second-level dimensions and further specify a dimension. For example, a sub-category of the dimension people could be self-organizing teams. Finally, *assessment questions* are essential to determine the maturity level of the capabilities. Each dimension has its assessment questions aimed at mapping the capabilities to a maturity level.

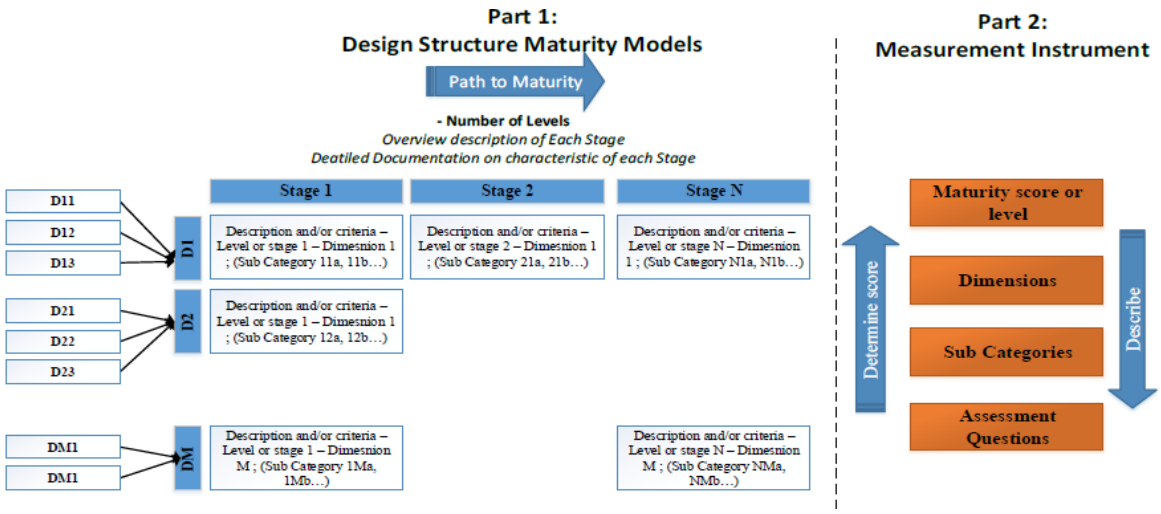


Figure 11: General maturity model structure adopted from (Lasrado et al., 2015)

The first maturity model originates from the year 1993 and is known as the Capability Maturity Model (CMM) (Paulk et al., 1993). This maturity model is based on the ideas of Crosby's quality management maturity grid developed and Nolan's model for data processing, both developed in 1979 (Wendler, 2012). Nowadays, there exists a vast number of maturity models for different domains ranging from software development/engineering, which is the most popular domain, to sustainability and IT alignment (Wendler, 2012). Relevant maturity models for this paper are maturity models in the domain of agile and DT, as described in (Patel and Ramachandran, 2009; Teichert et al., 2019). Although according to both papers, Patel and Ramachandran (2009); Teichert et al. (2019), there is a need for further research on this topic.

2.4 Systematic Literature Review

This section describes the SLR method used to answer the first (partly), third and fourth research questions. The systematic literature review will follow the guidelines of Kitchenham and Charters (2007) combined with the methodology used by Rouhani et al. (2015). The guidelines proposed by Kitchenham & Carter in 2007 are widely accepted in research, and the methodology used in the paper of Rouhani follows these guidelines and can be used as a clear roadmap on how to apply the SLR method. The SLR consists of three main phases planning, conducting and reporting. The main phases with their corresponding sub-activities are depicted in Figure 12

2.4.1 Planning

The planning section will cover the need, objective and execution path of the SLR. Firstly, the research goal and questions are presented. Afterwards, the keywords for the search query are determined, together with the scientific databases where the search query will be performed. Finally, inclusion and exclusion criteria for the review will be stated.

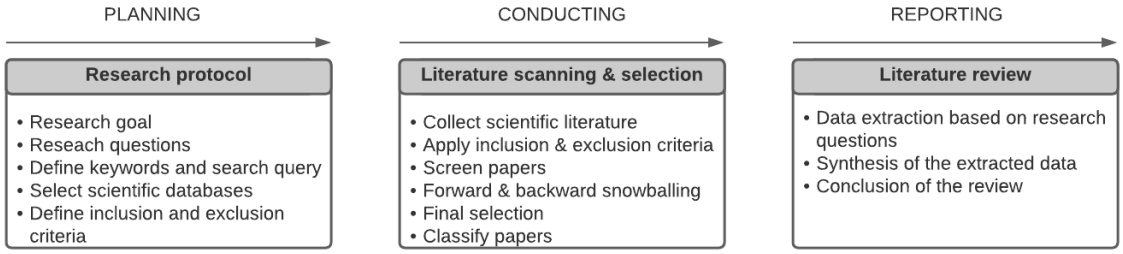


Figure 12: SLR approach

2.4.2 Research Questions

Research questions are the core of the SLR and determine the execution of the three primary stages of an SLR in such a manner that the research questions will be answered (Kitchenham and Charters, 2007). As mentioned in the introduction, one of the paper's goals is to obtain information regarding existing agile maturity models and guidelines and to measure the gap between agile maturity models and guidelines on the one hand and DT maturity models and guidelines on the other hand. As a result, to reach the goal, the following main research questions are formulated:

Main RQ:
Which agile maturity models and agile guidelines with regard to digital transformation are provided in literature?

By retrieving agile guidelines and practices, the first sub-question mentioned in Section 1.3 can be partly answered. In addition, based on the combined findings of agile maturity models concerning digital DT and agile guidelines, the fourth sub-question stated in Section 1.3 can be answered. As a result, the following sub-questions, which the SLR can answer, have been formulated:

Sub RQs:

1. What is an agile way of working and how can this be leveraged by companies?
2. How to design a maturity model for companies which adopt an agile way of working and engage in digital transformation?

2.4.3 Search Query

The search query should obtain results that can answer the research questions. This is because the main keywords are based on the formulated research questions presented above. Table 2 gives an overview of the search keywords consisting of the initial search terms and their synonyms. Combining the initial search terms and their synonyms in the search query will result in an increasingly accurate search.

When performing the search query, the goal is to obtain articles that include an agile maturity model or guideline focusing on DT. As a result, the search query is defined as follows: ("agile maturity model" OR "agile framework" OR "agile capability model" OR "agile maturity framework" OR "agile capability framework") OR ("agile guideline" OR "agile roadmap" OR "agile adoption framework" OR "agile adoption method" OR "agile migration method" OR "agile migration framework" OR "agile transition method" OR "agile transition framework") AND ("digital transformation" OR digitization OR digitalization)

2.4.4 Scientific Databases

Several scientific databases are chosen to run the query:

Agile maturity model	Agile guideline	Digital transformation
Agile capability model	Agile roadmap	digitalization
Agile capability framework	Agile framework	digitization
Agile maturity framework	Agile adoption framework	
	Agile adoption method	
	Agile migration framework	
	Agile migration method	
	Agile transition framework	
	Agile transition method	

Table 2: Search query keywords

- Google Scholar
- Scopus
- IEEE Xplore

According to Google, these databases are chosen since all three are trusted databases and are in the top 5 most trusted databases. Furthermore, Google Scholar has been chosen since it is one of the largest scientific databases and includes much grey literature. According to Kitchenham and Charters (2007), grey literature has to be included in a well-performed SLR. In addition, the term 'maturity model' is often used by consultants and published in grey literature. As a result, obtaining grey literature is desirable when conducting the research.

2.4.5 Inclusion & Exclusion criteria

This section discusses the inclusion and exclusion criteria for the SLR. These criteria are specified to obtain relevant literature to answer the research question and decrease the chance of bias in the search process (Kitchenham and Charters, 2007). As mentioned before, grey literature has been considered as it increases the value of the SLR. Furthermore, literature on DT is crucial to answer the research questions stated and thus has to be incorporated in the found literature. On the other hand, non-English, duplicate, unrelatable, and unspecific literature is not considered to assure readable and relevant literature. The inclusion and exclusion criteria are displayed in Table 3.

Inclusion criteria	Exclusion criteria
English based literature	Non-English based literature
Scientific and grey literature	Duplicate literature
Literature on agile maturity models and digital transformation	Literature which is shorter than five pages
Literature on agile guidelines and digital transformation	Literature without representation of maturity levels
	Literature without specific guidelines
	Literature which is unrelated to the main RQ

Table 3: Inclusion & exclusion criteria

2.4.6 Conducting

The conducting phase describes the selection path of the literature incorporated in the final set. Running the search query in all three chosen databases resulted in nearly 700 studies which were brought down to a final set of 27 studies. The inclusion and exclusion criteria of Table 3 have been used to guide through the selection of literature, first by screening through title and abstract and afterwards by reviewing the full text. The selection process is displayed in Figure 13. The gap in papers between the second and third steps of the selection process can be explained by adding the word 'framework' to the search query and the addition of the scientific database Google Scholar. When performing the conduction phase, many irrelevant papers were found with the inclusion of the word 'framework'. This is due

to the word having a broad meaning and not constantly applying to this research. However, several papers, including the word 'framework', are relevant and included in the final set. As a result, the word 'framework' explains the large gap between steps two and three of the selection phase but could not have been omitted. In addition, the scientific database Google Scholar has been used to include grey literature, which resulted in book and master thesis hits. However, many books were not accessible, and master theses often included much information but not enough relevant information. In the end, 24 literature hits were found on agile guidelines and only three on agile maturity models. Due to the low number of hits on agile maturity models and the possibility of missing relevant literature, forward and backward snowballing has been applied on the three papers about agile maturity models (Wohlin, 2014). As a result, the reference lists and the literature that cited the three papers have been examined on additional relevant literature, resulting in six papers.

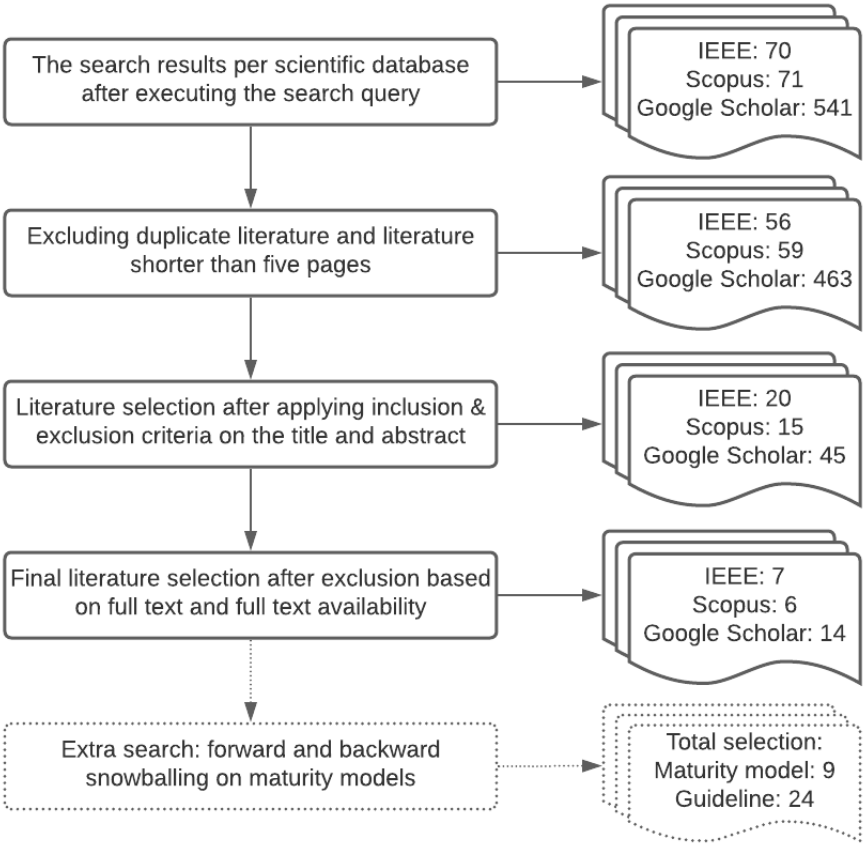


Figure 13: SLR selection flow

2.4.7 Reporting

The reporting stage of the SLR analyses the quality of the studies included in the final set, provides data extraction forms to make sure relevant data to answer the research questions is extracted and synthesizes the extracted data. Since grey literature has been used in the SLR, analyzing the quality of the studies is of significant importance. A quality assessment form has been constructed based on the paper of Rouhani et al. (2015) and has been depicted in Table 4. The research purpose, methods, and outputs per study have been examined, and an overview is given. The research method criteria are literature review (**L**), expert interviews (**E**) and case study (**C**). These criteria are chosen, as the studies in the final set commonly used it. Observing Table 4, 31 of the papers conducted a literature review on the topic. Two studies chose to disregard the literature review and only consider expert interviews or a case study as the research method. One study based the results solely on a literature review without validating the results with experts or a case study. In addition, the distribution between expert interviews (14) and case studies (16) is close to equal.

The research output criteria are composed of agile maturity model (**M**), Agile guideline (**G**), Agile framework (**F**) and Agile process (**P**). An agile guideline only describes extensive recommendations and solutions to become agile. An Agile framework proposes a set of structural components to consider to become agile. The Agile process proposes a structured process or method that has to be followed when becoming agile. These research output criteria are selected due to the goal of this research to determine state of the art on agile maturity models and agile guidelines. In addition, these research output criteria contribute to the quality description of the final set as well. Analyzing the research output of the studies, only six studies reported a process, a framework has been proposed by 14 studies, and 24 studies offer guidelines. As a result, all the studies on agile guidelines in the final set proposed a guideline, but presenting a framework or process seems difficult.

No.	Reference	Research purpose	Research method			Research output			
			L	E	C	M	G	F	P
1	Stojanov et al. (2015)	”Develop a maturity model for adopting agile and SAFe practices”	X	X	X	X			
2	(Leusink, 2012)	”CMMI is combined with agile practices and concepts to obtain an agile CMMI framework.”	X		X	X			
3	(Ifenthaler and Egloffstein, 2020)	”This research intents to fill the gap of a holistic model of technology adoption in eductional organizations through developing a theoretically grounded maturity model.”	X		X	X			
4	(Özcan-Top and Demirors, 2019)	”We developed the Software Agility Assessment Reference Model for the appraisal of software projects from agility perspective and to provide guidance on specifying gaps on the road towards agility.”	X	X	X	X			
5	(Elnagar et al., 2018)	”This research proposes a comprehensive maturity framework called agile requirement engineering maturity model for industry 4.0.”	X			X			
6	(Sidky, 2007)	”We present the Agile Adoption Framework and the innovative approach we have used to implement it.”	X	X		X			

No.	Reference	Research purpose	Research method			Research output			
			L	E	C	M	G	F	P
7	(Schuh et al., 2017)	”We revisit the original guidelines for a successful digital transformation in manufacturing companies.”	X		X	X			
8	(Berghaus and Back, 2016)	In order to foster an understanding of the phenomenon and the development of a digital transformation strategy, this research derives typical stages in a digital business transformation process from empirical data.”	X	X		X			
9	(Packlick, 2007)	”Drawing from Agile principles, we have developed an approach for improvement that enables teams to accelerate change, deepen their degree of understanding, and increase their success in execution.”	X	X	X	X			
10	(Qadadeh and Abdallah, 2020)	”We have developed an improved Agile data mining framework to fulfill the government and business objectives and needs.”	X		X		X	X	
11	(Hostettler et al., 2017)	”TAF Agile Framework addresses the challenge of providing a methods framework for agile mechatronic product development.”	X				X	X	X
12	(Soundararajan and Arthur, 2009)	”We propose a soft-structured framework combining the principles of agile and conventional software development that addresses the issue of rapidly changing requirements for larger scale systems.”	X				X	X	X
13	(Prouza et al., 2020)	”The focus is put on identifying yet unspecific or unknown aspects during a starting phase of a BI project.”	X				X	X	X
14	(Noll et al., 2016)	”The SAFe mapping onto the Global Teaming model provides a concrete roadmap for teams who need specific advice on how to implement GTM practices that have been identified as necessary to their success.”	X				X		
15	(Conboy and Carroll, 2019)	Identify challenges and provide recommendations with regard to implementing Scaled Agile Framework, Scrum at Scale, Spotify, Large-Scale Scrum and Nexus.”			X		X		

No.	Reference	Research purpose	Research method			Research output			
			L	E	C	M	G	F	P
16	(Pradhan and Nanniyur, 2021)	”This paper presents a case study of a large-scale transformation of a legacy quality management system to a modern system developed and implemented at Cisco Systems.”	X		X		X	X	
17	(Horlach et al., 2019)	”By deriving design principles for an agile portfolio management system, our work closes a gap in existing research, which focuses on principles for adaptive IT portfolio management processes instead of proactive systems.”	X	X	X		X		
18	(Moi and Cabiddu, 2020)	”This exploratory single-case study involving the international digital firm Spotahome provides an empirical and theoretical investigation of a new marketing capability we define as Agile Marketing Capability.”	X	X	X		X	X	
19	(Gerster et al., 2020)	”We aim at examining how established enterprises adopt and scale agile forms of organizational design.”	X		X		X	X	
20	(Reichwein et al., 2020)	”This contribution presents an approach using agile product development methods to develop components for additive manufacturing.”	X		X		X	X	
21	(Gandomani and Nafchi, 2015)	”This study inductively developed a substantive Agile transition and adoption framework and describes how various steps of this framework could help software companies to achieve Agile transformation.”	X	X			X	X	
22	(Mako et al., 2019)	”The study contributes to the academic literature on the leadership of agile transformations for large corporates, and provides organisations with valuable input to improve the success of such undertakings.”	X	X			X		
23	(Freedman, 2016)	”My original contribution is the EVOLVE framework which is based on already developed Agile frameworks and I try to shift the conversation from team-focused practice adoption to enterprise-focused agile evolution.”	X				X	X	

No.	Reference	Research purpose	Research method			Research output			
			L	E	C	M	G	F	P
24	(Alhroub, 2016)	”This study aims at investigating the possibility of achieving the benefits of agile project management in software development through using agile project management practices.”	X	X			X	X	
25	(Poth et al., 2019)	”To facilitate a systematic implementation of agile and lean, this article proposes a transition kit based on abstraction.”	X		X		X		X
26	(De Souza, 2020)	”This study investigated the key elements that shape the transition from a traditional to an Agile ISD approach in an organisation and aims to develop an explanatory theory for how and why elements identified shape the organisation’s transition.”	X	X			X		X
27	(Drop et al., 2017)	”This research project investigated the strategy that can be used to execute organization-wide transfromations to the agile way-of-working.”	X	X	X		X		
28	(F. Tripp and Armstrong, 2018)	”This study examines how organizations’ motivations for adopting agile impact the practices they adopt and explores how a fit between an organization’s motives for agile method adoption and the tailored agile practices it adopts may lead to differences in project perfromance.”		X			X		
29	(AKHTER and ÅKERLIND, 2018)	”The study investigates how larger IT infrastructure transformation projects can be executed by the help of agile practices.”	X	X	X		X	X	
30	(Marnewick, 2015)	”This research sought to understand the practices and principles that should be put in place during agile implementation, and assessed how these practices and principles contributed to the acclaimed agile software quality according to literature.	X		X		X		
31	(Fabian, 2019)	”This thesis examines how a technology-driven firm can drive innovation through the concept of organizational agility.”	X	X			X	X	
32	(Orvos et al., 2019)	”This book will help guide on organization’s adoption of business agility.”	X		X		X		X

No.	Reference	Research purpose	Research method			Research output			
			L	E	C	M	G	F	P
33	(Duong, 2014)	”This thesis aims at investigating the adoption practices of agile development methods in companies in Vietnam.”	X		X		X		X

Table 4. Quality assessment form

In addition, to further analyze the quality of the studies, the number of studies per study type has been identified. These results are depicted in Table 5. On the one hand, the grey literature consists of books and theses, which result in 11 studies. On the other hand, the scientific literature contains conference proceedings and journal papers which result in 22 studies. As a result, the final set consists of 33% grey literature and 66% scientific literature.

Study	Count	Percentage
Conference proceeding	11	33%
Journal paper	11	33%
Book	2	6%
Thesis	9	28%

Table 5: Studies per type

Furthermore, the citations per study are displayed in Table 6 and have been retrieved using Google Scholar. As a result, the final set has been further synthesized, and the table provides a slight indication of the quality of the papers. However, the table is not meant to compare the papers, as papers have different publication dates, meaning a paper can have zero citations but has just been published. So, the tables primary use is to indicate the citations per study. Observing Table 6, 22 papers are cited less than ten times, and 10 of these 22 papers have zero citations. In addition, 11 papers are cited more than ten times, and five out of these 11 papers have over 50 citations. Finally, observing the papers on agile maturity models (1-9), every paper has been cited at least once, six papers are cited more than ten times, and three papers are cited more than 50 times.

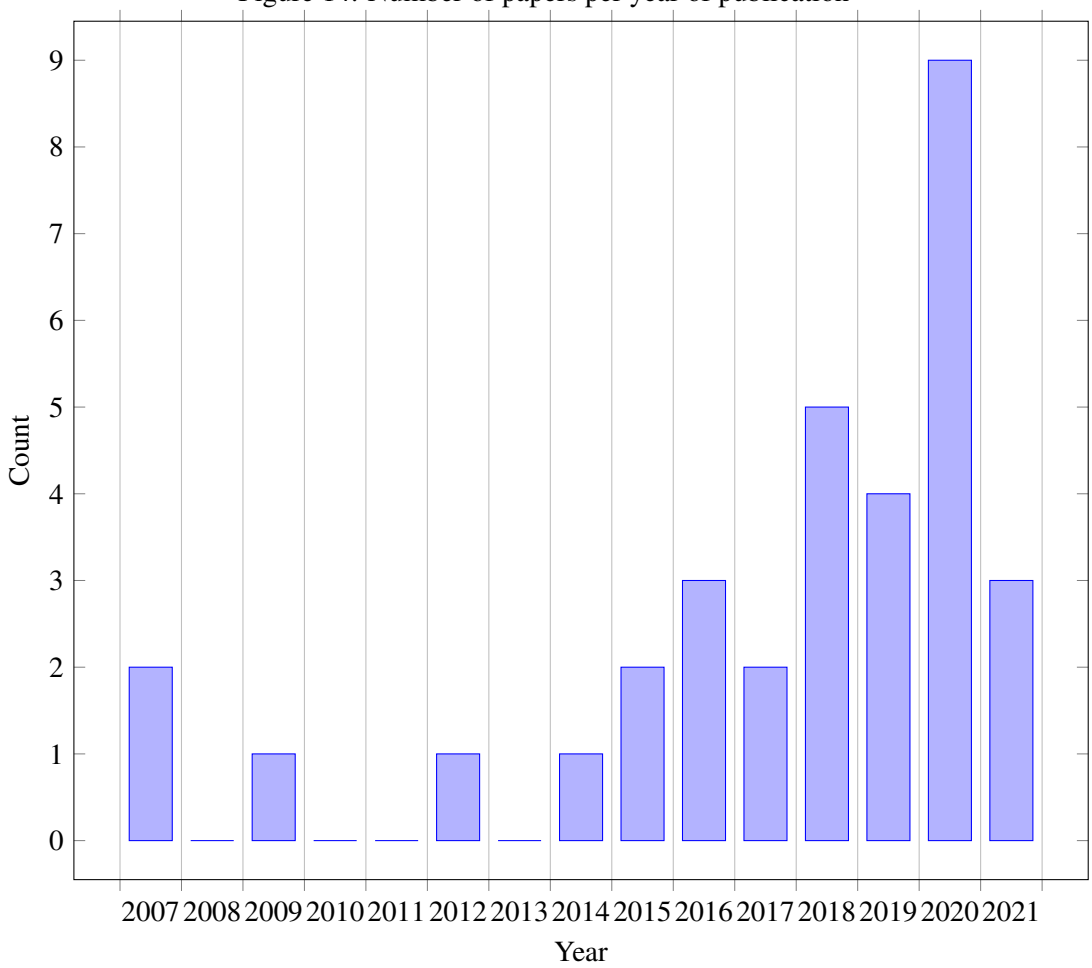
Study	Citations	Study	Citations	Study	Citations
1	40	12	27	23	0
2	1	13	0	24	3
3	6	14	5	25	3
4	11	15	52	26	1
5	9	16	0	27	2
6	91	17	3	28	44
7	344	18	0	29	0
8	105	19	7	30	0
9	36	20	3	31	0
10	0	21	89	32	1
11	10	22	0	33	2

Table 6: Citations per study

Moreover, the citations per paper can be explained by analyzing the publication count per year. Figure 14 depicts the number of publications per year. Observing Figure 14, the number of publications starts to grow in 2014 gradually. Before 2014 there exist years with zero publications indicating the topic of agile, with DT not being reasonably popular. Since the number of publications in 2018, 2019

and 2020 is the highest, it can be concluded that the topic is significantly relevant nowadays. This partly explains the low citations of specific papers being published only in the last few years. In addition, analyzing Figure 14 shows the first publication on this topic being in the year 2007, the years 2008, 2010, 2011 and 2013 having zero publications and having a total of 21 papers which have been published in the recent peak years. The low publication of three in the year 2021 can be explained by the search conducted in March 2021. Following the trend of one published paper per month in 2021 until now could result in an increase of publications compared to the nine publications in 2020.

Figure 14: Number of papers per year of publication



Finally, according to Kitchenham and Charters (2007); Rouhani et al. (2015), a data extraction form has to be established to support the extraction of relevant data concerning the research questions of the research. Since this research aims to retrieve two different types of data, agile maturity models and agile guidelines, two data extraction forms have been constructed. The extracted data fields of the data extraction form are based on the proposed method used by Proença and Borbinha (2016). This method is specifically focused on the comparison of maturity models' construction, assessment and support. Thus, this method seems a good fit to compare the retrieved agile maturity models in this research. In addition, the extracted data fields for agile maturity models could be altered so that it fits comparing agile guidelines as well. Both data extraction forms are described in Table 7 and Table 8. Observing Table 7, the first four rows cover the construction of the maturity model, row five till seven describe the assessment of the model and row eight discusses the validation support of the model. As a result, this table tries to answer the second sub research question of the SLR: *"How to design an agile maturity*

model for companies which are driven by digital transformation?" Furthermore, observing Table 8 the extracted data fields are mainly focused on retrieving agile guidelines per application domain, types of agile guidelines and the number of agile practices. This table aims to partly answer the first sub research question of the SLR: *"What is an agile way of working and how can this be leveraged by companies?"*

No.	Extracted data	Description
1	Name	The name of the Agile maturity model
2	Levels	The number of maturity levels
3	attribute name	The name of attributes the maturity model uses
4	attribute number	The number of attributes and sub attributes
5	Assessment method	Method which describes how to assess the maturity model
6	Quality identification	Describes strong and weak points of the organization
7	Improvement prioritization	Proposes an order of improvement execution
8	Validation support	The degree of validation of the maturity model

Table 7: Data extraction form agile maturity model

No.	Extracted data	Description
1	Name	The name of the Agile guideline
2	Type	The type of guideline
3	Application domain	The application domain of the guideline
4	Guideline name	The categorized name of the guidelines proposed in the guideline
5	Guideline number	The number of practices proposed in the guideline
6	Guideline order	Proposes an order of execution of the practices
7	Assessment method	Method which describes how to assess the guideline

Table 8: Data extraction form agile guideline

2.5 Agile Maturity Models

This section includes the findings of the data extraction form on agile maturity models based on the nine discovered studies on maturity models. The synthesized findings are presented in Table 9. The numbers between parentheses refer to the first column **No.** of table 4. The author decided to refer to the studies in this way to prevent long references when citing every reference in APA style. An important first note is that not all the nine found maturity models are agile. To make a clear distinction between the maturity models, the coverage of agile in the maturity models is described first. Study (1, 2, 4, 6, 9) include agile maturity models, study (3, 8) include DT maturity models, study (7) includes DT maturity combined with industry 4.0 maturity and study (5) includes an agile maturity model, a requirements engineering and an industry 4.0 maturity model. As a result, the maturity models have significant differences compared to each other. However, six maturity models consist of agile aspects to at least some extent. The other three found DT maturity models are used for comparison. A comparison between the attributes' names is established and discussed at the end of this chapter to pinpoint the differences between maturity models on the considered attribute names.

2.5.1 Levels

Observing the maturity levels of the maturity models, most maturity models consist of five maturity levels except for (2, 4, 7). The Agile CMMI Framework combines five agile maturity levels with three relevant maturity levels presented in the CMMI. This results in a total of five times three maturity levels that can be reached. The AgilityMod only has four maturity levels: not implemented, ad-hoc, lean

Name	Levels	Attribute name	Attribute no.	Assessment method	Quality identification	Improvement prioritization
SAFe maturity model[1]	5	Principle/practice	5/62	Yes	Yes	No
Agile CMMI Framework[2]	5/3	Practice/concept	5/40	Yes	Yes	No
MMEO[3]	5	Dimension/indicator	6/22	Yes	Yes	No
AgilityMod[4]	4	Dimension/aspect	5/11	Yes	Yes	No
ARE-MMI4.0[5]	5	Dimension	9/62	Yes	Yes	Yes
SAMI[6]	5	Principle	5/40	Yes	Yes	Yes
Maturity Index 4.0[7]	6	Structural area	4/8/27	Yes	Yes	Yes
DMM[8]	5	Dimension	9 /25	Yes	No	No
AMM[9]	5	Goal	5	Yes	No	No

Table 9: Data extraction form agile maturity model results

and effective. In addition, AgilityMod is the only maturity model with a level 0 and starts with not implemented. The maturity Index 4.0 includes six maturity levels and has one more level compared to most of the other maturity models. This is due to the maturity model having two DT levels before transposing to four industry 4.0 maturity levels. All papers describe how to get to a certain maturity level. Some maturity models describe practices that should be implemented, and other papers fully describe each stage in detail.

2.5.2 Attribute Names

Analyzing the attribute names of the maturity models results in the common used terms principle, practice and dimension. However, the maturity Index 4.0 and the AMM use different terms. The maturity Index 4.0 uses the primary term structural area and describes four structural areas: resources, information systems, culture and organizational structure. Each structural area consists of two principles and complementary capabilities to measure the principles and eventually the structural area. For instance, the structural area resources include the digital capability and structured communication principles. The efficient communication and task-based interface design capabilities measure the structured communication principle. In addition, the provide digital competencies is one of the capabilities to measure the digital capability principle. The AgilityMod's attribute name is "goal", and instead of looking at what agile is composed of and determine the maturity level based on that, the goals of agile are used to determine the maturity level. The attribute names used in AgilityMod are acceptance criteria, green-bar tests and builds, iterative planning, learning and adapting and engineering excellence.

2.5.3 Assessment Method

Examining the assessment method row, it can be observed that each maturity model describes how the maturity model can be assessed to determine the maturity level. Maturity models (1, 2, 4, 9) each propose an interview-based assessment method. The SAFe maturity model and the AMM both decided to interview specific teams to determine the organization's maturity level. Random employees have been interviewed to assess the Agile CMMI Framework's maturity, and role-based interviews have been conducted with AgilityMod. In addition, maturity models (1, 2, 4) all used a Likert scale in their evaluation, differing between a 3, 4 and 5-point Likert scale. The maturity model (9) did not mention or display any information about how the attribute names were assessed. On the contrary, maturity models (3, 5, 6, 7, 8) all used self-assessment questionnaires. On the one hand, the questions in the questionnaire are based on a Likert scale in the maturity models (3, 5, 6, 8). On the other hand, the

Maturity Index 4.0 uses a multiple-choice format which each choice having a specific score attached.

2.5.4 Quality Identification

Quality identification describes the strong and weak points of an organization after conducting the maturity model assessment. The first seven maturity models of Table 9 incorporated quality identification methods. The most common quality identification method was determining a colour-based overview, using green, orange and red colours, to show the maturity per dimension or practice (1, 2, 4, 6). Another quality identification method showed the maturity scores of dimensions and an average maturity score of the organization (3, 5). However, the maturity model (5) translated the maturity scores to a radar chart to construct a visualization of the scores. The Maturity Index 4.0 is the most innovative in visualizing the strong and weak points of an organization. This is due to the use of concentric circles and radar charts. The concentric circle has six layers which correspond to the number of maturity levels in the model. The circle has been split into eight different parts corresponding with the eight principles and four structural areas. Each principle has scored a score based on the multiple-choice based questionnaire, which is reflected by a green area. The larger the green area, the higher the maturity for that principle. The dotted line in the concentric circle displays the desired maturity level of the organization. Figure 15 displays an example of the concentric circle. In contrast to the first seven papers, the last two papers have no quality identification methods. The DMM disregarded the importance of showing the strong and weak points per organization and only presented an average score per dimension of the 555 respondents to the questionnaire. In addition, the AMM did not show the results of the self-assessment. As a result, no clear identification or knowledge of existing quality identification methods could be obtained.

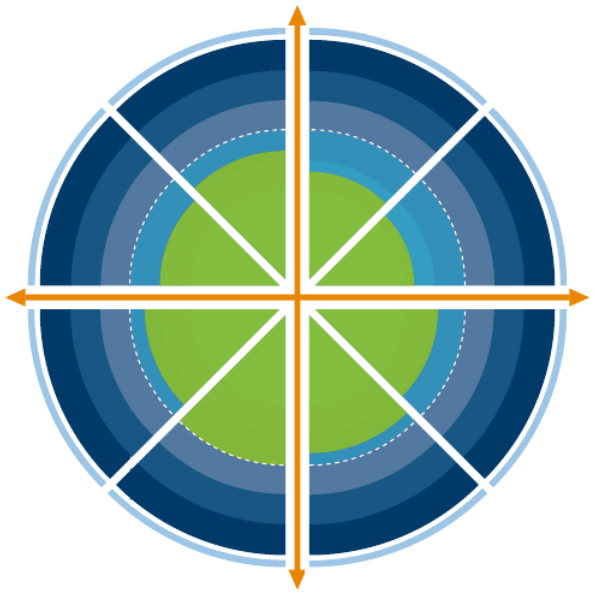


Figure 15: Concentric circle example

2.5.5 Improvement Prioritization

Observing the improvement prioritization row of Table 9, it can be concluded that only maturity models (5, 6, 7) propose an order of improvement to reach higher maturity. The other maturity models (1, 2, 3, 4, 8, 9) provide no additional guidance on improving maturity. For instance, the maturity models show dimensions in red, showing a weak point but not providing improvement order information on how to tackle all the weak points. The ARE-MMI4.0 provides a process step to determine an order of focus points to increase maturity. First, an organization fills in the questionnaire based on

current practices. This questionnaire shows the score per dimension and an average score of all the dimensions in total. Afterwards, the ARE-MMI4.0 compares the scores of the dimension to the average score, and the scores which are lower than the average are the dimensions to focus on first. Finally, it provides detailed practices to focus on to improve this dimension. The SAMI provides a 4-stage process consisting of discontinuing factors, a project-level assessment, an organizational readiness assessment and a reconciliation phase. This process determines the desired state but organizational readiness as well. Eventually, it proposes an order of improvement based on the desired state the organization wants to reach and based on its capabilities in place. Lastly, the Maturity Index 4.0 applies a similar approach. Based on the desired and current state of the organization, it provides a step by step approach to reaching the desired maturity level. As a result, the approach recognizes and displays capabilities that must be focused on to increase maturity in different structural areas. As a result, an order of improvement is determined.

2.5.6 Attribute Number & Mapping

The attribute number in Table 9 refers to the number of primary attributes and sub-attributes referring to the main attribute. Observing the table, the number of attributes differ significantly. One of the causes is the difference in nature between the maturity models, as explained in Section 2.5. Examining the agile maturity models (1, 2, 4, 6, 9), all models have five attributes. However, analyzing the other maturity models (3, 5, 7, 8), the number of attributes differ between four, six and nine. This could result from industry 4.0 and DT maturity models, including broader topics, compared to the agile maturity models. The AMM is the only model which is not transparent in the number of sub-attributes used. All other maturity models share the sub-attributes used, and the number of sub-attributes used differ substantially. The least number of sub-attributes used is 11, and the highest number is 62. Observing the purely agile maturity models, most models base the practices on the "Agile Manifesto" or results of expert interviews (Fowler et al., 2001). The MMEO model combines the DT maturity literature with literature on educational science to establish a proper fit. The Maturity Index 4.0 based the principles and capabilities solely on existing literature. Lastly, the DMM based the dimensions on literature and the sub-attributes on literature verified by expert interviews.

Furthermore, there exists a difference in the meaning of the attributes as well. To get an improved grasp on the different attributes used in each maturity model, Table 10 has been constructed. Table 10 includes all attributes of each maturity model and maps the attributes with the attributes from the other maturity models if there is any overlap. Each maturity model has eight rows since eight unique attributes have been found across the nine maturity models. If a unique attribute is not found in one of the maturity models, this is annotated with '-'. If more than one attribute corresponds with the same attribute, then the attributes in this row are separated with '/'. According to Table 10, a total of 59 attributes are included in the combined nine models. The AMM only overlaps with other maturity models on three rows, and the Maturity Index 4.0 overlaps on each row and can be categorized as most complete. The models have been grouped according to their type to improve comparability. As can be observed from Table 10, agile maturity models (1, 2, 6) use the same attributes to determine agility. Maturity models (3, 5, 7, 8) all include an additional attribute with the name 'organization', 'operations', 'resources' or 'process digitalization'. According to their definitions, this attribute covers available resources in the organization, for instance, resources, digital resources, financial resources or technical support. Furthermore, maturity models (3, 7) specifically mention the learning aspect of their employees. This can be on a digital or continuous professional development level. In addition, maturity models (5, 7, 8) all identified an eighth attribute covering governance which is regarded not only to the quality of code or software but to the overall performance of the organization. In addition, the DMM mentions management support as well. Thus, the agile maturity models mainly focus on the "Agile Manifesto", except for AgilityMod, which has an additional focus on learning. Moreover, the Industry 4.0 and DT models include an additional focus on organizational resources and aspects, continuous

learning of employees and governance of the organization as a whole and not only the code or teams. Below, each row's definition is given to have an increased understanding of each dimension. The first five rows describe the common term used by agile maturity models and afterwards the common term used by DT/industry4.0 maturity models to visualize the differences. Row six until eight only contain one word, as the Agility maturity models used the same term or excluded this dimension.

1. **Embrace change/Culture:** This row defines the importance of embracing change and focus on customer value. DT maturity models broaden this by incorporating it into the whole company culture.

2. **Plan and deliver software quality/Strategy:** This row defines how to establish quality. DT maturity models expand this into the strategy of the company.

3. **Human centricity/People:** This row defines the importance of collaborating Agile teams and being self-organized. This does not differ from the definition stated by digital transformation maturity models.

4. **Technical excellence/Technology:** This row defines the level of continuous integration and delivery together with the documentation and tracking tools of the progress. DT models extend this by implementing self-learning processes and increased focus on automation.

5. **Customer collaboration/Customers:** This row defines the importance of including customer interaction in the development of the product. This does not differ from the definition stated by DT maturity models.

6. **Resources:** This row focuses on the digital competencies of the company. For instance, the automation of the processes, usage sensors to obtain data, and processing this sensor data.

7. **Learning:** This row defines the importance of continuous learning by employees to maintain the required knowledge level.

8. **Governance:** This row defines the governance of the whole organization, not only on the data produced by teams but on IT security as well.

SAFe maturity model[1]	Agile CMMI Framework[2]	SAMI[6]
Embrace change to deliver customer value	Embrace change to deliver customer value	Embrace change to deliver customer value
Plan and deliver software quality	Plan and deliver software quality	Plan and deliver software quality
Human centricity	Human centricity	Human centricity
Technical excellence	Technical excellence	Technical excellence
Customer collaboration	Customer collaboration	Customer collaboration
-	-	-
-	-	-
-	-	-
AgilityMod[4]	**AMM[9]**	**MMEO[3]**
Performing aspect practices/Simple	Learning and adapting	Culture
Iterative	Acceptance criteria/iterative planning/green-bar tests and builds	Strategy and Leadership
Learning	-	Employees
Technically Excellent	Engineering excellence	Equipment and technology
-	-	-
-	-	Organization
Learning	-	Digital learning and teaching
-	-	-
ARE-MMI4.0[5]	**Maturity Index 4.0[7]**	**DMM[8]**
Culture	Culture	Culture & expertise
Strategy/Leadership/Products	Organisational structure	Product innovation/strategy
People	Culture	Collaboration
Technology	Information systems	Information technology
Customers	Organisational structure	Customer experience/Product innovation
Operations	Resources	Organization/Process digitalization
-	Culture	-
Governance	Information systems	Transformation management

Table 10: Attribute mapping between maturity models

2.5.7 Section Conclusion

Section 2.5 describes the results from the data extraction form presented in Table 9. It discusses the different levels, attribute names, assessment methods, quality identifications, improvement prioritizations, attribute numbers and attribute definitions of all nine maturity models in the final set of selected

studies. The question which Section 2.5 attempts to answer is sub-questions two of the SLR: *"How to design a maturity model for companies which adopt an agile way of working and engage in digital transformation?"*. To answer this question, several aspects of a maturity model should be considered. First, the number of levels of the maturity model has to be determined. If the model solely considers agile levels, the suggested number of levels used is five according to Table 9. However, suppose the maturity model consists of two separate maturity models, for instance, agile levels and DT levels. In that case, the number of levels increases, and the total number of levels is determined by multiplying the number of agile levels by the number of DT levels. Second, attribute names, definitions, and numbers have to be established. Common attribute names are principles or dimensions, and which one is chosen does not significantly matter. Attribute numbers and definitions are harder to choose, and to make a proper decision on the number of attributes and their definitions, Table 10 compares all attributes found in the nine maturity models. Table 10 displays a significant difference between the attributes used in agile maturity models and DT maturity models. When designing an agile maturity model concerning DT, all attribute rows in Table 10 should be considered and not only the attributes found in agile maturity models. Third, an assessment method should be established. According to Table 9, all nine maturity models used an assessment method to determine the maturity level. When designing an agile maturity model concerning DT, an assessment method should be established to determine the level of agility and the level of DT. Moreover, seven out of nine maturity models indicate strong and weak points of the company. At least most maturity models provide a coloured indication of all practices and dimensions to indicate strong and weak points. As a result, when designing an agile maturity model with regard to DT, it should at least incorporate a coloured indication of strong and weak points with a possible extension to radar charts or even a concentric circle. Finally, an improvement prioritization method is not necessary to establish but could be added. Only three out of the six maturity models incorporated an improvement prioritization method. It can be concluded that an improvement prioritization method determines a more straightforward approach to reach higher maturity.

2.6 Agile Guidelines

This section includes the findings of the data extraction form on agile guidelines based on the 24 discovered studies on agile guidelines. The synthesized findings on agile guidelines are presented in Table 11. The numbers between parentheses refer to the first column **No.** of table 4. The results in the following section will be presented on a higher level and less detailed to lower complexity. For instance, the three most relevant guideline names per guideline type are discussed instead of the guideline names of all guidelines. This choice is based on the retrieved number of studies being substantially more significant than the number of studies on agile maturity models.

Name	Type	Application domain	Guideline name	Guideline no.	Guideline order	Assessment method
Data mining framework[10]	Framework	Data mining	Business objectives or data dimensions investigation, Design Thinking, Problem identification, Data mining goal, Data mining task, Data mining task target, Data preprocessing, Modelling, Evaluation, Deployment	10	Yes	Yes
TAF Agile Framework[11]	Framework	Mechatronics	Product vision, Problem-solution idea, Desirability PDCA, Feasibility PDCA, Viability PDCA	14	No	Yes
Soft-structured framework[12]	Framework	Software development	Education, Feature development phase, Story development phase, Development process	14	Yes	Yes
Agile BI Framework[13]	Framework	BI projects	Prepare development phase, Initial development phase, Dealing with uncertainty, End-user collaboration, Scaling teams	5	No	Yes
GTM for Agile development[14]	Guidelines	Software development	Global task management, Global project management, Operating procedures, Collaboration between locations	15	No	No
Adopting large-scale agile[15]	Guidelines	Software development	Defining concepts and terms, Comparing and contrasting framework, Readiness and appetite for change, Balancing organizational structure and frameworks, Top-down versus bottom-up implementation, Framework value, Evidence-based use, Maintaining developer autonomy, Alignment between customer processes and frameworks	30	No	No
Quality transformation framework[16]	Framework	Software development	Metrics standardization, Process standardization, Measurement, Reporting, Quality analytics, Culture and leadership	17	No	Yes

Name	Type	Application domain	Guideline name	Guideline no.	Guideline order	Assessment method
Agile portfolio management design principles[17]	Guidelines	Portfolio management	Customer solution-driven portfolio management, multi-level cross-functional portfolio governance body, Aligned autonomous portfolio decision-making, synchronized short portfolio cycles, Alignment of portfolio management with adjoining strategic management processes, Extension towards innovation management capabilities integration	18	No	Yes
The Agile Marketing Capability Framework[18]	Framework	Marketing	Adaptability to changing conditions, Collaborative and integrated working environment, Continual and fast pace of innovation, Forecasting and monitoring of market needs	4	No	No
Agile models of organizational design[19]	Framework	Organizational structure	Spotify-template/fully agile unit, Fully agile unit with cross-product support, Fully agile unit with cross-product projects, Fully agile unit in a multiple-partner setting	24	No	Yes
Additive manufacturing scrum framework[20]	Framework	Additive manufacturing	Scrum team, Sprint planning, Sprint, Sprint review, MVP, Retrospective	11	Yes	Yes
Agile transition and adoption framework[21]	Framework	Software development	Structural characteristics, Key activities	8	No	Yes
Leadership attributes [22]	Guidelines	Leadership	Servant, Empowering, Distributing/sharing, Adaptive	10	No	No

Name	Type	Application domain	Guideline name	Guideline no.	Guideline order	Assessment method
Evolve Framework[23]	Framework	Organizational structure	Explore and engage, Visualize success, Observe and plan, Lead teams to agility, Visible results, Evolve and adapt	6	Yes	No
Agile project management framework[24]	Framework	Project management	Organizational orientation, Process orientation	6	No	Yes
Agile and lean transition kit[25]	Process	Team structure	Pre-transition, Transition, Post-transition	8	Yes	Yes
Integrated thematic model of change [26]	Process	Organizational structure	Conditions for Agile adoption and implementation, Agile adoption and implementation, Consequences of Agile adoption and implementation	6	Yes	Yes
Agile way-of-working design propositions[27]	Guidelines	Organizational structure	Organization design, Recruitment policies, Extensive training, Coaching, Pilot, Rearrangement of office space, Team assessment, Leadership approach, Responsibility, Implement framework	18	No	Yes
Guidelines for tailoring agile methodologies[28]	Guidelines	Organizational structure	Focus on the biggest pain before expanding adoption, Identify key performance metrics going in, Clarify motive for the agile adoption, Evaluate chosen practices	9	No	No
The Agile Model[29]	Framework	Organizational structure	Team, Team communication, administration, Customer engagement, Life cycle management, Continuous improvement, Testing, Retrospective, Business alignment, Lesson learned, Project ending, Continuous work	17	Yes	Yes

Name	Type	Application domain	Guideline name	Guideline no.	Guideline order	Assessment method
Agile recommendations for software quality[30]	Guidelines	Software development	Implement a central quality management system, Rethink the team approach, Consider the right tools	15	No	Yes
Hallmarks of organizational agility[31]	Framework	Organizational structure	Structure, Decision-making, Culture, Insights, Processes, People	13	No	Yes
Business agility strategies [32]	Guidelines	Organizational structure	Sound the alarm, Look in the mirror, Shine the light, Agile business realization	19	No	Yes
Agile adoption process[33]	Process	Software development	Preparation phase, Practice phase	4	Yes	Yes

Table 11. Data extraction form agile guideline results

2.6.1 Type

Observing Table 11, three different types of agile guidelines can be distinguished: guidelines, frameworks and processes. This distinction has been made due to the broad range of the term guideline. Guidelines can be observed as general recommendations or solutions proposed by certain studies that have to be implemented to become agile. The second grouping, framework, proposes a set of agile practices which should be implemented to become agile. This is distinguishable from recommendations since the proposed way to become agile is more concrete. Finally, the process typically consists of a defined set of phases, stages or steps which have to be followed in a predefined way to achieve agility eventually. This differentiates from the other types in being the most formal type found in the studies of the final set. The indicated type of each study corresponds with the most advanced type of guideline. For instance, if a study proposes guidelines and a framework, this will be indicated with type framework. Analyzing Table 11, eight studies only provide guidelines (14, 15, 17, 22, 27, 28, 30, 32). Moreover, 13 studies provided a framework in addition to guidelines (10, 11, 12, 13, 16, 18, 19, 20, 21, 23, 24, 29, 31). Finally, only three studies specified a process that contained phases, stages or steps (25, 26, 33). These three studies provided guidelines as well, but no framework.

2.6.2 Application Domain

Analyzing Table 11, 11 different application domains are indicated. Organizational structure (19, 23, 26, 27, 28, 29, 31, 32) is the most common application domain with eight paper hits, followed by software development (12, 14, 15, 16, 21, 30, 33) with seven paper hits. In addition, several standalone application domains have been found: data mining (10), mechatronics (11), business intelligence projects (13), portfolio management (17), marketing (18), additive manufacturing (20), leadership (22), project management (24) and team structure (25). Organizational structure and software development are, without a doubt, the most popular application domains. Several studies tried to precisely target a certain domain which is not yet studied regularly. For instance, several studies focused on organizational structure in general, but only one focused specifically on the team structure (25), which can be included in the organizational structure in the bigger picture. Other studies tried to apply agile to product development (11, 20) instead of software development. On the one hand, mechatronics (11) focuses on engineering electrical, electronic, and mechanical engineering systems. On the other hand, additive manufacturing (20) implies creating products by using 3D printing. Furthermore, next to agile practices used in software development projects, agile is used in data mining (10) and business intelligence (13) projects or the management of all projects within an organization in terms of portfolio management (17) and project management (24). Also, one study focused on leadership changes to become agile and provided guidelines for leaders of organizations (22). Lastly, one study created a completely new agile marketing (18) capability to execute marketing tasks in an agile way.

2.6.3 Guideline Name

Observing Table 11, a considerable number of different guideline names can be obtained. In addition, the guideline names differ per guideline type, for instance, guideline names of processes are focused on phases (25, 33). Therefore, the three most relevant guideline names per guideline type will be discussed further instead of all guideline names. The relevance of the guideline names is based on frequency, the validity of the study and applicability to companies in general. First, three studies (15, 28, 32) of type **guideline** will be discussed.

Study (15) covers guidelines for adopting large-scale agile using frameworks like SAFe, Less and Scrum at Scale. It proposes 30 recommendations which can be categorized into nine topics. The topics discussed in the study are: defining concepts and terms, comparing and contrasting frameworks, readiness and appetite for change, balancing organizational structure and frameworks, top-down versus bottom-up implementation, overemphasis on 100% frameworks adherence overvalue, lack of evidence-based use, maintaining developer autonomy and misalignment between customer processes and frameworks. The recommendations are primarily focused on the phase before implementing agile.

This is not explicitly stated but can be concluded when analyzing the recommendations. For instance, ”consider involving customer stakeholders during the selection of a large-scale agile framework to increase transparency, cooperation and alignment.” This recommendation guides the implementation of the framework. In total, seven out of nine topics focus on the pre-implementation, and two topics focus on the implementation phase. One example of a recommendation for the implementation phase is to build metrics to support the implemented large-scale agile framework. Thus, this guideline is relevant since it applies to large companies and proposes general recommendations. In addition, the recommendations are based on 15 case studies over 13 years which provide validation to the recommendations. Finally, most recommendations proposed are frequently stated in found literature.

Study (28) provides guidelines for tailoring agile methodologies. It proposes four guidelines, three on an organization level and one on a team level. The four guidelines are: focus on the biggest pain, then expand adoption/identify key performance metrics going in/clarify the motive for adopting agile methodologies, the performance metrics, and agile practice category focus/adopt multiple practices but choose wisely. These guidelines are based on statistical evidence of relationships between motives for adoption and practices deployed. Survey data of an annual survey administered by VersionOne corporation and additional interviews with agile practitioners are used to obtain a substantial set of data for the analysis. VersionOne is a software firm that is concerned with, among other things, agile software development. The guidelines in this study focus on the pre-implementation and implementation phase of adopting agile. On beforehand, organizations should clarify their motive for adopting agile and establish key performance indicators to measure before the adoption phase. In addition, the study suggests focusing on the most urgent pain points first and not on every organizational aspect during the agile adoption. Lastly, the study provides guidelines on the team level to choose the agile practices they want to adopt wisely since a higher number of adopted agile practices do not automatically result in higher performance. This guideline is perceived as relevant, as it applies to companies in general, provides statistical evidence, and the guidelines proposed partly appear in found literature.

Study (32) describes four business agility strategies for companies to achieve business agility. The study proposes four strategies: sound the alarm, look in the mirror, shine the light and agile business realization. Sound the alarm tries to get an executive’s attention by pointing out an emerging business problem that implies new competitors winning over a part of your customers. The strategy is focused on creating awareness of a problem with urgency. The look in the mirror strategy details that an executive realizes a problem but lacks knowledge that they are part of the problem. This strategy focuses on how the operation and behaviour of the executive is a problem and how to change this to be instrumental in creating the future. The third strategy, ’shine the light,’ focuses on how a new agile operating model addresses the current company problem. The problem can be addressed by demonstrating how executives benefit from a new agile operating model considering the four business pillars delivery, finance, marketing and channels. Finally, the agile business realization strategy scales the new agile operating model through the whole organization. It focuses on delivering customer value that leads to achieving business results to create agile business realization. The strategies are based on the four pillar theory. The four pillars describe the competing strategy between businesses and consists of the original pillars product, price, production and place. These pillars changed to deliver, finance, marketing and channels over time and the strategies proposed in this study are based on how these pillars are affected by each strategy and how this eventually helps companies become agile. Figure 16 displays the four pillars. For instance, during the ’sound the alarm’ strategy, the finance pillar of the organization can be attacked by competitors who have higher profit margins with innovations. The first three strategies focus on the pre-implementation phase, and the fourth strategy implements the new agile operating model in the organization. This study is relevant as it provides clear strategies for companies on how to adopt and leverage agile. In addition, it is based on the approved four pillars theory and validated at one case company.

Second, three studies (12, 21, 31) of type **framework** will be discussed. Study (12) proposes a

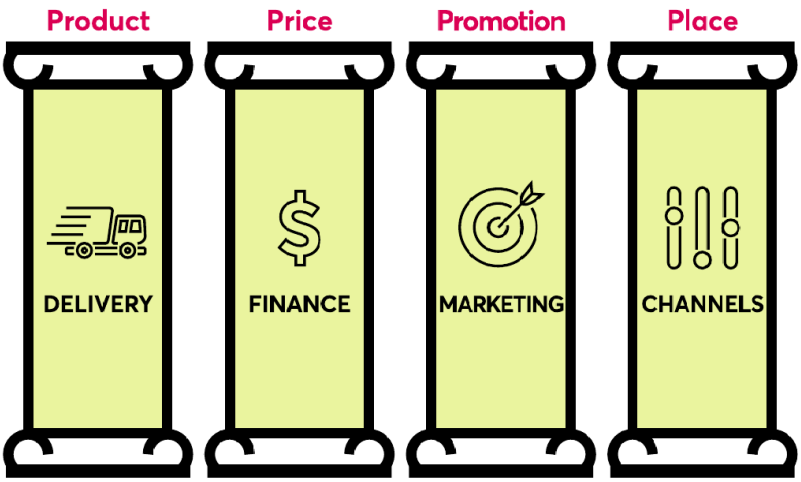


Figure 16: The four pillars, obtained from (Orvos et al., 2019)

soft-structure Agile framework. The framework consists of two components: The Agile Requirement Generation Model (ARGM) and the Agile development process. The ARGM includes three stages: the education, feature development and story development stage. The education phase entails the process of better understanding the business process of customers. This supports the creation of a mission statement and determines the expected functionalities during the feature development stage. Afterwards, the feature development stage determines the features through preparation, elicitation, validation, estimation and prioritization activities. Finally, the story development stage further decomposes the features into stories representing refined user or customer expected functionality. This stage follows identical steps compared to the feature development stage. If all the stages of the ARGM are completed, the Agile development process starts. This process distinguishes between two systems: small-scale and large-scale systems. Each process follows a different development process. The small-scale system process starts with the task identification stage, which further splits the user stories into tasks and again, the activities in this stage are similar to the feature and user story stage. Afterwards, the task implementation stage starts. The tasks are implemented using Test-Driven Development (TDD) which means developers create tests before writing code. In addition, Customer Acceptance Testing (CAT) is used to ensure the system developed meets the user's expectations. Compared with the small-scale development process, the large-scale development process follows the same activities but in an increased Waterfall style. Thus, the stages of the ARGM focus on pre-implementation and the Agile development process displays the implementation phase. This study is relevant since it focuses on the agile development of systems in companies. Besides, the ARGM is based on the well established RGM theory, and the Agile development process includes TDD and CAT, which is accepted in academic circles. Finally, the proposed stages and practices correspond with the literature presented in the Agile Manifesto.

Study (21) provides an agile transition and adoption framework. The framework consists of structural characteristics and critical activities. On the one hand, the structural characteristics are value-based, iterative, continuous and gradual. On the other hand, the key activities cover practice selection, adaptation, assessment, retrospective and adjustment. Practice selection covers the agile practices which the organization wants to implement during an adoption cycle. The practice selection should be based on the organization's needs. Adoption is the ultimate goal of the agile transition process and focuses on changing people's mindsets, behaviours, and cultures to fit the agile way of working. The assessment activity keeps track of the agile adoption process and helps to find and tackle challenges along the way. In addition, performance is monitored to keep track of the organization's performance.

The retrospective meeting activity covers the discussion about the results of the assessment activity. It helps to reflect on the adoption progress and supports formulating solutions to problems revealed during the assessment activity. Finally, the adjustment activity focuses on adjusting agile practices to particular conditions present in the organization before moving onto the next iteration. Therefore, the study is identified as relevant, as it describes an agile adoption framework that an organization can apply to transition to agile. Furthermore, the framework is the outcome of a grounded theory on existing literature and, in the end, applied to the already existing literature in the form of a Plan Do Act Check (PDCA) approach. The PDCA cycle distributes the framework results over a plan, do, act, check cycle, which is displayed in Figure 17. In conclusion, the practice selection activity corresponds with the pre-implementation phase, adapting and assessment correspond with the implementation phase and the retrospective and adjustment activities with the post-implementation phase.

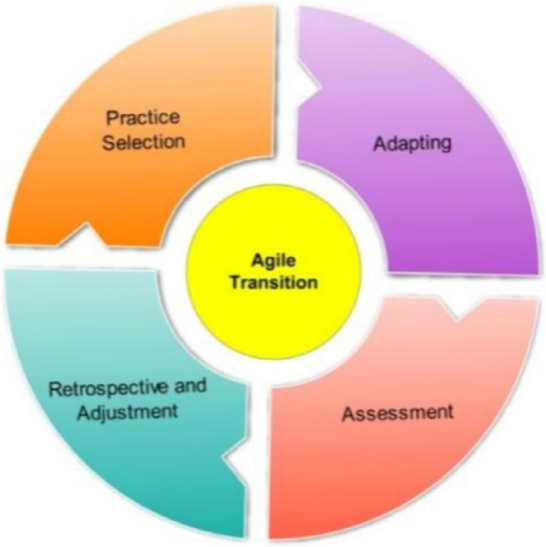


Figure 17: PDCA Agile transition model, obtained from (Gandomani and Nafchi, 2015)

Study (31) describes the hallmarks of organizational agility and displays them in a framework. The distinguishing characteristics, also known as hallmarks, are structure, decision-making, culture, insights, processes and people. First, an agile company's organizational structure should be composed of a flat hierarchy, dual leadership, and dynamic teams. Second, decision-making to enforce organizational agility should be decentralized, and end-to-end accountability should be enabled. Decentralized decision-making leads to autonomous teams and working increasingly agile. Third, the culture of an agile company should be based on a culture of trust, a culture of open communication and information sharing. This is important since openness and transparency are the basics to an agile environment to function correctly. Moreover, the study identified insight-gathering mechanisms as an essential characteristic since data-driven and data can support customer-centric approaches. For instance, using data-gathering mechanics supports the delivery of products and services which a customer needs by understanding and analyzing customer data. The fifth hallmark analyzed by the study is the use of iterative processes. Due to the overall aim of an agile transformation to achieve flexibility, speed and customer focus, an iterative process repeating the same working cycle every few weeks is desirable. Which agile development approach to use to realize these iterations can vary between Scrum, Kanban, or Lean frameworks and methodologies. The final hallmark, people, covers the versatile, resilient and transparent workforce which has to be established for the employees of an agile organization. Such workplaces facilitate the desired environment for employees to perform their work in an agile way. To conclude, all hallmarks can be categorized as characteristics of an agile organization in the

implementation phase of an agile adoption process. This study is relevant as it provides an agile framework describing the background, hallmarks, challenges and benefits of an agile adoption process. In addition, the study validates its findings through a literature review, eight interviews and one case study. Finally, the findings are compared to existing literature when possible.

The last three studies (25, 26, 33) discussed in this section are the guidelines of type **process**. Study (25) proposes an agile and lean transition kit for teams to follow during an agile transition. The process consists of three phases: the pre-transition phase, the transition phase and the post-transition phase. The pre-transition phase consists of a readiness check to identify the status quo and objectives of the transition. The output of the readiness check is a recommendation or non-recommendation to start the agile transition. A non-recommendation is applied when there exists a low chance to finish the transition in time successfully. Afterwards, the transition phase starts and includes four steps: prepare, implement, stabilize and consult. The preparation step contains a kickoff workshop, consulting and agile workflow creation. It explains the main principles of agile based on the ”Agile Manifesto”. Afterwards, the implementation of the methods and the tooling step is conducted where the explained agile practices and principles described in the first step are implemented in the teams. For instance, the team roles, such as scrum master and product owner, are explained, and the typical agile development method activities are explained and walked through. Next, in the stabilization step, the agile coaches sustain the change process by motivating the employees, inspecting the team during the first two steps and adapting the agile practices to the team when needed. The final step of the implementation phase is the consulting step. This step serves as an occasion for the team to ask questions regarding the first three steps of the implementation phase. Agile coaches answer these questions and provide recommendations. The post-transition phase provides the teams with a capability check on their agility. The capability check is primarily based on the stabilization step during the transition phase. In addition, the teams receive a report with conclusions of the whole process and are registered as agile. The activities described in the transition kit are depicted in Figure 18. This study is relevant since it describes a comprehensive process for teams of companies to adopt agile. However, the study has a narrow focus on the teams of an organization and not on the organization as a whole. As a result, this study can only be used for teams to transition to an agile way of working. In addition, the proposed transition kit is significantly validated. Volkswagen has used the transition kit to support 100+ teams in becoming agile. Moreover, it has already been used for years and is improved frequently based on developments in agile. Finally, the transition kit contains scientifically validated theories, such as the Stacey matrix, the Spiral Dynamics model and the Agile Manifesto. On the one hand, the Stacey matrix helps to understand the complexity of an organization and provides management actions based on a certain complexity level. On the other hand, the Spiral Dynamics model indicates how organizations, individuals and societies developed over time when their working systems changed. The Spiral Dynamics model provides eight different ways of responding to such a system change, and this can be used by companies when changing from traditional systems to agile systems.

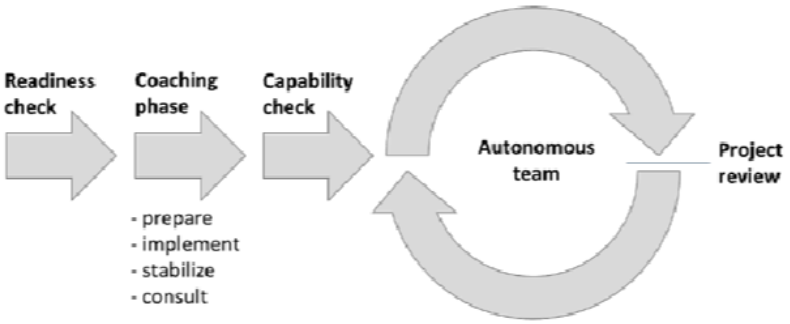


Figure 18: Transition kit activities, obtained from (Poth et al., 2019)

Study (26) depicts a process of radical organizational change around a transition to agile. The process includes conditions for agile adoption and implementation, agile adoption and implementation, and the consequences of agile adoption and implementation. The relevant stage to discuss is the agile adoption and implementation stage since it proposes agile adoption recommendations. The proposed recommendations are: adopt and implement an agile Information System Development (ISD) approach, communicate the need to change, institute new culture, institute new organizational operations/processes/roles/practices, train and educate staff, coach staff and team building. These recommendations are based on the conditions for agile adoption and implementation described in the first stage and lead to consequences of agile adoption and implementation in the third stage. Analyzing the recommendations, several similarities between the recommendations and the activities during the transition phase of the transition kit (25) can be found. Therefore, this study is relevant since it proposes recommendations to transition to agile successfully. However, it is the least relevant SLR process since it is not detailed and only provides recommendations without explicit guidance. In addition, the study is based on literature and expert interviews, but the process has only been validated through one case study.

Study (33) describes an agile development method adoption process consisting of two phases: preparation and practice. On the one hand, the preparation phase includes the stages of decision, planning and training. On the other hand, the practice phase solely covers an experimentation stage. The decision stage includes the decision to transform from a traditional development method to an agile development method. This decision is often caused by an increase in project failure and a decrease in team performance. Next, the journey of preparing for the adoption of agile practices starts in the planning stage. The main activities in this stage are focused on selecting an appropriate agile development method and an adoption plan that is well matched to the company's situation. Next, the training stage covers the learning and teaching of the chosen agile development method. The study states that this step is significant since employees are often hesitant of changing their way of working and are accustomed to the traditional development model. In the second phase, during the final stage of experimentation, the agile development method is applied to trial projects to test the performance of the agile development method. This study is relevant, as the study describes an agile adoption process by companies. However, the process model is based on interviews of five case companies and not compared with or based on existing literature. Thus, the validation of the model is scarce, which impacts the validity of this study. Observing the four stages, the process suddenly ends with implementing the agile development in trial projects. The process seems to end there, but compared to another process (25), it misses a post-implementation phase with a concluding stage.

In conclusion, the three most relevant studies per guideline type have been discussed above. Analyzing all nine studies, it seems that agile can be leveraged by going through three phases categorized as pre-implementation, implementation, and post-implementation. The pre-implementation phase focuses on preparation activities before implementing agile, the implementation phase focuses on the implementation itself and the coaching next to it, and the post-implementation phase focuses on governance and improvement activities of agile adoption. In addition, each paper discusses, to some extent, agile practices which can or need to be adopted by companies when leveraging agile. Finally, the studies included in this subsection are based on the author's opinion on the relevance of the studies. If a study is not included in this study, it does not mean the study is not relevant but less relevant. Causes of this can be studies with a specific focus, for instance, business intelligence projects or studies providing little academic evidence.

2.6.4 Guideline Number

The guideline number depicts the number of practices that the guideline is based on. Combining all 24 papers, a total of 301 practices can be identified with an average of $\tilde{1}3$ practices per guideline. The lowest number being four (33) and the highest number being 30 (15). If we divide the number of

guidelines over the guideline types, the following results develop guidelines 134, framework 149 and process 18. Analyzing the average practices per guideline type, a decreasing trend can be observed: guidelines 17, framework 11 and process 6.

2.6.5 Guideline Order

Observing the guideline order, eight studies provide order in the implementation of the guidelines. No guidelines of type guidelines, five frameworks and three processes provide an order to follow when transforming to agile. The guidelines solely provide recommendations to implement, but no fixed structure is identified and thus are not discussed. Study (10) provides a data mining framework with two different start points, 'business objectives' and 'data dimensions investigation' and one endpoint 'deployment'. The steps in between the start and endpoints are defined and related with arrows defining a complete agile framework of 10 steps. The soft-structured framework proposed in the study (12) displays two frameworks with steps that can be executed by following the arrows in the agile requirement phase and the agile development process. In addition, it distinguishes between an agile development process for small and large scale processes. The scrum additive manufacturing framework (20) proposes a development approach based on scrum practices, such as the retrospective, combined with additive manufacturing processes, for instance, printing. It follows a step by step approach as well. The Evolve framework (23) proposes six steps to follow, displayed in a particular order. However, this is not a strict order to follow, and other orders can be explored. It starts with an explore and engage phase and ends with an evolve and adapt phase. Finally, the Agile model (29) proposes a set of activities displayed over a timeline. Again, some activities can be switched with each other but should be executed some time in the process. Analyzing the five described frameworks above, all propose a specific, clear set of steps or activities in a particular order. However, most frameworks have different order execution possibilities or not all proposed activities are necessary to become agile, and it is just a list an organization chooses from if an agile transformation is needed. The transition kit (25), the integrated thematic model of change (26) and the agile adoption process (33) all describe a process consisting of a certain number of phases, stages and activities. To proceed to the next phase, the activities or stages of the preceding phase have to be completed first. In addition, the phases have a fixed order which has to be followed.

2.6.6 Assessment Method

Analyzing the assessment methods of the studies, a number of 18 studies proposed an assessment method or demonstrated the assessment of the guideline. Most studies (10, 11, 12, 13, 19, 20, 21, 25, 26, 31, 32, 33) describe or display a step by step approach to implement the guideline. In some cases (13, 19, 20, 31), a picture of how the guideline can be assessed is provided. The second most common assessment method provided by literature is concrete actions (17, 24, 29, 30) described on how to implement the guideline. One study (16) did not implicitly state an assessment method for implementing the guideline but provided a method to determine the results after implementing the proposed framework. As a result, three different outcome metrics can be defined: defects during testing, annual failure rate and time to maturity. Finally, one study (27) proposed design propositions and detailed how to implement these design propositions by creating a tool. Six studies have not included an assessment method, four of the six studies are categorized as type guidelines and two out of the six studies are categorized as a framework.

2.6.7 Section Conclusion

Section 2.6 describes the results from the data extraction form presented in Table 11. It discusses the different types, application domains, guideline names, guideline numbers, guideline orders and assessment methods of all 24 guidelines in the final set of selected studies. The question which Section 2.6 attempts to answer is sub-questions one of the SLR: *"What is an agile way of working and how can this be leveraged by companies?"*. To answer this question, companies should consider different

aspects of agile guidelines. First, a company should determine the type of guideline it desires to follow to leverage agile practices. If the company solely requires recommendations or solutions, it should consider following one or several guidelines with type guideline from Table 11. However, if the company wants to leverage agile by implementing certain agile aspects from a set of proposed agile practices, it should focus on a framework. On the other hand, if the company wants to leverage agile by following a predefined process with phases, stages and activities, it should consider one of the guidelines with type process in Table 11. The application domain is the second aspect of companies' consideration when choosing a guideline to leverage agile. According to Table 11, there exists a considerable number of guidelines focusing on organizational structure and software development. However, if a company wants to leverage agile on a specific domain, for instance, marketing, this is also an option (18). In addition, analyzing the guideline names, it can be concluded that agile practices are often leveraged in three phases: pre-implementation, implementation, and post-implementation. As a result, a company can leverage agile by implementing agile practices of each phase or one specific phase if they already are in a particular phase of the agile adoption process. Furthermore, guideline numbers vary significantly. If companies are unfamiliar with agile and want to obtain many agile practices, a guideline including many guideline numbers could be considered when leveraging agile practices. In different circumstances, a guideline with fewer guideline numbers is suitable for companies that want to follow a guideline of type process or want to obtain recommendations on less specific agile practices. In addition, companies can choose agile guidelines with a specified order of implementation example if wanted. Finally, some agile guidelines specify an assessment method or provide an implementation example that can be utilized if a company wants to leverage agile practices.

2.7 Conceptual Model

This section proposes a conceptual model of an agile DT maturity model based on the results of the SLR. This conceptual model can be used as a guideline when developing an agile maturity model with regard to DT. The remainder of this section describes the contents of the conceptual model. The conceptual model is displayed in Figure 19

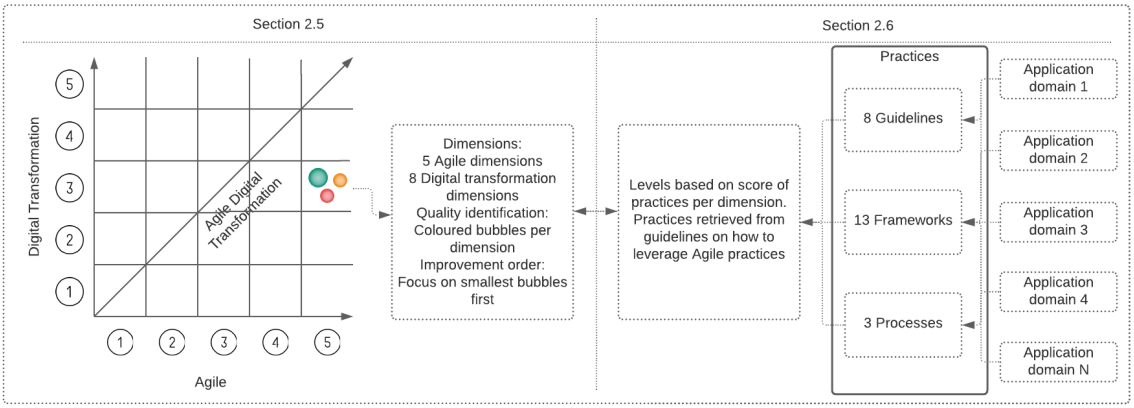


Figure 19: Conceptual model

2.8 Contents

This section describes the contents of the conceptual model displayed in Figure 19. Observing Figure 19, the conceptual model consists of two parts: Section 2.5 and Section 2.6. Analyzing the left part of the conceptual model, different parts of the discussed findings in Section 2.5 can be distinguished. First, the grid displays an agile DT maturity model. On the one hand, the numbers on the x-axis display the

agile maturity level. On the other hand, the numbers on the y-axis depict the DT level. The choice of separating the agile DT levels is based on the conclusion of Section 2.5 that agile and DT excessively differ from each other and are not yet combined into one maturity model in scientific literature. As a result, calculating both maturity levels separately provides a better result. Second, the choice for five agile and DT levels is based on the conclusion on the number of levels frequently consisting of five levels. In addition, the bubbles depict the dimensions which are included to measure the maturity level. The number of dimensions is based on Table 10, and the conclusions determined from this table are represented in Section 2.5. In Figure 19, the quality identification is displayed by the colour of the bubbles and the improvement prioritization by the size of the bubble. The colour green presents a strong point, orange indicates an average point, and red indicates a weak point. In addition, improvement prioritization can be established by focusing on the minor red bubbles first. In practice, the quality identification and improvement prioritization can be displayed differently, for instance, by concentric circles or radar charts.

Analyzing the right part of the conceptual model, different findings of Section 2.6 are depicted. The relation between the findings of Section 2.5 and 2.6 are displayed by the arrow between the dimensions and practices going both ways. This is the result of the dimensions consisting of practices related to the definition of the dimension. For instance, the score of a dimension covering the 'team' can be measured by the found practices implemented by an organization on this dimension. As a result, the findings of Section 2.5 and 2.6 can be related to each other. Furthermore, the practices are retrieved from guidelines on how to leverage agile. As explained in Section 2.6, three different types of guidelines can be distinguished, each applying to a specific domain. As a result, Figure 19 visualizes this by adding the three guideline types and the different application domains. Finally, each guideline proposes certain agile practices. This is represented by the "practices" box surrounding the three different types of guidelines. As discussed in Section 2.6, these practices can be distributed in three phases: the pre-implementation phase addressing agile practices preparing an agile adoption, the implementation phase containing agile practices during the implementation of agile, and the post-implementation phase covering agile practices focused on governance and improvement after implementing agile.

3 DESIGN & DEVELOPMENT OF THE ARTIFACT

The Design & Development of the Artifact Chapter describes the development of the first version of the ADT maturity model. It starts with describing the maturity model development strategy in Section 3.1. Afterwards, the first version of the ADT maturity model will be described part for part in Section 3.2. Finally, it will discuss the results of the development phase in more detail in Section 3.3.

3.1 Maturity Model Development Strategy

As described in Section 1.3.1, the research methodology of this research follows the design science cycle. For the development of the ADT maturity model, the maturity model development methodology of Becker has been followed (Becker et al., 2009). This methodology has been chosen as it is based on the design science methodology used as the baseline of this project. In addition, the methodology of Becker is widely used and has nearly 1000 citations. The methodology of Becker shows a procedure model for how to develop a maturity model and contains several steps. The procedural model applied to this research is displayed in Figure 20. The procedural model slightly differs from the original model presented by Becker, as this research has two separate evaluation steps. The seven steps of the procedural model will be explained below.

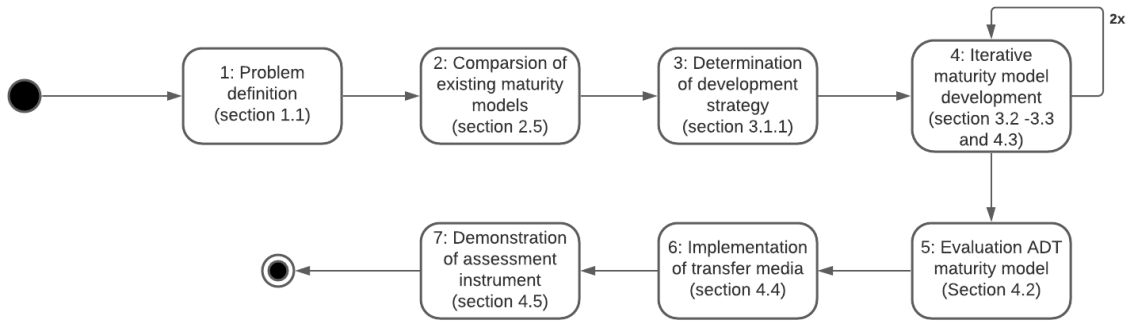


Figure 20: Maturity model development model, adapted from (Becker et al., 2009)

Problem definition: In the first step, the problem definition should explain the target domain and the problem relevance. Both attributes of the problem definition have already been introduced in Section 1.2 of this research.

Comparison of existing maturity models: In the second step, the comparison of existing maturity models is executed. In Section 2.5, five agile and four DT maturity models have been compared. This has been established by first retrieving the maturity models via an SLR and afterwards discussing its contents.

Determination of development strategy: In the third step, the development strategy is determined. According to Becker et al. (2009), there are four basic strategies: the completely new model design, the enhancement of an existing model, the combination of several models into a new one and the transfer of structures or contents from existing models to new application domains. The development strategy of this research focuses on combining existing maturity models on DT and on agile. Before this combination can be established, the four DT and five agile maturity model have been synthesized in, as explained in 3.1.1.

Iterative maturity model development: In the fourth step, according to Becker et al. (2009), the iterative maturity model development process consists of selecting the design level, selecting the

approach, designing the model section and testing the results. The select design level explains the objective, the select approach documents the approach, the design model section shows the designed (part) of the maturity model, and the test results test the outcome. These steps are described by following the systematic meta-model comparison by Lautenschutz et al. (2018). The aspect constructs of the found maturity models' meta-models are compared to identify equivalent DT aspects which can be used as main building blocks for the synthesized DT maturity model. The same steps are repeated to obtain equivalent agile aspects, which helped combine the synthesized DT maturity model with an agility aspect. This process is discussed in Sections 3.1.2 and 3.1.3. Expert interviews, described in Section 3.1.4, have been conducted to confirm DT aspects, retrieve DT and agile indicators, and to investigate which agile aspects are crucial for DT. As described in Section 3.1.5, market research is done to obtain sub-aspects and indicators of ADT. The final method described in Section 3.1.7 in the development strategy is the brainstorm session. This method is used to determine the weight of the found indicators during expert interviews and market research. Finally, in Section 3.1.8, a summary of the complete development process is given. Observing Figure 20, a line returning to step four is displayed. This visualizes that the maturity model has two versions, and step four has been executed twice.

Evaluation ADT maturity model: In the fifth step, the first part of the evaluation process of the ADT maturity model is conducted. The evaluation of the ADT model consists of expert evaluation interviews to evaluate the model. The feedback from the experts is used as input for the second version of the ADT maturity model. In addition, evaluation criteria are rated by the experts to give an indication about the degree of compliance to the non-functional requirements of ADT maturity model. This evaluation step is described in Section 4.2

Implementation of transfer media: In the sixth step, the implementation of transfer media will be described. In this case, an application is made to make self-assessment possible in the form of answering assessment questions based on the indicators of the ADT maturity model. The maturity levels per indicator, per sub-aspect, per aspect, and total are automatically calculated at the end of the self-assessment. This step is described in Section 4.4.

Demonstration assessment instrument: In the final step, the second part of the evaluation process of the assessment instrument is conducted. The demonstration of the assessment instrument consists of two observational case studies. The observational case studies are performed to investigate if the assessment instrument is effective in practice. As a result, the observational case studies are performed to evaluate the functional requirements stated in the Introduction. This evaluation step is described in Section 4.5

3.1.1 Synthesizing & Combining Maturity Models

The systematic literature review resulted in four DT and five agile maturity models. The choice has been made to first synthesize the found DT and agile maturity models by performing a meta-model analysis and systematically comparing all models afterwards. This choice has been made since not all DT and agile maturity models were documented in detail, and differences between the structure of the models were obtained, as described in Section 2.5.

After synthesizing the DT and agile maturity models, both synthesized models are combined. The choice has been made to add the 'agility' aspect to the synthesized DT maturity model. The 'agility' aspect focuses on the main aspects of the synthesized agile maturity model and is expanded with findings from the expert interviews and the market research. After analyzing the maturity models in Section 2.5, it was concluded that the DT maturity models already have overlapping aspects with the

agile maturity models. As a result, the choice had been made to combine the DT and agile maturity models into one model, adding an additional aspect to the synthesized DT maturity model since agile is a subset of DT. Another advantage of adding agile as a separate aspect compared to letting agile flow through the already existing DT aspects is measuring the agile and DT maturity levels separately.

3.1.2 Meta-model Analysis

As described in the section above, the design strategy is first to synthesize and afterwards combine existing maturity models. However, the maturity models found in Section 2.5 differ significantly from each other. As a result, to perform the design strategy, first, a meta-model analysis has been conducted. The meta-model analysis helps to identify the different constructs of a maturity model by making a model of the construct model (Lautenschutz et al., 2018). After creating a meta-model of each maturity model, the constructs, which often have different names in different models, can be easily compared and eventually synthesized. The meta-models of the five agile maturity models are displayed in Figure 21 and the meta-models of the four DT maturity models are depicted in Figure 22.

Analyzing the agile meta-models in Figure 21, six different rows can be identified. The names of the rows are based on the style of Lautenschutz et al. (2018). The rows are filled based on a similar hierarchical structure and level of detail of each construct. The first row describes the maturity model name construct for each model. The second row describes domain groups which indicate the different types of domains that are measured. Only the Agile CMMI Framework and AgilityMod include this. The third row describes the construct attributes, which defines which aspects are measured in the maturity model. This construct often consists of two or three levels of detail since an aspect can have sub-aspects. The fourth row covers the assessment construct and describes how the attribute construct is measured. SAMI has the most detailed form of assessment containing four levels. The fifth row describes the construct attribute level, which displays the name of the level of an attribute. Finally, the sixth row details the construct maturity level and defines the name of the overall maturity level of a maturity model. Many different names are used for each construct, but by performing this meta-model analysis, each construct can now be easily compared. The attribute and maturity level constructs will be systematically compared to extract essential findings in the next section.

Analyzing the DT meta-models in Figure 21, six different rows can be identified. The names of the row are based on the style of Lautenschutz et al. (2018). The rows are filled based on a similar hierarchical structure and level of detail of each construct. If we compare the DT meta-models with the agile meta-models, the level of detail is less. For instance, the MMOE only has one attribute construct, and the attribute-level construct is less detailed than the agile meta-model SAMI. Analyzing Figure 22, the first row describes the maturity model name construct for each model. The second row describes domain groups which indicate the different types of domains that are measured. Only the ARE-MMI4.0 and the Maturity Index 4.0 include this. The third row describes the construct attributes, which defines which aspects are measured in the maturity model. Only the MMOE has one primary attribute construct of the name dimension, and the Maturity Index 4.0 has three attribute construct components. The fourth row covers the assessment construct and describes how the attribute construct is measured. These all consist out of one component. The fifth row describes the construct attribute level, which displays the name of the level of an attribute. The DMM has the most detailed form of assessment and describes how the attribute-level construct comprises two sub-constructs. Finally, the sixth row details the construct maturity level and defines the name of the overall maturity level of a maturity model. Many different names are used for each construct, but by performing this meta-model analysis, each construct can now be easily compared. The attribute construct and the maturity level construct will be systematically compared to extract essential findings in the next section.

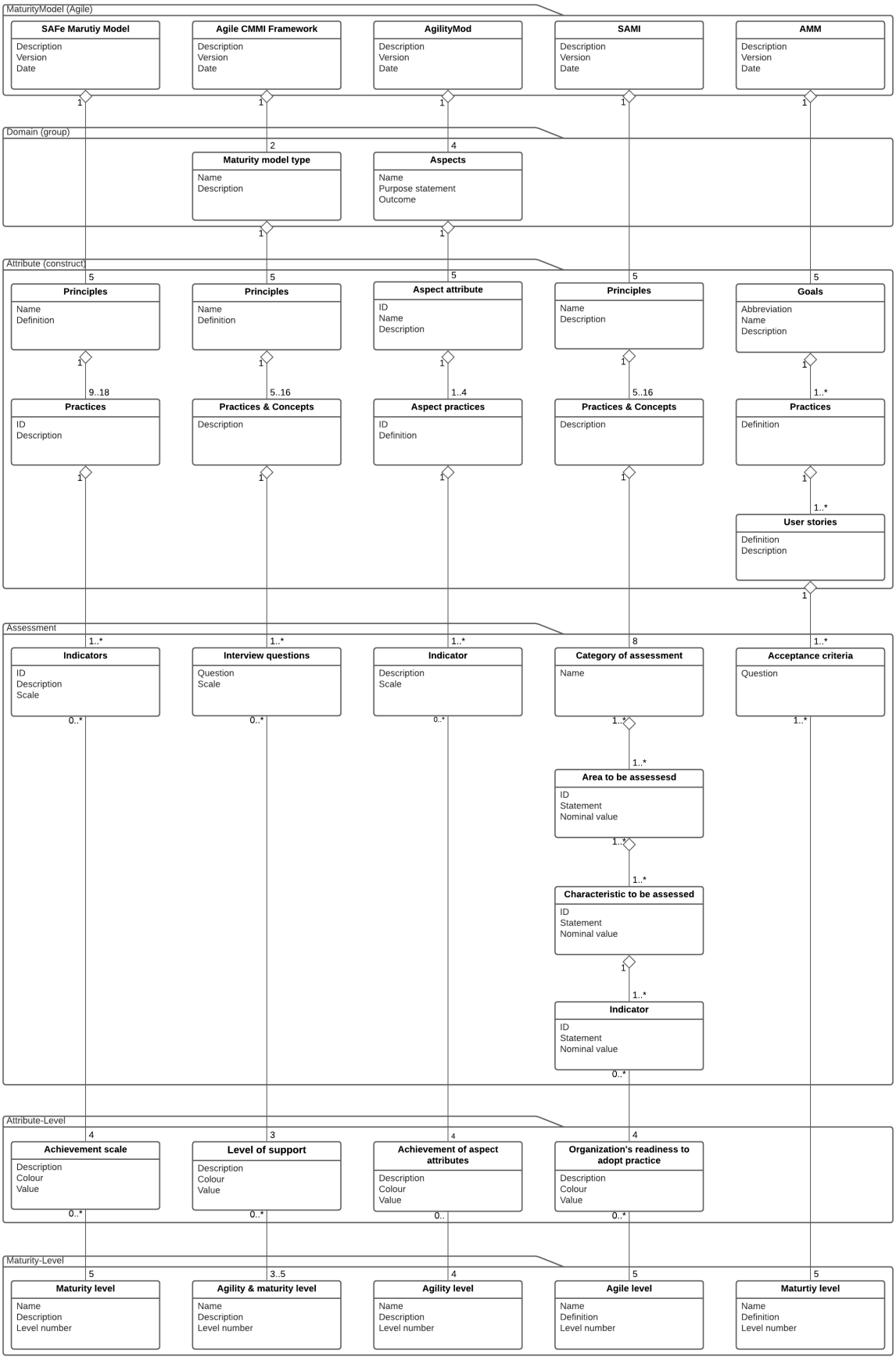


Figure 21: Agile meta-models

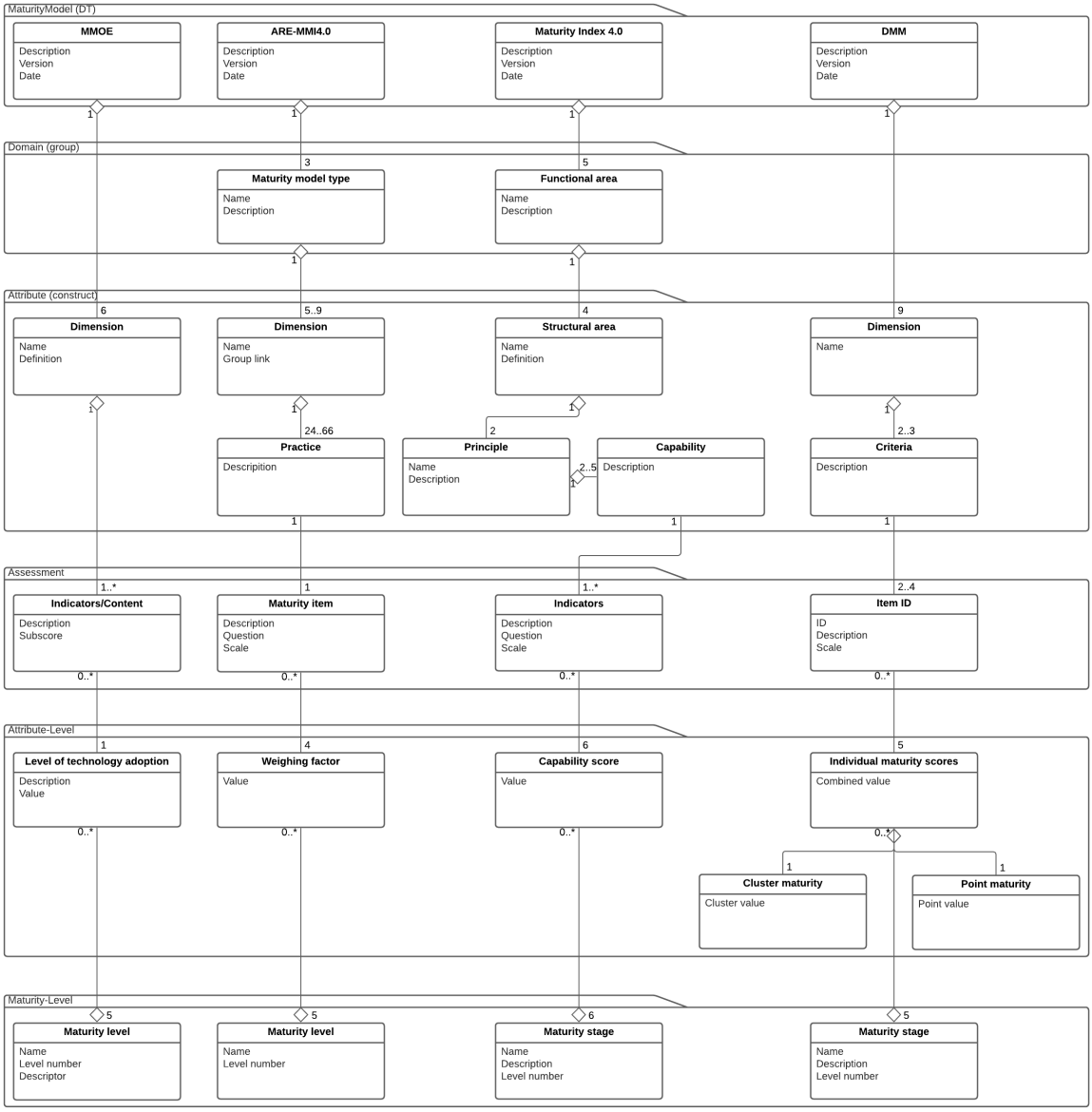


Figure 22: Digital transformation meta-models

3.1.3 Systematic Meta-model Comparison

After the meta-models are created, the constructs have to be compared. To facilitate this process, the systematic meta-model comparison of Lautenschutz et al. (2018) is used. This method is chosen since it fits the approach of this research, as this approach allows a comparison of different models with different constructs. The outcomes, two matrices, provide an overview of all the aspects found in the models and how they overlap. These matrices provide the synthesized results of the DT and agile comparisons and are used to determine the aspects for the ADT maturity model. These matrices are presented in Appendix A. The first step of the systematic meta-model comparison consists of performing a systematic literature review to find maturity models in the literature. This is described in Sections 2.4-2.5. The second step of the systematic meta-model comparison covers the creation of meta-models from the construct models of the maturity models. Since all sources of the maturity models provided a construct model, those did not have to be constructed by the researcher. This is described in Section 3.1.2. The third step consists of choosing the pivot model for the comparison. The pivot model serves the comparison, and each maturity model is compared to the pivot model. This is described in the current section. Finally, the fourth step, which is the most crucial step, is to systematically compare the constructs of maturity models to the constructs of the pivot model. This comparison results in every existing construct between all found maturity models and can be used to synthesize the maturity models. How this last step will be done is described in the current section as well.

This process can be supported by qualitative content analysis, which allows constructs of different names to be compared with each other (Elo and Kyngäs, 2008). This is useful for this research since the names of the constructs are not relevant, but the meaning behind the constructs is. There are two possible variations in qualitative content analysis: inductive content analysis and deductive content analysis. On the one hand, *Inductive content analysis* is used when going from a detailed description to a general description. This can be helpful to identify the underlying concept of a complex construct and can be used to group several constructs into one concept. On the other hand, *Deductive content analysis* is used when going from a general description to a detailed description. This can be helpful when having to split up a general construct into smaller constructs to support the construct mapping. To give an example of deductive reasoning: one of the aspects in the ARE-MMI4.0 is called 'people'. This aspect has been split up into 'autonomy of employees', which could be mapped to the 'culture' aspect of the pivot model and onto 'ICT competence of employees', which could be mapped to the 'expertise' aspect of the pivot model. To give an example of inductive reasoning: a new aspect, 'learning', has been added when comparing agile maturity constructs to the pivot model construct. The smaller constructs 'focus on improving skills' and 'learning from doing' from the AMM model and 'collect measures to support learning' from AgilityMod have been combined to get the 'learning' aspect.

During the systematic meta-model comparison of this research, several comparison matrices have been created. To visualize the systematic meta-model comparison process, an example is given in Figure 23. The most left column in the picture describes the final result after comparing all the constructs of each maturity model. The second column displays the pivot model chosen for the comparison. Choosing a pivot model does not matter on any criteria, but for this comparison, the Maturity Index 4.0 has been chosen for the DT comparison and the SAMI for the agile comparison (Lautenschutz et al., 2018). These two models are chosen as pivot models since the researcher indicated both as most complete, which eases the comparison process. The models to the right of the pivot model are the remaining maturity models found in the literature, which are compared to the pivot model. The models are displayed in such a way that each row corresponds with the same construct. For example, the above row contains a construct in the pivot model, which is displayed in model 2 by indicating an 'X'. However, model N does not contain this construct since the construct is empty. Each found unique aspect is included in the column 'all aspects'. Most of the time, the pivot model already contained all aspects, but as shown in Figure 23, model N might contain an aspect that is not included in the pivot

model. As a result, the aspect in model N is included in the all aspects column. After the systematic comparison, the following matrices have been build: 'DT Aspects' and 'Agile Aspects'.

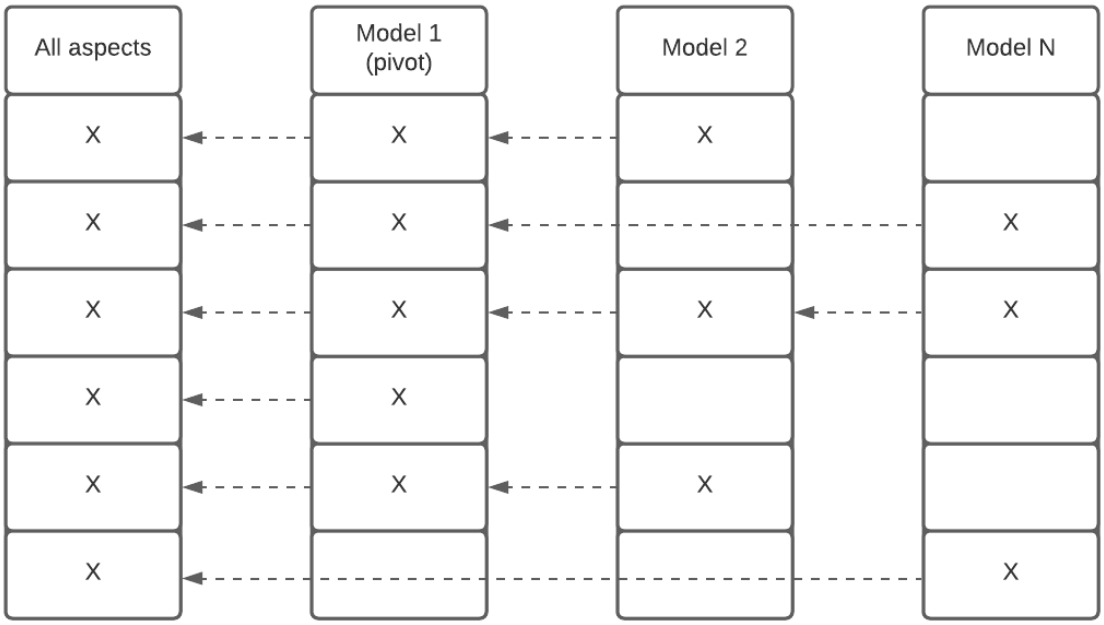


Figure 23: Systematic meta-model comparison example

3.1.4 Expert Interviews

The expert interviews on DT and DT maturity are part of the ADT maturity model's development strategy. These interviews are inspired by Newcomer et al. (2015). There are two main reasons to conduct these interviews: the description of DT is extensive, and, in this master thesis, **not much focus has been on the actual meaning** (i). In addition, **DT is a relatively recent term that keeps evolving**, which may lead to a discrepancy between literature and practice (ii). As a result, the expert interviews should provide additional information about the meaning of the DT aspects found in the literature. Therefore, the following expert interviews goals have been determined before creating the interview questions and the interview protocol: **To confirm the six DT aspects** found after the systematic meta-model comparison (i), **to find missing DT aspects** if there are any (ii), **to find indicators** on how to assess the maturity of the DT aspects (iii), and **to obtain knowledge on what aspects of agile are essential for DT** (iv).

By keeping these goals in mind, the interview protocol and interview questions have been developed. The interview protocol serves as a guide during the expert interviews and has been altered in between expert interviews to improve the interview flow, as advised by Newcomer et al. (2015). The interview questions are semi-structured since this provides the opportunity to dive deeper into the reasoning process of the interview participant (Newcomer et al., 2015). This is needed since the DT aspects and the corresponding indicators have to be discussed. This requires asking many additional how and why questions. The interview questions corresponding to each header are presented in Appendix B1, and the interview protocol is presented in Appendix B2. The following four main interview headings have been created:

1. Demographic information of the respondent.
2. Discussing the found DT aspects in literature.

3. Assessing the maturity of the aforementioned DT aspects by linking indicators to the aspects.
4. Combining agile and DT aspects into one maturity model to come up with a maturity model for achieving DT in an agile way.

The interview participants are all experts in the field of DT and agile. The participants are drawn from a list provided by the supervisor of the sponsor of this thesis project. These participants were chosen based on their background knowledge on DT and agile. To be more specific, the selection criteria for the participants are: experience within CAPE Groep B.V., number of projects for a client group, background knowledge on DT, and background knowledge on agile. seven interview participants are listed in Table 12.

Interviewee ID	Role	Date conducted
P1	Business & IT consultant/Teamlead	10-05-2021
P2	CEO	10-05-2021
P3	Teamlead/Manager Digital Factory	11-05-2021
P4	Business & IT consultant/Teamlead	12-05-2021
P5	Product owner order management system	17-05-2021
P6	Cluster lead/Product owner integration	17-05-2021
P7	Chief product owner of 6 agile teams	28-05-2021

Table 12: Interview participants

The interviews were followed-up by market research analysis, as reported in Section 3.1.5. The data collected by conducting interviews and market research was processed by following qualitative analytical techniques which are presented in Section 3.1.6.

3.1.5 Market Research

The following method of the development strategy for the ADT maturity model is conducting market research on ADT. The goal of the market research is to obtain existing information on ADT which can be helpful for the development of the ADT maturity model. For example, helpful information exists of core principles of ADT, capabilities of ADT tools, ADT level characteristics and ADT aspects. Information found during the market research on ADT can be, in some way, included in the ADT maturity model, as it describes how ADT should be envisioned. Market research has been conducted on the scientific databases Scopus, Web of Science and Google Scholar. In addition, market research has been conducted on Google. Since ADT is relatively new and undiscovered, no relevant scientific publications were found on the scientific databases. However, five relevant sources have been found on Google, and the tool created by CAPE Groep B.V. is also considered. These six sources are listed in Table 13 and further described in Section 3.2.6 and Appendix C.

Reference ID	Reference	Date conducted
R1	Whitepaper describing principles, (Ricci, 2020)	12-05-2021
R2	Website describing benefits, (Vernon, 2020)	12-05-2021
R3	Platform describing capabilities, (BiZZdesign", 2021)	12-05-2021
R4	Website describing principles, (Gopalakrishnan, 2020)	12-05-2021
R5	Website describing levels, (Altexsoft", 2020)	12-05-2021
R6	Poster describing aspects, Figure 9	12-05-2021

Table 13: Market research references

3.1.6 Qualitative Data Analysis

After the interviews and the market research were conducted, relevant parts were coded by performing qualitative data analysis. The coding process has been based on the handbook of practical program evaluation (Newcomer et al., 2015). First, the relevant lines of the interview and market research are coded. This is done by annotating a line and giving it a descriptive word or phrase. After all the lines have been coded, categories will be developed based on a cluster of codes. According to Newcomer et al. (2015), the category incorporates a collection of codes that relate to the same issue, topic or feature in the data.

The codes and categories can be identified a priori or inductively generated from the examination of the data corpus. On the one hand, a priori means that the identification is made based on existing theory. On the other hand, the inductively generated codes and categories are based on the researcher's observation. Since the six DT aspects questioned in the interview were established from theory, these categories are identified a priori. However, the indicators of a DT aspect were not predefined. As a result, the codes are generated inductively based on the researcher's interpretation and afterwards grouped to the correct category. In addition, categories are identified inductively when needed. For example, feedback comments are grouped into the feedback category. The coded transcriptions of the interviews are presented in Appendix B3. The coded market research is presented in Appendix C.

3.1.7 Brainstorm Session

The final method of the development strategy of the ADT maturity model is a brainstorm session. First, this brainstorm session is used to gather ideas on the importance of all the indicators. Then, it is used to determine final indicator weights for all indicators.

This development strategy has been chosen, as a brainstorm allows for quick generation of multiple ideas (Boddy, 2012). This is beneficial since the indicators are the most detailed and numerous component of the ADT maturity model. According to Boddy (2012), a brainstorm session with participants from different backgrounds has a higher collective effect compared to individual parts. As a result, the brainstorm group consist of the researcher plus three experts from the organization. One criterion for the brainstorm group is that not all experts have the same role to increase diversity. Finally, this development strategy is chosen since brainstorms are more often used in the population of a maturity model, with the knowledge management capability assessment as a leading example (De Bruin et al., 2005).

The brainstorm session is structured by introducing the ADT maturity model, and each aspect will be discussed separately. The participants are first asked to look through the aspect, sub-aspects of the aspect and indicators of the sub-aspects. Then, the participants can individually mention anything that comes up to mind when reading through the model. It is encouraged to mention new aspects, sub-aspects or indicators when possible. According to Boddy (2012), this stage of the brainstorm session is called "brain dump" and is used to let participants write everything down, anything which comes to mind. Afterwards, the participants are asked to order the indicators based on importance as a group, which describes the second stage of a brainstorm (Boddy, 2012). As a final stage, the group decides on the order of importance of the indicators only when possible. This process is repeated for all the seven aspects of the ADT maturity model. When there is a disagreement between the brainstorm session participants in ordering indicators of a certain sub-aspect by importance, the researcher leaves the maturity level scores empty.

3.1.8 Construction of the ADT Maturity Model

Based on the described development strategy in the earlier subsections of this section, the ADT maturity model is developed. After performing the systematic comparison, the ADT aspects were developed by adding an 'agility' aspect to the six found DT aspects. The 'agility' aspect contains the main essential findings from the agile systematic comparison. It has been decided to synthesize the DT and agile aspects with each other since one of the goals of this research is to measure the maturity of DT and agile

separately. In addition, this decision helps to scope this research since there exists a time constraint. Finding and adequately displaying the relations between agile and DT aspects requires much time and is suggested for future work. As the systematic comparison mainly provided the aspects and sub-aspects of the ADT maturity model, expert interviews and market research has been conducted to fill the aspects with indicators to measure the maturity of each aspect. In literature, most maturity models indicators have not been described, since it is valuable to the model and can be kept secret for market value reasons (Becker et al., 2009). Finally, the indicator weights are determined by a brainstorm session. During the brainstorm session, a group of experts determined the importance of all the indicators to their corresponding sub-aspect. Figure 24 displays the construction of the ADT maturity model. The bottom layer depicts the added 'agility' aspect, which has been added to the DT aspects.

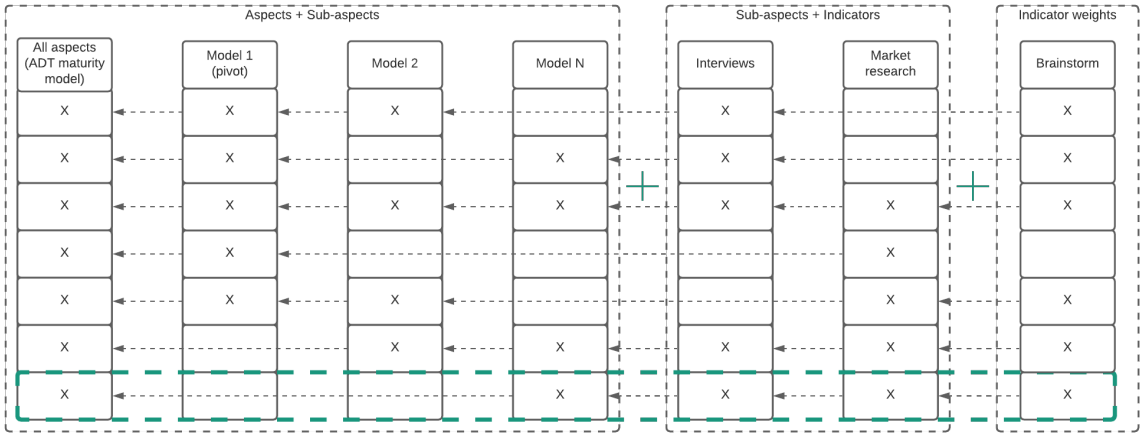


Figure 24: Overview of the total construction of the ADT maturity model

3.2 ADT Maturity Model First Version

This section describes the development of the first version of the ADT maturity model. Firstly, it describes how the DT and agile aspects found in the literature are synthesized by systematically comparing them. Afterwards, it explains how the synthesized DT and agile aspects are synthesized into the ADT maturity model. Thirdly, it discusses the expert interviews, market research, and how these two development strategy steps helped select sub-aspects and the ADT maturity model indicators. Finally, this section describes how the indicator weights are established based on expert experience through conducting a brainstorm session.

3.2.1 DT Aspects Synthesizing

The first step in creating the ADT maturity model is to synthesize the DT aspects by systematically comparing the aspects of the four DT maturity models found in Section 2.5. The four DT maturity models are: the Maturity Index 4.0, the ARE-MMI4.0, the MMOE and the DMM (Schuh et al., 2017; Elnagar et al., 2018; Ifenthaler and Egloffstein, 2020; Berghaus and Back, 2016). Table 14 displays the comparison of the DT aspects of the four models. The models are all compared to the pivot model Maturity Index 4.0. No new aspects were found, but the names of the compared aspects differ significantly from each other, as can be seen in Table 14. In addition, sometimes, one aspect could be mapped onto two different aspects of the pivot model. For example, process digitization could be mapped onto structured communication but also integration. The detailed systematic comparison is presented in Appendix A. In addition, this appendix describes the synthesized DT aspects established as a result of the systematic comparison. The synthesized DT aspects are: culture, strategy & expertise,

information systems and internal & external organization. Finally, descriptions of these aspects, all the aspects found in the maturity models and explanations of the mapping are described in this appendix.

Maturity Index 4.0	ARE-MMI4.0	MMOE	DMM
Willingness to change	People	Culture	Culture
Social collaboration	Culture	Culture	Collaboration
Digital capability	Strategy People	Equipment Employees Strategy	Strategy Product innovation Expertise
Structured communication	Technology	Digital learning and teaching	Process digitization
Information processing	Products Operations	Organization	Process digitization
Integration	Governance Products	Technology	Information technology
Organic internal organization	Leadership Operations	Leadership	Organization Transformation management Information technology
Dynamic collaboration in value networks	Customers	X	Product innovation Customer experience Organization

Table 14: Digital transformation aspects

3.2.2 Agile Aspects Synthesizing

The second step in creating the ADT maturity model exists to synthesize the agile aspects by systematically comparing the aspects of the five agile maturity models found in Section 2.5. The five agile maturity models are: SAMI, SAFe MM, Agile CMMI MM, AgilityMod and AMM (Sidky, 2007; Stojanov et al., 2015; Leusink, 2012; Özcan-Top and Demirors, 2019; Packlick, 2007). Table 15 displays the comparison of the agile aspects of the five models. The models are all compared to the pivot model SAMI, and the names of the agile aspects in the top two rows have been shortened for comparison. The learning aspect was observed as a new agile aspect and added to the synthesized agile aspects. The SAMI, SAFe MM and Agile CMMI MM have identical aspect names, as can be seen in Table 15. This is the result of the researchers choosing a certain model and building further on it. The agile aspect names remained the same, but the contents of the aspect changed. In addition, the aspect 'performing aspect practices' of the AgilityMod is observed as an iterative aspect that belonged to every aspect in the maturity model. As a result, this aspect has been mapped to each aspect of the pivot model. The detailed systematic comparison is presented in Appendix A. In addition, this appendix describes the synthesized agile aspects established as a result of the systematic comparison. The found synthesized DT aspects are: embrace change to deliver customer value, plan and deliver software quality iteratively, human-centric, technical excellence, customer collaboration and learning. Finally, descriptions of these aspects, all the aspects found in the maturity models and explanations of the mapping are described in this appendix.

SAMI	SAFe MM	Agile CMMI MM	AgilityMod	AMM
Embrace change	Embrace change	Embrace change	Simple Performing aspect practices	Adapting
Plan and deliver	Plan and deliver	Plan and deliver	Iterative Performing aspect practices	Iterative planning Acceptance criteria
Human-centric	Human-centric	Human-centric	Human-centric Performing aspect practices	X
Technical excellence	Technical excellence	Technical excellence	Technically excellent Performing aspect practices	Engineering excellence Green-bar tests and builds
X	X	X	Learning Performing aspect practices	Learning

Table 15: Agile aspects

3.2.3 ADT Aspects

The ADT aspects have been established as a third step in the creation of the ADT maturity model. First, the DT and agile aspects were established by systematically comparing both DT and agile aspects independently. Next, refinements were made where needed by inductive or deductive reasoning. Afterwards, minor changes have been made to the aspects based on the feedback of the first expert interviews. This process was done in an agile way to keep improving the main ADT aspects. An example of a change made based on expert feedback is the change in name from the aspect 'information systems' to 'technology'. Finally, both the DT aspects and agile aspects were combined to create the aspects of the ADT maturity model.

The combining of different maturity models is one of the strategies which can be chosen to develop a maturity model (Becker et al., 2009). This strategy is chosen since one of the goals of this research is to create an ADT maturity model, and no existing ADT maturity models were found in the literature. The DT and agile aspects are combined by adding an 'Agility' aspect to the six DT aspects. This 'Agility' aspect entails all the found agile aspects during the systematic comparison, which are the following: embrace change to deliver customer value, plan and deliver software quality iteratively, human-centric, technical excellence, customer collaboration and learning. As a result of adding one 'Agility' aspect to the six DT aspects, the maturity of DT and agile can be measured separately and in combination to obtain the ADT maturity.

All the aspects, descriptions, and explanations of changes compared to the systematic comparison outcome are described in detail in Appendix A. The remainder of this section will describe the definitive aspects and their description of the first version of the ADT maturity model. This is described in Table 16.

Aspect	Description
Culture	The culture describes the culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities, the culture of change which should be in the veins of the employee - think change, do change and the culture of teamwork between the employees to increase knowledge sharing to keep learning from each other.
Strategy	The strategy describes the management's strategic viewpoint on how to manage DT, the transformative vision of the strategy, the digital strategy itself, the strategic resources needed to transform digitally and the monitoring of the digital strategy.
Expertise	The expertise describes the management of DT expertise within an organization. This expertise is important for performing DT within an organization and an organization's ability to offer continuous learning opportunities and the ability of employees to learn continuously.
Technology	The technology describes the core flexible IT systems an organization needs for DT and their reason to choose them, the building blocks and structure of the IT architecture, the ability of an organization to obtain data from systems and to make decisions based on analysis of the data during DT, the ability of an organization to monitor the obtained data from systems, the measures taken to increase the security of the systems and the degree to which core processes inside of an organization are automated.
Internal Organization	The internal organization describes the leadership components for top management in the internal organization, the department/teams components for the internal organization, the components for organizational roles within the organization and the components for the way of working when performing DT in an organization.
External Organization	The external organization describes the digital partner network of the organization, the extent to which they have digitally transformed themselves and the collaboration with them. Besides, it describes the competition of the external organization and the digital customer engagement of the external organization, which describes how the customer is involved in the DT.
Agility	The agility aspect describes the relevant parts of agile to execute DT in an agile way. It is a broad aspect based on the following core agile maturity aspects: embrace change to deliver customer value, plan and deliver software quality iteratively, human-centric, technical excellence, customer collaboration and learning.

Table 16: ADT aspects

3.2.4 Expert Interview Results

The expert interviews have been conducted as a fourth step in the creation of the ADT maturity model. In total, seven expert interviews have been conducted with experts in the field of DT and agile. The first seven rows from Table 17 display the interview participants and their working field. Interview participants one to four are from the same organization, and five to seven are from another organization. Experts from two different organizations are interviewed since it broadens the view on DT and agile and prevents a narrow vision on the subject. The experts have worked on ten to 100 DT projects with an average of around 20. The experts were asked to answer questions about the found DT aspects, the indicators of these aspects and how to transform digitally in an agile way.

The interviews resulted mainly in additional information about indicators for certain DT and agile aspects. Besides, some feedback points were given and considered for implementation. These changes are explained in Section 3.2.3. Furthermore, all experts agreed on the completeness of the DT aspects, except for comments about sub-aspects of certain aspects, which were added to the model later on by the author of this paper. Finally, comments on the importance of DT aspects were reviewed, and no consensus was established, except for 'culture' being important to all seven interview participants.

3.2.5 Market Research Results

Market research has been conducted as a fifth step in the creation of the ADT maturity model. As mentioned in Section 3.1.5, six sources have been found during the market research. These six sources were retrieved via a quick search on Google containing the keywords 'agile digital transformation' and 'agile' AND 'digital transformation'. These six sources are presented in Table 17. The relevant parts for ADT of the six sources, such as principles, capabilities, aspects and level characteristics, have been listed in Appendix C and labelled by performing qualitative data analysis as described in Section 3.1.6. The six sources conducted during the market research are listed below.

CohnReznick is an advisory, assurance and tax firm. The firm published an article that explains the five principles of ADT. These five principles are: start with a transformative vision, focus on building digital customer engagement, support the vision with secure digital platforms and drive insight with data-driven visualization. These principles overlap with the strategy, expertise, technology, internal organization, external organization and agility aspects of the ADT maturity model.

Fintricity is a consultancy company focusing on advising strategy, innovating, transforming digitally and delivering change. The company published an article about the ten benefits of an Agile approach to DT. These ten benefits are: flexibility, business value comes first, continuous improvement, frequent value delivered, cost control, risk reduction, great communication and engagement, complete transparency, high quality and higher team morale. These benefits overlap with every aspect of the ADT maturity model.

BiZZdesign is a company that focuses on helping others make smarter decisions and optimize their outcomes. To accomplish this, BiZZdesign developed the tool HoriZZon, which brings together strategy, IT architecture, operating models, data, capabilities, change portfolios and ideas into a single, intuitive, collaborative business design platform. According to BiZZdesign, this tool helps companies achieve agile DT, and therefore its aspects and capabilities are analyzed. These aspects and capabilities overlap with the strategy, technology, internal organization and agility aspect of the ADT maturity model.

Altexsoft is a software r&d engineering company that helps in the completion of projects of clients. Alexsoft published an article on business agility practices during DT. It describes how agility can help

on three different organizational levels during DT. These organizational levels are: strategic business agility, organizational agility and operational agility. These levels and their characteristics overlap with the strategy, technology, internal organization, external organization and agility aspect of the ADT maturity model.

Intellyx is a company that partly focuses on DT. It has released an ADT roadmap poster covering the crucial aspects of ADT. This poster is presented in the Introduction section in Figure 9. The aspects depicted in the poster are: customer experience, enterprise IT, big data, DevOps and agile architecture. These aspects overlap with the technology, internal organization, external organization and agility aspects of the ADT maturity model.

CAPE Groep B.V. has started to build a maturity tool, called CAPE Moby 2, for their transformation, including ADT aspects. This tool is still in child shoes, but since it covers ADT aspects, it is considered part of the market research. The aspects in the tool are: management agility, business agility, business - ICT trust, governance, agile continuous delivery, product vision excellence, team agility, learning culture, skills of the team, DevOps implementation and data management. These aspects overlap with all aspects of the ADT maturity model.

3.2.6 Selecting Sub-aspects & Indicators

This section describes the process of selecting sub-aspects and indicators for the ADT maturity model. On the contrary to the ADT aspects, the sub-aspects and indicators are determined by findings retrieved from expert interviews and market research. This choice has been made since there exists less detailed information about sub-aspects and indicators of DT and ADT in scientific literature. To close this gap, information is retrieved from practice via expert interviews and informal market research on Google. Qualitative data analysis links findings from expert interviews and market research to the right aspects retrieved from the scientific literature. When new findings were obtained from practice, which was not found in scientific literature, this information was added by asking the interview participant where the indicator or sub-aspect belonged or using common sense. Table 17 displays the interview participants and sources from the market research. This table functions as a reference selector to indicate which source mentions which sub-aspect or indicator.

Reference ID	Type	Role/Data	Date conducted
P1	Interview	Business & IT consultant/Teamlead	10-05-2021
P2	Interview	CEO	10-05-2021
P3	Interview	Teamlead/Manager Digital Factory	11-05-2021
P4	Interview	Business & IT consultant/Teamlead	12-05-2021
P5	Interview	Product owner order management system	17-05-2021
P6	Interview	Cluster lead/Product owner integration	17-05-2021
P7	Interview	Chief product owner of 6 agile teams	28-05-2021
R1	Whitepaper (Ricci, 2020)	Principles	12-05-2021
R2	Website (Vernon, 2020)	Benefits	12-05-2021
R3	Platform (BiZZdesign", 2021)	Capabilities	12-05-2021
R4	Website (Gopalakrishnan, 2020)	Principles	12-05-2021
R5	Website (Altexsoft", 2020)	Levels	12-05-2021
R6	Poster Figure 9	Aspects	12-05-2021

Table 17: References for the selection of sub-aspects and indicators

The remainder of this section describes the sub-aspects and indicators of each aspect. In addition, the table shows which references mentioned a certain sub-aspect or indicator. Inductive content analysis is used to get from a detailed description to a more general description. In other words, to get from the indicators to the sub-aspects. The detailed version with included descriptions of each sub-aspect,

indicator, and the assessment questions are presented in Appendix D.

3.2.6.1 Culture

The culture aspect consists of the following three sub-aspects: willingness to make decisions, willingness to change and knowledge sharing. In addition, the culture aspect is linked to 13 indicators that assess the culture aspect of an organization. Table 18 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Willingness To Make Decision	Everyone is allowed to make decisions	P4, P5, P6
	No blame culture	P4
	Open environment	P2, P5
	Transparent environment	P5, P6
Willingness To Change	Accept and expect change throughout the whole organization	P1, P2.
	Teams encouraged to embrace technological excellence	P1, R2
	Teams encouraged to embrace innovation	P1, R2
Knowledge Sharing	Business - ICT trust	R4, R6
	Constant communication	R2
	Identify, share, apply learnings to projects	P2, P3, P5, R2
	Open environment	P2, P5, P7
	No blame culture	P4
	Transparent environment	P5, P6

Table 18: ADT culture aspect overview

3.2.6.2 Strategy

The strategy aspect consists of the following five sub-aspects: digital management, digital transformative vision, digital strategy, digital resources and monitoring. In addition, the strategy aspect is linked to 20 indicators which together assess the strategy aspect of an organization. Table 19 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Digital Management	Commitment from top, middle and lower management	P1, P3
	Management focus on change management	P3, P4
	Top management establishes digital importance	P4, R1
Digital Transformative Vision	Clear digital transformation start point	P1, P2, P6, R1
	Clear digital transformation end point	P1, P2, P6, P7, R1
	Digital transformation roadmap to determine the path from start to end	P1, P2, P6, R1
	Execute your digital roadmap based on your culture and internal organization	P6
Digital Strategy	Strategy based on digital transformation goals	P1, P2, P5, P6, R2
	Chosen technology based on digital transformation goals	P1, P2, P3, P6
	Outside-in strategy	P2
	Prioritization of your digital transformation goals	P2, P5, P7
	Oversee all goals and don't become a one-trick pony	P2, P4, R1
	Start with small success and eventually scale	P3, P4, R2
	Continuously evolve digital strategy	R1
	Data-driven decision-making	R4
Digital Resources	Budgetting for digital transformation	P1, P4, P7
	Time management	P1, P6
Monitoring	Monitor execution progress of your strategy	P6, R1
	Monitor the execution of your roadmap	P6
	Establish KPIs and metrics to monitor execution	P6, R1

Table 19: ADT strategy aspect overview

3.2.6.3 Expertise

The expertise aspect consists of the following three sub-aspects: expertise management, digital expertise and continuous learning. In addition, the strategy aspect is linked to 14 indicators that assess the expertise aspect of an organization. Table 20 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Expertise Manage-ment	Digital transformation expertise flows throughout the entire organization	P1, P6
	Inhousing or outsourcing knowledge	P2, P3, P5, P6
	Digital transformation execution knowledge	P1, P2, P6
	Learning budget	P3, P4
Digital Expertise	IT knowledge	P1, P2, P3, P4, P5, P7
	Business knowledge	P3, P5
	Digital transformation execution knowledge	P1, P2, P6
	Personal knowledge	P2, P4
	Team roles knowledge	P3
	Digital process knowledge	P4
Continuous Learning	Having a digital academy	P2, P3, P4, P6, R6
	Having a learning mindset	P2, P3, P4, R6
	Employees keep learning	P2, P4, R2, R6
	Providing trainings	P4, R6

Table 20: ADT expertise aspect overview

3.2.6.4 Technology

The technology aspect consists of the following six sub-aspects: IT systems, IT architecture, data integration, data monitoring, IT security and process automation. In addition, the technology aspect is linked to 29 indicators which together assess the technology aspect of an organization. Table 21 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	Indicator	Ref.
IT Systems	Choose the right systems	P1, R6
	Financial system	P1
	Employee information system	P1
	Warehouse management system	P1
	Transport management system	P1
	Document management system	P1
	Flexible IT systems	P2, P3, P6, P7
IT Architecture	Usage of the cloud	P2, P6, R5
	Integration systems layer	P2, P3, P4, P5
	Datalake/datawarehouse	P2, P4, R5
	Open APIs	P2, R5
	Loose coupling between layers	P2
	Microservices	P3, P6, R5
	Enterprise architecture tool	R3, R5
Data Integration	Connecting systems to systems	P1, P2, P3, P4, P6, R3
	Get data from systems	P1, P2, P3, P5, P6, R3
	Do analysis with big data (reporting)	P1, P3, P4, P5, R1, R2, R3, R5, R6
	Simulations with AI	P1, P3, P5, P7, R2, R3
	Make decisions based on data	P3, P4, R2, R3, R5
Data Monitoring	Data monitoring based on KPIs	P5, P6, R5, R6
	Functionality based data monitoring	P5, R5, R6
	Technological based data monitoring	P5, R5
IT Security	Ration on cloud/on premise	P2, P6, R5
	Technological standards	P2, R3, R5
	Manage risk using smart tools	P8, P9, R5
	Secure interfaces	R1, R3, R5
	Intrusion detection	R1, R5, R6
	Security testing	R6
Process Automation	BMS to automate and manage processes	P4, P5, P6, P7, R4, R5

Table 21: ADT technology aspect overview

3.2.6.5 Internal Organization

The internal organization aspect consists of the following four sub-aspects: leadership, department and teams, organizational roles and way of working. In addition, the internal organization aspect is linked to 15 indicators which together assess the internal organization aspect of an organization. Table 22 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Leadership	Leadership vision	P1, P3, P6, R1, R4
	Democratic leadership	P3, P4, P7
	Comfortable work environment	R4
Department and Teams	IT in departments	P1
	Connect business & IT	P1, P3, P5, R4
	Communication with top management	P2
	Self-organized	P3, P4, P5, P7, R2, R5, R6
	Collaboration between teams	P5, R2, R3, R4, R6
Organizational Roles	Defined roles	P1, P2, P3, P5, P6, P7
	Defined responsibilities	P1, P5, P6, P7
Way of Working	MVPs	P2, R4
	Planning rhythm	P2
	Flexible prioritization	P2
	Two way operations	P2, P7, R5
	Context aligned	P6

Table 22: ADT internal organization aspect overview

3.2.6.6 External Organization

The external organization aspect consists of the following three sub-aspects: digital partner network, competition and digital customer engagement. In addition, the external organization aspect is linked to 13 indicators that assess an organization's external organization aspect. Table 23 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Digital Partner Network	Partners kickstarting the DT	P1
	Digitally transformed partners	P1, P2, P3
	Event driven chain architecture	P2, P3
	Continuous stakeholder management	R2, R4
	Collaborative feedback	R2
Competition	Competition growth	P1
	Power distribution in chain	2
Digital Customer Engage-ment	Pull clients in your context	P2, P4
	Customer centricity	P6, R1, R5, R6
	Personalized content	P6, R1
	Digital customer journey	P6, R1, R5
	Expose growth opportunities	R1, R5
	End-user communication	R4, R6

Table 23: ADT external organization aspect overview

3.2.6.7 Agility

The agility aspect consists of the following six sub-aspects: embrace change to deliver customer value, plan and deliver quality iteratively, human-centric, technical excellence, learning and customer collaboration. In addition, the agility aspect is linked to 32 indicators that assess the agility aspect of an organization. Table 24 displays the sub-aspects with their corresponding indicators and the references which mentioned these indicators.

Sub-aspect	**Indicator**	**Ref.**
Embrace change to deliver customer value	Change based on outside developments	P1, P2, R3
	Complex, uncertain problem	P6, R5
	Accept and expect change throughout the whole organization	R2
	Management agility	R6
Plan and deliver software quality iteratively	Quater planning (PI)	P1, P2, P3, P5, P7, R4, R6
	Adaptive planning	P1, P2, P6, R2, R4, R6
	Priority planning	P2, P5, P7, R2, R6
	Defined strategic themes	P1, P2, P7, R6
	MVPs	P2, P3, P4, P5, P6, R2, R6
	Feedback loops with stakeholders	P2, P3, P5, P6, R2, R6
Human-centric	Define agile roles	P1, P2, P5, P6, P7, R4, R6
	Defined responsibilities	P2, P5, P7
	Collaboration between departments, teams and management	P1, P5, P6, R2, R3, R4, R6
	BizDevOps	P2, R2, R4, R6
	DevOps	P3, R5, R6
	Self-organized teams	R4, R5, R6
	Team size of 5-9	P7
	Employee dedicated to one team	P7
	Distributed agile network	R4
Technical excellence	Security	P2, R5, R6
	Build under architecture	P2, R5
	Quality of 'code'	P2, R2, R6
	Validation of code	P6, R6
	Monitor using KPIs	R3, R4, R6
	CI/CD	R5, R6
Learning	Retrospective	P3, P4, R2
	Continuous learning	R2
	Monitor agile program	R1
	Monitor using KPIs and learn	R3, R4, R6
Customer Collaboration	Digital customer engagement	R1, R2, R5
	Communication with end-users	R4, R6
	Customer journey	R5, R6

Table 24: ADT agility aspect overview

3.2.7 Establishing Indicator Weights

This section describes the seventh step in the establishment of the ADT maturity model. It describes how the indicator weights are determined. The indicator weight construction method, as described by NLP-NU (2018), exists of one brainstorm session with three experts in the field of DT and agile. Three experts and the author attended the session. Table 25 displays the experts who participated in the brainstorm session, their roles and the brainstorm session date. During the brainstorm session, as many indicator weights as possible were discussed. However, not every indicator ended up having a weight after the brainstorm session due to the time limit of two hours of the brainstorm session. As a result, the three experts ranked the remaining indicators on importance in an additional online session. Due to the time constraint of this master thesis, it has been decided to only organize one brainstorm session to develop the indicator weights. The established indicator weights help to calculate the maturity level scores of each sub-aspects and eventually the aspects. In addition, the indicator weights are established to display the difference of importance of each indicator. Some indicators are rated equally on importance and will thus have the same weight for the corresponding sub-aspect. The least important indicator of a sub-aspect has weight one. The second least important indicator has weight two. The weight keeps increasing by one if a more meaningful indicator exists until all indicators have a representative weight based on importance. As a result, the highest weight number varies depending on the number of sub-aspect indicators and on the importance of indicators. According to NLP-NU (2018), this method can be used to determine the importance and thus the weight of items.

Reference	Role	Date
1	Consultant	14-06-2021
2	Program manager	14-06-2021
3	Solution architect	14-06-2021

Table 25: Brainstorm session participants

The remainder of this section describes the findings of the brainstorm session about the indicator weights of the first version of the ADT maturity model. This is done by creating tables with the sub-aspects, corresponding indicators and the indicator weight.

3.2.7.1 Culture

The sub-aspects, indicators and corresponding weights of the culture aspect are displayed in Table 32. The highest reached weight is six, and no duplicate weights for the indicators of the same sub-aspect are determined.

Sub-aspect	Indicator	Weight
Willingness To Make Decision	Everyone is allowed to make decisions	5
	No blame culture	4
	Open environment	3
	Transparent environment	2
	Multicultural disciplinary team	1
Willingness To Change	Accept and expect change throughout the whole organization	3
	Teams encouraged to embrace technological excellence	2
	Teams encouraged to embrace innovation	1
Knowledge Sharing	Business - ICT trust	2
	Constant communication	1
	Identify, share, apply learnings to projects	3
	Open environment	6
	No blame culture	5
	Transparent environment	4

Table 26: ADT culture indicator weights

3.2.7.2 Strategy

The sub-aspects, indicators and corresponding weights of the strategy aspect are displayed in Table 27. The highest reached weight is seven, and duplicate weights for the indicators of the same sub-aspect are determined. According to the experts, these indicators are equally important to them.

Sub-aspect	Indicator	Weight
Digital Management	Commitment from top, middle and lower management	1
	Management focus on change management	2
	Top management establishes digital importance	3
Digital Transformative Vision	Clear digital transformation start point	2
	Clear digital transformation end point	3
	Digital transformation roadmap to determine the path from start to end	1
	Execute your digital roadmap based on your culture and internal organization	1
Digital Strategy	Strategy based on digital transformation goals	3
	Chosen technology based on digital transformation goals	3
	Outside-in strategy	7
	Prioritization of your digital transformation goals	6
	Two way operations	5
	Oversee all goals and don't become a one-trick pony	1
	Start with small success and eventually scale	4
	Continuously evolve digital strategy	2
	Data-driven decision-making	2
Digital Resources	Budgetting for digital transformation	2
	Time management	1
Monitoring	Monitor the execution progress of your strategy	1
	Monitor the execution of your roadmap	2
	Establish KPIs and metrics to monitor execution	3

Table 27: ADT strategy indicator weights

3.2.7.3 Expertise

The sub-aspects, indicators and corresponding weights of the expertise aspect are displayed in Table 28. The highest reached weight is six, and no duplicate weights for the indicators of the same sub-aspect are determined.

Sub-aspect	**Indicator**	**Weight**
Expertise Management	Digital transformation expertise flows throughout the entire organization	1
	Inhousing or outsourcing knowledge	2
	Digital transformation execution knowledge	3
	Learning budget	4
Digital Expertise	IT knowledge	5
	Business knowledge	4
	Digital transformation execution knowledge	1
	Personal knowledge	6
	Team roles knowledge	2
	Digital process knowledge	3
Continuous Learning	Having a digital academy	1
	Having a learning mindset	4
	Employees keep learning	3
	Providing trainings	2

Table 28: ADT expertise indicator weights

3.2.7.4 Technology

The sub-aspects, indicators and corresponding weights of the technology aspect are displayed in Table 29. The highest reached weight is five, and duplicate weights for the indicators of the same sub-aspect are determined. According to the experts, these indicators are equally important to them. Especially the sub-aspect 'IT Architecture' has many equal indicator weights, as the experts mentioned that most indicators referred to design principles.

Sub-aspect	**Indicator**	**Weight**
IT Architecture	Usage of the cloud	4
	Process automation	4
	Choose the right systems	3
	Flexible IT systems	4
	Integration systems layer	4
	Datalake/datawarehouse	2
	Open APIs	4
	Loose coupling between layers	4
	Microservices	4
	Design principles	4
	Enterprise architecture tool	1
Data Integration	Connecting systems to systems	3
	Get data from systems	5
	Do analysis with big data (reporting)	2
	Simulations with AI	1
	Make decisions based on data	4
Data Monitoring	Data monitoring based on KPIs	3
	Functionality based data monitoring	1
	Technological based data monitoring	2
IT Security	Ration on cloud/on premise	5
	Technological standards	5
	Manage risks	4
	Secure interfaces	3
	Intrusion detection	1
	Security testing	2

Table 29: ADT technology indicator weights

3.2.7.5 Internal Organization

The sub-aspects, indicators and corresponding weights of the internal organization aspect are displayed in Table 30. The highest reached weight is five, and no duplicate weights for the indicators of the same sub-aspect are determined.

Sub-aspect	Indicator	Weight
Leadership	Leadership vision	3
	Democratic leadership	1
	Comfortable work environment	2
Department and Teams	IT in departments	5
	Connect business & IT	4
	Communication with top management	3
	Self-organized	2
	Collaboration between teams	1
Organizational Roles	Defined roles	1
	Defined responsibilities	2
Way of Working	MVPs	3
	Planning rhythm	1
	Flexible prioritization	2
	Context aligned	4

Table 30: ADT internal organization indicator weights

3.2.7.6 External Organization

The sub-aspects, indicators and corresponding weights of the external organization aspect are displayed in Table 31. The highest reached weight is six, and no duplicate weights for the indicators of the same sub-aspect are determined.

Sub-aspect	Indicator	Weight
Digital Partner Network	Partners kickstarting the DT	3
	Digitally transformed partners	2
	Event driven chain architecture	1
	Continuous stakeholder management	5
	Collaborative feedback	4
Competition	Competition growth	2
	Influence in competitive chain	1
Digital Customer Engage-ment	Pull clients in your context	1
	Customer centricity	5
	Personalized content	2
	Digital customer journey	4
	Expose growth opportunities	3
	End-user communication	6

Table 31: ADT external organization indicator weights

3.2.7.7 Agility

The sub-aspects, indicators and corresponding weights of the agility aspect are displayed in Table 32. The highest reached weight is eight, and duplicate weights for the indicators of the same sub-aspect are determined. According to the experts, these indicators are equally important to them, as they are closely related. The 'Agility' aspect has the highest indicator weight, and the assumed cause for this is the volume of the aspect. Furthermore, the 'Agility' aspect has the most indicators, as all the relevant parts of agile for DT are incorporated in this sub-aspect.

Sub-aspect	**Indicator**	**Weight**
Embrace change to deliver customer value	Change based on outside developments	2
	Apply agile to complex, uncertain problems	1
	Accept and expect change throughout the whole organization	3
	Management agility	4
Plan and deliver software quality iteratively	Quater planning (PI)	1
	Adaptive planning	2
	Priority planning	4
	Defined strategic themes	6
	MVPs	5
	Feedback loops with stakeholders	3
Human-centric	Define agile roles	7
	Defined responsibilities	8
	Collaboration between departments, teams and management	5
	BizDevOps	2
	DevOps	4
	Self-organized teams	3
	Team size of 5-9	6
	Employee dedicated to one team of 5-9	6
	Distributed agile network	1
Technical excellence	Security	4
	Build under architecture	5
	Quality of 'code'	3
	Validation of code	4
	Monitor using KPIs	2
	CI/CD	1
Learning	Retrospective	4
	Continuous learning	3
	Monitor agile program	2
	Monitor using KPIs and learn	1
Customer Collaboration	Digital customer engagement	1
	Communication with end-users	3
	Customer journey	2

Table 32: ADT Agility indicator weights

3.2.8 ADT Maturity Levels

The final step in the construction of the ADT maturity model is the construction of the maturity levels. It has been chosen to use maturity levels with point intervals instead of using maturity levels with descriptions. This choice has been made since it seemed the most suitable, as the last section established the indicator weights. Using these indicator weights together with a score given by the organization, a certain number of points can be calculated, and it can easily be determined to which point interval a sub-aspect or aspect belongs. The MMEO, retrieved during the SLR and described in Section 2.5, is used for the determination of point intervals and maturity level descriptors, as it uses a similar approach to what fits this research (Ifenthaler and Egloffstein, 2020). During an assessment of the ADT maturity model, organizations are asked to score each indicator on a 5 point Likert scale. The point interval can be determined by using the indicated score and the indicator weights. On the one hand, a maturity level of one is the worst possible maturity level and thus indicated with a red colour. On the other hand, a maturity level of five is the best possible maturity level and thus indicated with a green colour. Figure 25 displays the maturity level descriptors and point intervals of the ADT maturity model.

Maturity levels:	Point interval:
Agile digitally minimalist (1)	0-30
Agile digitally conservative (2)	31-50
Agile digitally pragmatist (3)	51-70
Agile digitally advanced (4)	71-90
Agile digitally trailblazing (5)	91-100

Figure 25: ADT maturity levels

Maturity levels are calculated on four different levels: indicator, sub-aspect, aspect and total level. All four calculations are different, and the sub-aspect maturity level calculation is the most complex due to the indicators having weights. First, the indicator level has to be determined. This maturity level is determined by mapping the score of an assessment question given during an assessment directly to the maturity level of the corresponding indicator. Second, the sub-aspect maturity levels have to be calculated. An example of such a calculation has been provided at the end of this section. Third, the aspect maturity level has to be calculated. This maturity level is calculated by the average points of the sub-aspects of the corresponding aspect and relating it to a maturity level. Finally, the total maturity level can be calculated by the average points of the seven aspects and afterwards relate it to a maturity level.

An example of calculating a maturity level for a sub-aspect is given by calculating the maturity level of the sub-aspect willingness to change: the sub-aspect consists of three indicators: accept and expect change throughout the whole organization, teams encouraged to embrace technological excellence, and teams encouraged to embrace innovation with their corresponding weights 3, 2 and 1. An organization has scored the three indicators respectively 2, 5 and 4.

1. The total weight of the sub-aspect willingness to change is: 3 + 2 + 1 = 6

2. The indicated scores are multiplied with the weights divided by the total weight of the sub-aspect: 2 * (3/6) + 5 * (2/6) + 4 * (1/6) = 3,34

3. Translate the outcome to points: 3,34 * 20 = 67 points.

4. Translate the points to a maturity level: Agile digitally pragmatist (3)

3.3 Result of ADT Maturity Model Development

This section describes the result of the development phase of the ADT maturity model. It displays the ADT maturity model figure and screenshots of the detailed ADT maturity model Excel sheet.

The ADT maturity model figure depicts a high-level overview of the ADT maturity model displaying the aspects and sub-aspects of ADT. In addition, each agile sub-aspect has its colour, and the DT sub-aspects which have a relationship with this agile aspect are given the same colour. As a result, relations between agile and DT aspects are displayed. The sub-aspects in white display the DT aspects, which have no relation with agile aspects. A relation is displayed when at least one indicator of the DT sub-aspect is the same compared to an indicator of an agile sub-aspect. The ADT maturity model is displayed in Figure 26. The Excel sheet, with all the details of the ADT maturity model, has a mock-up introduction tab, which is displayed in Figure 27, a tab for every ADT aspect which provides details on the sub-aspects, indicators, assessment questions and maturity level scores of each aspect and a mock-up of a dashboard tab, which is displayed in Figure 29. In addition, at the bottom of each tab, the score and desired score of the concerning aspect is displayed. The culture mock-up tab is displayed in Figure 28. These mock-ups have been developed to gain feedback on them during the expert and expert evaluation interviews. Besides, the mock-ups can be used as a first step of important contents for the ADT assessment instrument.

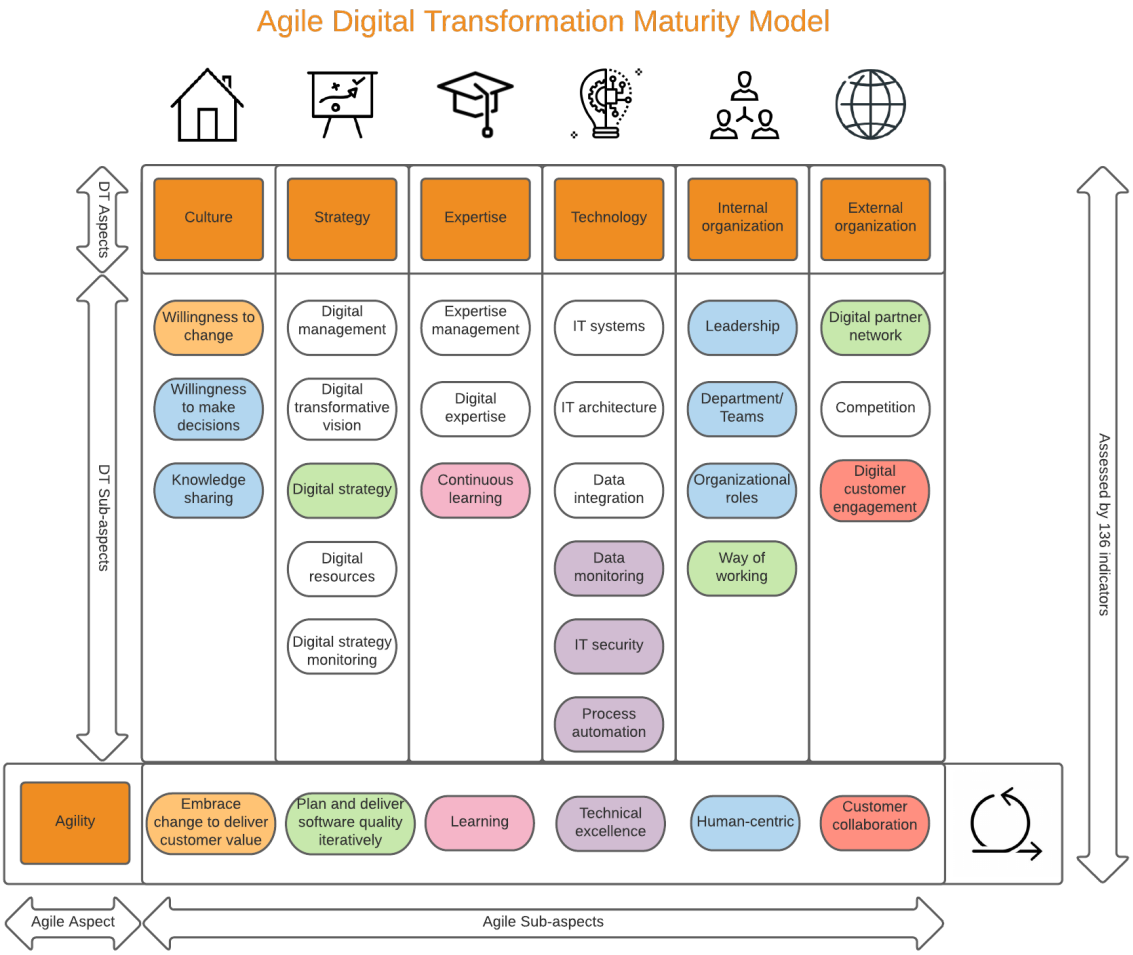


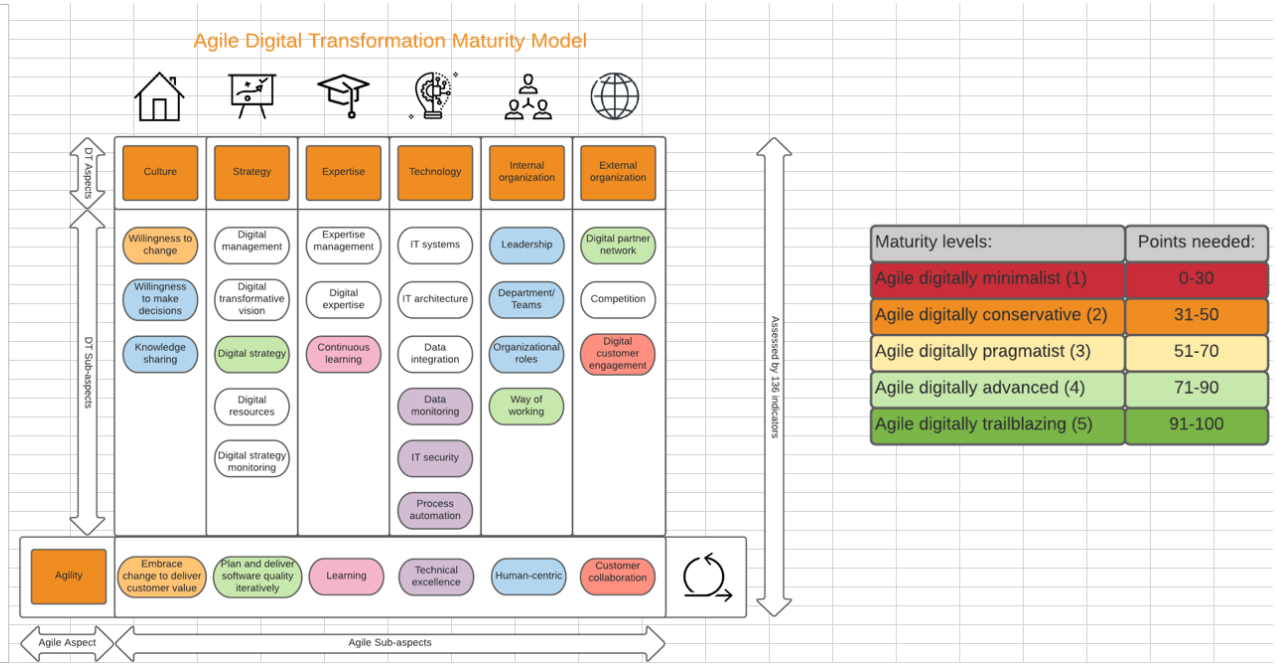
Figure 26: The ADT maturity model V1.

Introduction: This Excel details the 'agile digital transformation maturity model'. This maturity model serves as an instrument to assess how mature an organization is in performing digital transformation in an agile way. It does this by going through 7 aspects of 'agile digital transformation' and scoring each indicator with a score between 1 and 5. Afterwards, the maturity scores will be calculated based on the given scores by the organization multiplied by weights. This will determine the maturity of an organization in the field of performing digital transformation in an agile way. The maturity levels are displayed next to the figure of the 'agile digital transformation maturity model'. In addition, it can calculate the maturity of the one 'agility' and six digital transformation aspects seperately to come up with those individual scores as well.

The figure to the right of this text displays the 'agile digital transformation maturity model figure' which describes the maturity model on a high level. The 7 main aspects of 'agile digital transformation' are displayed in the dark orange blocks and contain the aspects: culture, strategy, expertise, technology, internal organization, external organization and agility. Each aspect has several sub-aspects which describe the sub categories of each main aspect. All the sub-aspects are assessed by answering assessment questions based on indicators of a certain sub-aspect. These indicators and assessment questions are not in the figure for clarity reasons, but are incorporated in **tab 2-8** of this Excel file. Finally, sub-aspects with the same colour describe the relation between them. This is done to show how agile sub-aspects and digital transformation sub-aspects are related with each other. Sub-aspects without an colour (in white) have no relation with any agile sub-aspects, these sub-aspects are purely related to digital transformation.

Next to calculating the current maturity levels of the 'agile digital transformation' aspects, the model asks you to fill in a desired maturity state. This allows for a quick overview of the as-is and to-be state state of an organization's digital transformation in an agile way.

In the end, on the bottom of **tab 2-8**, the maturity level score and the desired maturity state are displayed for the specific 'agile digital transformation' aspect.



Maturity levels:	Points needed:
Agile digitally minimalist (1)	0-30
Agile digitally conservative (2)	31-50
Agile digitally pragmatist (3)	51-70
Agile digitally advanced (4)	71-90
Agile digitally trailblazing (5)	91-100

Figure 27: The introduction mock-up tab of the ADT maturity model.

Aspect	Sub-aspect	Ref	Description	Indicator	Weight	Ref	Description	Assessment question (ranked 1-5 Likert scale)	Current score (1 to 5)		Desired score (1 to 5)
Culture	Willingness To Make Decisions	2, 4, 5, 6	The culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities.	Everyone is allowed to make decisions	4	P4, P5, P6	Decision making is possible throughout all levels of the organization.	To what extent does there exist a culture which allows employees to make his/her own decisions?			
				No blame culture	3	P4	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports the willingness of an employee to make his/her own			
				Open environment	2	P2, P5	Environment where it's supported and encouraged to make decisions and pitch them.	To what extent does there exist an open environment which supports the willingness of an employee to make his/her own decisions?			
				Transparant environment	1	P5, P6	Environment where it's supported to make decisions, since all knowledge is availalble to everyone.	To what extent does there exist a transparant environment which supports the willingness of an employee to make his/her own decisions and base this decision on importance and value?			
	Willingness To Change	1, 2, 9	The culture of change which should be in the veins of the employee - think change, do change.	Accept and expect change throughout the whole organization	3	P1, P2	Not only accept change, but expect it and even think about things you can change.	To what extent does there exist a culture where employees are accepting change and think in change?			
				Teams encouraged to embrace technological excellence	2	P1, R2	Be open to new developments in the technology area and make sure your team is up to date.	To what extent does there exist a culture in which employees are open to technologies and embrace them?			
				Teams encouraged to embrace innovation	1	P1, R2	Be open to innovation and change your team based on innovative ideas.	To what extent does there exist a culture in which employees are open to new innovation and embrace new digital advancements?			
	Knolwedge Sharing	2, 3, 4, 5, 6, 7, 9, 11, 13	Between the employees there exist an environment of teamwork to increase knowledge sharing to keep learning from each other.	Business - ICT trust	2	R4, R6	The business and IT department should trust each other and wanting to collaborate.	To what extent does there exist a culture where the business & IT trust each other and share knowlegde?			
				Constant communication	1	R2	The employees of an organization have a mindset of constant communication.	To what extent does there exist a culture where knowledge sharing is encouraged by constant communication between employees?			
				Identify, share, apply learnings to projects	3	P2, P3, P5, R2	The employees are focused on learning from expercies during projects and identify, share and apply these learning to new projects.	To what extent does there exist a culture where learnings from experience are identified, shared and applied to other project?			
				Open environment	6	P2, P5, P7	Environment where it's supported and encouraged to share knowledge.	To what extent does there exist an open environment which supports knowledge sharing between employees?			
				No blame culture	5	P4	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports the willingness of an employee to make his/her own			
				Transparant environment	4	P5, P6	Environment where it's supported to share knowledge, since all knowledge is availalble to everyone.	To what extent does there exist a transparant environment which supports knowledge sharing between employees by making knowledge available throughout the organization?			
									Current Score Willingness to Make Decisions:		Desired Score Willingness to Make Decisions:
									Current Score Willingness to Change:		Desired Score Willingness to Change:
									Current Score Knowledge Sharing:		Desired Score Knowledge Sharing:
									Total Current Score Culture:		Total Desired Score Culture:

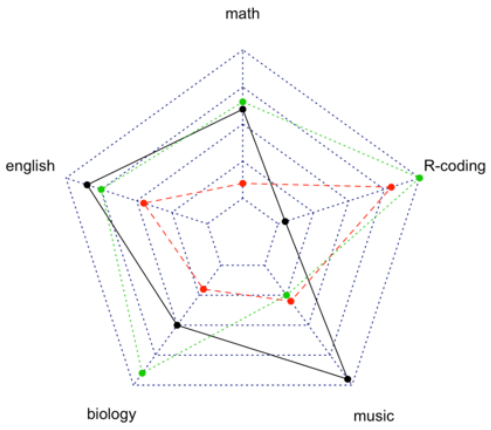
Figure 28: The culture mock-up tab of the ADT maturity model.

Dashboard: This page should present a dashboard based on the results of the assessment. There should at least be a score overview present on the dashboard screen describing the scores and desired scores. In addition, a visualization of the assessment results should be available in the form of a spider chart displaying the results per aspect and in total.

Remark: This is a mock-up version and the final dashboard version will be made in the prototype.

Aspect	Maturity Level	Desired maturity level
Culture	3	4
Strategy	5	5
Expertise	4	5
Technology	3	3
Internal Organization	4	4
External Organization	2	4
Agility	2	3

Aspect	Sub-aspect	Indicator	Maturity level	Desired maturity level
	Willingness to make decisions	Everyone is allowed to make decisions	2	3
		No blame culture	2	3
		Open environment	1	3
		Transparant environment	3	3
	Willingness to change	Accept and expect change throughout the whole organization	4	5
		Teams encouraged to embrace technical excellence	3	4
Culture		Teams encouraged to embrace innovation	5	5
	Knowledge sharing	Business - ICT trust	3	4
		Constant communication	4	5
		Identify, share, apply learnings to projects	2	4
		Open environment	1	3
		No blame culture	2	4
		Transparant environment	4	4



Aspect	Sub-aspect	Maturity level	Desired maturity level
	Willingness to make decisions	2	3
Culture	willingness to change	4	5
	Knowledge sharing	3	4

Figure 29: The dashboard mock-up tab of the ADT maturity model.

4 EVALUATION & DEMONSTRATION OF THE ARTIFACT

This chapter describes the evaluation and demonstration of the ADT maturity model and assessment instrument. The ADT maturity model is evaluated through a type 2 evaluation: expert evaluation interviews. The goal of this evaluation is to check the **completeness** and **clarity** of the ADT maturity model. This is important for the author to come up with an improved second version of the model. Hence, the open questions and evaluation criteria, used during the expert evaluation interviews, are formulated based on those goals. Afterwards, the ADT maturity model has been demonstrated through the use of the ADT assessment instrument. This type 3 evaluation has been performed to validate if the model **can be used in practice**. Two observational case studies have been conducted to validate if the model can be used in practice.

4.1 Evaluation Methods

This section discusses the used evaluation methods to evaluate the ADT maturity model. The paper of Helgesson et al. (2012) mentions three different types of evaluations for maturity models found in literature:

- Type 1: An evaluation without the involvement of experts. This evaluation type is conducted by the author of the research himself based on his knowledge or by comparing it to other maturity models.
- Type 2: An evaluation with the involvement of experts. This evaluation type is conducted through interviews or surveys and with experts in the field of the subject of the maturity model.
- Type 3: An evaluation with the involvement of experts. This evaluation type is conducted using the maturity model in a practical setting to assess the process improvement activities.

For this research, the choice is made to conduct a type 2 and a type 3 evaluation for the ADT maturity model. The type 1 evaluation is disregarded since the maturity model has been developed by comparing existing maturity models in the same field. In addition, the researcher has little experience in creating maturity models and is no expert in the field of agile or DT. As a result, a type 1 evaluation comparing the model to existing similar models or the author's knowledge is unfavourable.

The type 2 evaluation is used in this research to evaluate the model's contents and validate if it corresponds with the current state of practice of DT in an agile way. Consultants with expertise in the field of DT and agile participated in this evaluation, as they are the normal operators and thus end-users of the system. To evaluate the model's contents, a set of open questions is developed, following Newcomer et al. (2015), to ask about specific parts of the ADT maturity model. This set of open questions is described in Section 4.2.3. In addition, the experts are asked to rate a set of evaluation criteria. These criteria are established based on UTAUT (Venkatesh et al., 2003). It is asked to score these evaluation criteria on a 5 point Likert scale to test the non-functional requirements described in the Introduction. These evaluation criteria are described in Section 4.2.4. Based on the type 2 evaluation results, the second version of the ADT maturity model is created.

The type 3 evaluation is used in this research to demonstrate the use of the assessment instrument prototype in practice by performing two observational case studies Wieringa (2014). One of the case studies involves CAPE Groep B.V. itself, and the other case is a client of CAPE Groep B.V. A client of CAPE Groep B.V. is used as a case study since they are the functional beneficiaries of the ADT maturity model, and the maturity model, together with the assessment instrument, will eventually be used to improve their DT in an agile way. Therefore, the evaluation is mainly used to demonstrate the assessment instrument prototype and check if the assessment instrument prototype allows for a proper maturity assessment on the subject of ADT. Thus, the functional requirements described in the Introduction are tested in this type 3 evaluation. During the cases, the researcher will observe the usage of the assessment instrument prototype and write down essential findings.

4.2 Internal Expert Evaluations

This section describes the type 2 evaluation, which consists of internal expert evaluations. In addition, it discusses the open questions that will be asked to experts and the evaluation criteria used to test the non-functional requirements. Finally, it explains the qualitative data analysis approach, which is used to analyze the transcriptions of the expert evaluation interviews and the brainstorm session.

4.2.1 Brainstorm Session

The brainstorm session, which is described in Section 3.1.8, consists of an evaluation part next to the brainstorming part. All open questions are asked in the evaluation part, except for question 8, since this question cannot be answered yet. This is due to the maturity levels just being developed after the brainstorm part. Next to the open questions, the participants will score the evaluation criteria on a 5 point Likert scale. The Evaluation criteria are described in Section 4.2.4.

4.2.2 Expert Evaluation Interviews

The expert evaluation interviews are part of evaluation type 2, used to evaluate the ADT maturity model. The expert evaluation interviews follow the same guidelines as the expert interviews described in Section 3.1.4. (Newcomer et al., 2015). The goals of the expert interviews are twofold: **evaluate the contents** of the first version of the ADT maturity model (i), **test the non-functional requirements** based on evaluation criteria (ii). The feedback gathered during the expert interviews is used to create an improved second version of the ADT maturity model. The participants are again drawn from a participant list provided by the supervisor of the sponsor of this thesis project, who has extensive knowledge about the knowledge of the proposed participants. The criteria to be included in the expert evaluation interviews are equal to the criteria for the expert interviews described in Section 3.1.4. In addition, the participants are all DT consultants, the end-users of the artifact. The participants of the expert interviews are displayed in Table 33. The rows in **bold** indicate the expert interview participants for the evaluation who contributed to the expert interviews described in Section 3.1.4. It is chosen to evaluate the ADT maturity model with a mix of experts who did and did not attend the first round of expert interviews. On the one hand, experts who attended the first round are chosen to validate if proposed information on the contents of the ADT maturity model is implemented in the model. On the other hand, experts who did not attend the first round are chosen since they can provide feedback on the model with 'fresh eyes'.

Interviewee ID	Role	Date conducted
E1	Architect/Senior consultant	14-06-2021
E2	Program manager	14-06-2021
E3	Solution architect/Senior consultant	14-06-2021
E4	**Teamlead/Manager Digital Factory**	22-06-2021
E5	Consultant/Teamlead	23-06-2021
E6	**Business & IT consultant/Teamlead**	23-06-2021
E7	**Business & IT consultant/Teamlead**	29-06-2021

Table 33: Expert evaluation interview participants

Next to rating the evaluation criteria to reach the second goal of the expert evaluation interviews, open questions are asked to obtain feedback on the current version of the ADT maturity model. The interview questions are semi-structured since this provides the opportunity to dive deeper into the reasoning process of the interview participant (Newcomer et al., 2015). The feedback will be used to improve the model and create a second version to reach the first goal of the expert evaluation interviews. Therefore, the following open questions have been established for the expert interviews:

- **Q1:** In your perception, is there any aspect name and description that needs more clarity? Please

explain your answer.

- **Q2:** Would you add, remove or update any aspects? Please explain your answer.
- **Q3:** Do the sub-aspects names and descriptions sound clear? Please explain your answer.
- **Q4:** Would you add, remove or update any sub-aspects? Please explain your answer.
- **Q5:** Are the indicator names and descriptions clear to you? Please explain your answer.
- **Q6:** Would you add, remove or update any indicators? Please explain your answer.
- **Q7:** Do the assessment questions make sense to you. Please explain your answer.
- **Q8:** Are the maturity levels adequate and clearly explained? Please explain your answer.
- **Q9:** In your perception, is the maturity model practical? Please explain your answer.
- **Q10:** Is the maturity model 'introduction' tab clear to you? Please explain your answer.

To provide structure to the interviews, an interview protocol has been established (Newcomer et al., 2015). This interview protocol acts as an interview guide during the interviews. The interview protocol can be found in Appendix E1.

4.2.3 Evaluation Criteria

The evaluation criteria are answered during the internal expert evaluations. These criteria consist of relevant statements from the UTAUT template (Venkatesh et al., 2003). The criteria used to evaluate the maturity model are: performance expectancy, effort expectancy, attitude towards using technology, facilitating conditions and self-efficacy. It has been chosen to omit several evaluation criteria proposed in the paper by Venkatesh et al. (2003) as they seemed less relevant to evaluate a maturity model. For example, the criteria *anxiety* has been removed from the evaluation criteria list, as two of the corresponding statements on 'scared of making mistakes' are not applicable to the ADT maturiy model. When using the ADT maturity model, it is impossible to lose much information by hitting a wrong key and mistakes can always be corrected. The evaluation criteria and corresponding statements with the results from the seven interviews are depicted in Table 34. It has been decided to display the average value, the maximum value and the minimum value. As a result, the general results and the distribution of the results can be discussed.

Observing Table 34, the lowest average value is 2.9, and the highest average value is 4.8. The lowest value belongs to the *'using the maturity model increases my productivity'* which is a statement that measures the 'performance expectancy' of the ADT maturity model. The size of the maturity model can assumably explain this low value. The ADT maturity model consists of 133 indicators and 1̃00 assessment questions which have to be scored. As a result, using the ADT maturity model is time-intensive and might decrease productivity, as there are many questions to score before you get a result. In addition, **the experts mentioned that the model was extensive and a lot to take in during the expert evaluation interviews.** This might be a reason for the low average score for this statement. The highest average value belongs to the *'using the maturity model is a bad/good idea'*, which is a statement that measures the 'attitude toward using the ADT maturity model'. This high value might be explained by the background of the organization to which the experts belong. **The experts are all engaged with DT and are working in an agile way.** As a result, an ADT maturity model closely relates to the background of the organizations and employees. **During the expert interviews, several experts indicated the relevance and value of the model.** This might be a reason for the high average score for this statement.

Evaluation criteria	Avg.	Min.	Max.
Performance expectancy	**3.4**		
I would find the maturity model useful in my job.	4.4	4	5
Using the maturity model enables me to accomplish tasks more quickly.	3	2	4
Using the maturity model increases my productivity.	2.9	2	4
Effort expectancy	**4**		
My interaction with the maturity model will be clear and understandable.	4.1	3	5
It would be easy for me to become skillful at using the maturity model.	4.1	4	5
I would find the maturity model easy to use.	3.6	3	5
Learning to operate the maturity model is easy for me.	4.2	4	5
Attitude toward using technology	**4.3**		
Using the maturity model is a bad/good idea.	4.8	4	5
The maturity model makes work more interesting.	3,9	3	5
I like working with the maturity model.	4.2	4	5
Facilitating conditions	**3.6**		
I have the resources necessary to use the maturity model.	3.4	1	5
I have the knowledge necessary to use the maturity model.	3.6	2	4
The maturity model is compatible with other systems I use.	4.2	4	5
A specific person (or group) is available for assistance with maturity model difficulties.	3.4	2	5
Self-efficacy	**3.9**		
I could complete a job or task using the maturity model...			
If there was no one around to tell me how to do it.	3.6	2	5
If I could call someone for help if I got stuck.	4.4	4	5
If I had a lot of time to complete the job for which the software was provided.	3.6	2	5
If I just had the built-in help facility for assistance.	3.8	2	5

Table 34: Evaluation criteria

Furthermore, the lowest minimal value scored is one, and the highest maximum value is five. The lowest value belongs to the *'I have the resources necessary to use the maturity model.'* This might be scored low, as the usage of the model depends not only on the person using the system but also on the **other organizations agreeing on using the ADT maturity model to measure the maturity levels.** The expert scoring one elaborated on this by stating this argument. However, the expert indicated that **if the ADT maturity model was used for the organization itself, it has the resources to use the ADT maturity model.** The highest maximum value is five and scored as a maximum value to a statement 15 times. This indicates that experts are relatively optimistic about the ADT maturity model. In addition, it results in the average values often being higher than three.

Finally, the distribution of the results will be discussed. It has been decided only to discuss results where the minimum and maximum values have at least a difference of three. This choice has been made since a large gap indicates a significant difference in opinions between experts. Reflecting on Table 34, the only evaluation criteria which have at least a difference of three are the 'facilitating conditions' and 'self-efficacy' evaluation criterion. In total, five statements have at least a difference of three, namely: *'I have the resources necessary to use the maturity model', 'A specific person (or group) is available for assistance with maturity model difficulties', 'If there was no one around to tell me how to do it', 'If I*

had a lot of time to complete the job for which the software was provided' and 'If I just had the built-in help facility for assistance'. The first statement has already been discussed in the paragraph above. *'A specific person (or group) is available for assistance with maturity model difficulties'* has a minimum score of two, a maximum score of five and an average of 3.4. **The interpretation of the statement can explain the range of scores. For example, an expert scored the statement with a score of two but remarked that person 'X' was the only one with knowledge about the maturity model.** This means a person with this knowledge exists, but since this is only one person, the statement was scored with two. **However, you could score this statement with five since there actually exists a specific person who is available for assistance.** In addition, the author assumes that the three statements of the evaluation criteria 'self-efficacy' with a difference of at least three **can be explained by the difference in experience with maturity models and the difference of exposure to ADT.** An expert with much experience with both subjects probably has an easier time navigating through the model. However, the participant with less exposure to DT might have a more challenging time navigating through the model. As a result, the answers to these three questions might vary.

4.2.4 Qualitative Data Analysis

After the expert evaluation interviews were conducted, relevant parts were coded by performing qualitative data analysis as described in Section 3.1.6 Newcomer et al. (2015). The codes are based on the evaluation criteria and the ADT aspects of the ADT maturity model. Additional vital parts of the transcripts are coded by adding additional coding categories. The coded transcriptions of the expert evaluation interviews can be found in Appendix E2.

4.3 ADT Maturity Model Second Version

This section describes the second version of the ADT maturity model. Firstly, each aspect will be discussed one by one with the corresponding changes to the sub-aspects and indicators. Afterwards, the changes to the mock-up assessment instrument in Excel will be discussed. Furthermore, changes to indicator weights will be discussed. Next, additional changes to the ADT maturity model will be described. Finally, the results of the second version of the ADT maturity model will be displayed. All the feedback on the model and the changes based on the feedback are described in Appendix H. The green colour indicates changes that have been implemented based on feedback, the yellow colour indicates rejected changes based on feedback, and the orange colour indicates feedback for the prototype and future work.

4.3.1 Sub-aspects & Indicators Changes

This section discusses the changes made to the first version of the ADT maturity model based on the expert evaluation interviews. Changes to the model are made in two iterations: the first number of changes have been implemented after the brainstorm session, and the other changes after all four remaining expert evaluation interviews were conducted. This choice is made, as it presents the opportunity to evaluate the model in an agile way through two iterations. In addition, it helped with determining the weights during the brainstorm session since indicators could be removed immediately, and proper weights could be determined. The result of all changes is presented below. Words that have been added are displayed in bold and removed words are displayed by a line through the original words.

4.3.1.1 Culture

The culture aspect has been slightly changed. A new indicator has been added to the ”willingness to make decisions” sub-aspect, namely ”multicultural disciplinary team”. This indicator was proposed during the brainstorm session since a multicultural disciplinary team results in an increased range of unique knowledge due to team members of different cultures with different knowledge. E1, E2 and E3 proposed the indicator weight of one for this indicator. In addition, changes have been made to the descriptions of both indicators and sub-aspects to increase clarity. Furthermore, changes have been made to the assessment questions to support the ability to ask only one general assessment question about, for example, the ”open environment” indicator. These changes have been made, as the sub-aspect ”willingness to make decisions” and ”knowledge sharing” share the same indicators. Finally, slight changes have been made to the assessment questions to increase understandability. The changes to the sub-aspects and indicators are displayed in Table 35. The changes to the descriptions and assessment questions are displayed in Appendix G.

Sub-aspect	**Indicator**	**Ref.**
Willingness To Make Decision	Everyone is allowed to make decisions	P4, P5, P6
	No blame culture	P4
	Open environment	P2, P5
	Multicultural disciplinary team	E1, E2, E3
	Transparent environment	P5, P6
Willingness To Change	Accept and expect change throughout the whole organization	P1, P2.
	Teams encouraged to embrace technological excellence	P1, R2
	Teams encouraged to embrace innovation	P1, R2
Knowledge Sharing	Business - ICT trust	R4, R6
	Constant communication	R2
	Identify, share, apply learnings to projects	P2, P3, P5, R2
	Open environment	P2, P5, P7
	No blame culture	P4
	Transparent environment	P5, P6

Table 35: ADT culture aspect overview V2

4.3.1.2 Strategy

The strategy aspect has been slightly changed. A new indicator has been added to the ”digital strategy” sub-aspect, namely the ”two-way operations” indicator. This indicator has been moved from the aspect ”internal organization” to the ”strategy” aspect since E1, E2 and E3 all suggested that, after explaining the definition of this indicator, this indicator had a better fit in the ”strategy” aspect. This results from ”two-way operations” being a strategic decision to build the new digital way of working next to the traditional one. In addition, the description and assessment question of this indicator has been adjusted to increase understandability. Furthermore, the indicator ”Oversee all goals and don’t become a one-trick pony” has been changed to ”Oversee all goals instead of focusing on one goal”, since the word one-trick pony can be conceived negatively and someone scoring this indicator might never admit being a one-trick pony, but might be focusing on only one goal. Furthermore, one assessment question has been changed to increase understandability. The changes to the sub-aspects and indicators are displayed in Table 36. The changes to the descriptions and assessment questions are depicted in Appendix G.

Sub-aspect	**Indicator**	**Ref.**
Digital Management	Commitment from top, middle and lower management	P1, P3
	Management focus on change management	P3, P4
	Top management establishes digital importance	P4, R1
Digital Transformative Vision	Clear digital transformation start point	P1, P2, P6, R1
	Clear digital transformation end point	P1, P2, P6, P7, R1
	Digital transformation roadmap to determine the path from start to end	P1, P2, P6, R1
	Execute your digital roadmap based on your culture and internal organization	P6
Digital Strategy	Strategy based on digital transformation goals	P1, P2, P5, P6, R2
	Chosen technology based on digital transformation goals	P1, P2, P3, P6
	Outside-in strategy	P2
	Two way operations	E1, E2, E3
	Prioritization of your digital transformation goals	P2, P5, P7
	Oversee all goals **instead of focusing on one goal**	P2, P4, R1
	Start with small success and eventually scale	P3, P4, R2
	Continuously evolve digital strategy	R1
	Data-driven decision-making	R4
Digital Resources	Budgetting for digital transformation	P1, P4, P7
	Time management	P1, P6
Monitoring	Monitor execution progress of your strategy	P6, R1
	Monitor the execution of your roadmap	P6
	Establish KPIs and metrics to monitor execution	P6, R1

Table 36: ADT strategy aspect overview V2

4.3.1.3 Expertise

The expertise aspect has only one change. The indicator ”digital process knowledge” has been changed to ”digital processes knowledge” since interviewee E5 mentioned that this wording could be misinterpreted and proposed a change that resolves this problem. In addition, the description of this indicator has been changed accordingly. The change to the indicator is displayed in Table 37. Besides, the change to the description is depicted in Appendix G.

Sub-aspect	**Indicator**	**Ref.**
Expertise Management	Digital transformation expertise flows throughout the entire organization	P1, P6
	Inhousing or outsourcing knowledge	P2, P3, P5, P6
	Digital transformation execution knowledge	P1, P2, P6
	Learning budget	P3, P4
Digital Expertise	IT knowledge	P1, P2, P3, P4, P5, P7
	Business knowledge	P3, P5
	Digital transformation execution knowledge	P1, P2, P6
	Personal knowledge	P2, P4
	Team roles knowledge	P3
	Digital process**es** knowledge	P4
Continuous Learning	Having a digital academy	P2, P3, P4, P6, R6
	Having a learning mindset	P2, P3, P4, R6
	Employees keep learning	P2, P4, R2, R6
	Providing trainings	P4, R6

Table 37: ADT expertise aspect overview V2

4.3.1.4 Technology

The technology aspect has the most changes. The first significant change is the removal of the sub-aspect ”IT systems”. E1, E2 and E3 all agreed that it was nearly impossible to score these indicators on a 5 point Likert scale. As a result, they proposed to remove this sub-aspect, as it would only result in a lack of clarity. Therefore, the indicators ”choose the right systems” and ”flexible IT systems” were moved from the sub-aspect ”IT systems” to ”IT architecture” since E1, E2, and E3 agreed this was the right fit for these indicators. In addition, the indicator ”choose the right systems” has been changed to ”choose the right technology” to make it more general. An example of ”choosing the right systems” has been added to the description. The second significant change is the removal of the sub-aspect ”process automation”. This choice has been made, as E1 indicated that having a sub-aspect with one indicator would not benefit the model’s performance due to process automation being a broad topic and only having one indicator to measure it in the first version. As a result, process automation has been moved to ”IT architecture” as well. The third major change is changing the sub-aspect ”data integration” to ”data exploitation”, as the word integration failed to define the indicators mentioned in this sub-aspect. According to E3, exploitation suited the indicators better. The last major change has been made by removing the indicator ”do analysis with big data (reporting)”, as this indicator has much overlap with the sub-aspect ”data monitoring”, according to E4. As a result, the author of this thesis decided to remove this indicator. In addition, a new indicator has been added to the sub-aspect ”IT architecture”, namely ”design principles”. This indicator has been added, as E1 suggested, to add an umbrella indicator of all the mentioned design principles present in the ”IT architecture” sub-aspect. According to E1, E2 and E3, all indicators with the weight four can be observed as a design principle. The indicator ”design principles” describes the extent to which an organization follows design principles in general. Furthermore, the indicator ”manage risks using smart tools” has been changed to ”manage risks” because E3 indicated that adding ”using smart tools” is not necessarily needed to manage risks, and it would make the indicator too complex. Finally, minor changes have been made to the descriptions and assessment questions to increase understandability. The changes to the sub-aspects and indicators are displayed in Table 38. The changes to the descriptions and assessment questions are depicted in Appendix G.

Sub-aspect	Indicator	Ref.
~~IT Systems~~	~~Choose the right systems~~	~~P1, R6~~
	~~Financial system~~	~~P1~~
	~~Employee information system~~	~~P1~~
	~~Warehouse management system~~	~~P1~~
	~~Transport management system~~	~~P1~~
	~~Document management system~~	~~P1~~
	~~Flexible IT systems~~	~~P2, P3, P6, P7~~
IT Architecture	Usage of the cloud	P2, P6, R5
	Process automation	P4, P5, P6, P7, R4, R5, E1
	Choose the right technology	P1, P6, E1, E2, E3
	Flexible IT systems	P2, P3, P6, P7, E1, E2, E3
	Integration systems layer	P2, P3, P4, P5
	Datalake/datawarehouse	P2, P4, R5
	Open APIs	P2, R5
	Loose coupling between layers	P2
	Microservices	P3, P6, R5
	Design principles	E1
	Enterprise architecture tool	R3, R5
Data **Exploitation**	Connecting systems to systems	P1, P2, P3, P4, P6, R3
	Get data from systems	P1, P2, P3, P5, P6, R3
	~~Do analysis with big data (reporting)~~	~~P1, P3, P4, P5, R1, R2, R3, R5, R6~~
	Simulations with AI	P1, P3, P5, P7, R2, R3
	Make decisions based on data	P3, P4, R2, R3, R5
Data Monitoring	Data monitoring based on KPIs	P5, P6, R5, R6
	Functionality based data monitoring	P5, R5, R6
	Technological based data monitoring	P5, R5
IT Security	Ratio in cloud/on premise	P2, P6, R5
	Technological standards	P2, R3, R5
	Manage risks ~~using smart tools~~	P8, P9, R5
	Secure interfaces	R1, R3, R5
	Intrusion detection	R1, R5, R6
	Security testing	R6
~~Process Automation~~	~~BMS to automate and manage processes~~	~~P4, P5, P6, P7, R4, R5~~

Table 38: ADT technology aspect overview V2

4.1.3.5 Internal Organization

The internal organization aspect has been slightly changed. A new indicator has been added to the ”way of working” sub-aspect, namely ”agile framework”. E7 proposed to add this indicator, as adopting an agile framework, to some extent, benefits the way of working during your DT. A weight of four has been suggested for this indicator. As discussed earlier, the indicator ”two-way operations” has been removed from the ”internal organization” aspect and has been added to the ”strategy” aspect. Furthermore, the indicator ”collaboration between teams” has been changed to ”collaboration between teams and departments” to be consistent with the assessment question. Finally, slight changes have been made to the descriptions and assessment questions to increase understandability. The changes to the sub-aspects and indicators are displayed in Table 39. The changes to the descriptions and assessment questions are depicted in Appendix G.

Sub-aspect	**Indicator**	**Ref.**
Leadership	Leadership vision	P1, P3, P6, R1, R4
	Democratic leadership	P3, P4, P7
	Comfortable work environment	R4
Department and Teams	IT in departments	P1
	Connect business & IT	P1, P3, P5, R4
	Communication with top management	P2
	Self-organized	P3, P4, P5, P7, R2, R5, R6
	Collaboration between teams **and departments**	P5, R2, R3, R4, R6
Organizational Roles	Defined roles	P1, P2, P3, P5, P6, P7
	Defined responsibilities	P1, P5, P6, P7
Way of Working	MVPs	P2, R4
	Planning rhythm	P2
	Flexible prioritization	P2
	Agile framework	E7
	~~Two way operations~~	~~P2, P7, R5~~
	Context aligned	P6

Table 39: ADT internal organization aspect overview V2

4.1.3.6 External Organization

The external organization aspect has two slight changes. The indicator ”power distribution in chain” has been changed to ”influence in competitive chain”, as E3 indicated that the indicator was too neutral and hard to score. The description of this indicator has slightly changed as well, by adding ”dependent on others” due to E7 indicating that this will increase the understandability of this indicator. In addition, the indicator ”personalized content” has been changed to ”adaptable content” since E6 indicated that personalized content was not the right fit in every context. The changes to the sub-aspects and indicators are displayed in Table 40. The changes to the descriptions and assessment questions are depicted in Appendix G.

Sub-aspect	**Indicator**	**Ref.**
Digital Partner Network	Partners kickstarting the DT	P1
	Digitally transformed partners	P1, P2, P3
	Event driven chain architecture	P2, P3
	Continuous stakeholder management	R2, R4
	Collaborative feedback	R2
Competition	Competition growth	P1
	Influence in **competitive** chain	P2, E1, E3
Digital Customer Engagement	Pull clients in your context	P2, P4
	Customer centricity	P6, R1, R5, R6
	Adaptable content	P6, R1
	Digital customer journey	P6, R1, R5
	Expose growth opportunities	R1, R5
	End-user communication	R4, R6

Table 40: ADT external organization aspect overview V2

4.3.1.7 Agility

The agility aspect has several changes. First, the indicator ”complex, uncertain problem” has been changed to ”Apply agile to complex, uncertain problem” to improve understandability. In addition, the word ”development” has been added to the indicator ”team size of 5-9”, as E6 indicated that specifying which kind of teams need to have a group size of 5-9 is essential. Therefore, it was suggested to mention development teams. Furthermore, ”of 5-9” has been added to the indicator ”employee dedicated to one team” to improve consistency. Next, the indicator ”build under architecture” has been changed to ”design principles”, as E4 indicated that this indicator shared the exact definition compared to the indicator ”design principles” of the ”technology” aspect. Another change consists of changing the indicator ”monitor using KPIs and learn” to ”learn from monitoring” to remove the overlap between this indicator and the ”monitor using KPIs” indicator in the ”technical excellence” sub-aspect. Finally, slight changes have been made to the descriptions and assessment questions to increase understandability. The changes to the sub-aspects and indicators are displayed in Table 41. The changes to the descriptions and assessment questions are depicted in Appendix G.

Sub-aspect	Indicator	Ref.
Embrace change to deliver customer value	Change based on outside developments	P1, P2, R3
	Apply agile to complex, uncertain problem	P6, R5, E1, E3
	Accept and expect change throughout the whole organization	R2
	Management agility	R6
Plan and deliver software quality iteratively	Quater planning (PI)	P1, P2, P3, P5, P7, R4, R6
	Adaptive planning	P1, P2, P6, R2, R4, R6
	Priority planning	P2, P5, P7, R2, R6
	Defined strategic themes	P1, P2, P7, R6
	MVPs	P2, P3, P4, P5, P6, R2, R6
	Feedback loops with stakeholders	P2, P3, P5, P6, R2, R6
Human-centric	Define agile roles	P1, P2, P5, P6, P7, R4, R6
	Defined responsibilities	P2, P5, P7
	Collaboration between departments, teams and management	P1, P5, P6, R2, R3, R4, R6
	BizDevOps	P2, R2, R4, R6
	DevOps	P3, R5, R6
	Self-organized teams	R4, R5, R6
	Development team size of 5-9	P7, E6
	Employee dedicated to one team **of 5-9**	P7, E1, E3
	Distributed agile network	R4
Technical excellence	Security	P2, R5, R6
	Design principles	P2, R5, E4
	Quality of 'code'	P2, R2, R6
	Validation of code	P6, R6
	Monitor using KPIs	R3, R4, R6
	CI/CD	R5, R6
Learning	Retrospective	P3, P4, R2
	Continuous learning	R2
	Monitor agile program	R1
	Learn from monitoring	R3, R4, R6
Customer Collaboration	Digital customer engagement	R1, R2, R5
	Communication with end-users	R4, R6
	Customer journey	R5, R6

Table 41: ADT agility aspect overview V2

4.3.2 Mock-up Assessment Instrument Changes

This section reports the changes made in the mock-up assessment instrument. Specifically, it will report changes to the introduction tab and the dashboard tab. Several changes have been made to the introduction tab: E4 proposed changing the ADT maturity model figure in a way it does not show all the different colours, as it results in unclarity. To fix this issue, the author decided to remove the agility sub-aspects from the figure and only show the colours and relations in Excel to indicate that the sub-aspect of a DT aspect relates to the agile aspect. The detailed overview of all the aspects in Appendix G still describes the relationships between DT and agile in detail. In addition, the styling of the ADT maturity model figure has been changed to increase the representativeness, clarity and professionality of the model. E4, E5, E6 and E7 all indicated that it should be made clear how the maturity levels were established. As a result, the introduction text has added a textual explanation

about how to get to a certain maturity level and the origin of the maturity levels. Furthermore, it has been decided not to add concrete definitions to the maturity levels, as E1 and E3 indicated that this is difficult to establish when looking at the current indicators. E6 suggested adding a description of the indicator weights to the introduction text, and this has been added by explaining what the numbers mean. In addition, E5 and E6 mentioned that an explanation has to be added about the definitions of the one to five scales of the 5 point Likert scale. As a result, this has been added to the introduction text to increase transparency. Next, E5 and E7 suggested explaining why the ”Agility” aspect is placed differently in the ADT maturity model figure. Thus, an explanation about this has been added to the introduction text. Finally, the radar chart of the results from the dashboard tab has been added to the introduction tab as well. According to E4, this helps to envision the endpoint of the assessment and helps to explain the eventual results of the assessment.

Furthermore, several changes to the dashboard tab have been made: E7 proposed to add the colours displayed in the maturity levels to the scores in the dashboard tab. As a result, colours have been added to the tables providing an overview of the maturity scores. In addition, E4 and E5 mentioned that the table in the middle contained too much information and was unclear. Therefore, the researcher decided to delete this table from the dashboard tab. However, E4, E5, E6 and E7 all indicated that it is favourable to see details by clicking on aspects and sub-aspects. Thus, it has been made possible to select an aspect to see the maturity scores for each sub-aspect and to select a sub-aspect and to see the maturity levels for each indicator. Furthermore, E6 suggested showing the ADT maturity model figure in the dashboard tab as well. According to E6, this helps visualize the results and relate them to the ADT maturity model figure displayed in the introduction. Finally, E7 proposed adding a column that depicts the gap between the desired and actual maturity levels. This helps to indicate the discrepancies between both levels and significant gaps that must be focused on first.

All the above-described changes are displayed in Section 4.3.5 in figs. 30 to 33.

4.3.3 Indicator Weight Changes

This section describes the changes made to the weight of already existing indicators and newly added indicators. During the brainstorm session, E1, E2 and E3 decided to add a new indicator to the ”willingness to make decisions” sub-aspect. They approved the indicator weights of one for this indicator. In addition, E1 proposed to add ”process automation” as an indicator to the sub-aspect ”IT architecture”. According to E1, this indicator could be seen as a design principle and thus weighs four, the same weight as the new indicator ”design principles”. E2 proposed to move ”choose the right technology” and ”flexible IT systems” to the sub-aspect IT architecture. E1, E2 and E3 all agreed to weigh the indicators three and four, respectively. Furthermore, E4 suggested removing the indicator ”do analysis with big data (reporting)”. As a result, the indicator weights of the indicators ”connecting systems with systems”, ”get data from systems”, and ”make decisions based on data” changed accordingly. Next, E7 proposed to add a new indicator, ”agile framework”, to the sub-aspect ”way of working”. Indicator weight four has been chosen, as the indicators with lower weight in this sub-aspect, are all a part of an agile framework. Finally, the weight of the indicator ”security” has been changed from four to one, as E6 mentioned that security was the least important compared to the other indicators of this sub-aspect for agile.

Indicator	Weight	Ref.
Multicultural disciplinary team	1	E1, E2, E3
Process automation	4	E1
Choose the right technology	3	E2
Flexible IT systems	4	E2
Design principles	4	E1
Connecting systems to systems	2	E4
Get data from systems	4	E4
Make decisions based on data	3	E4
Agile framework	4	E7
Security	1	E6

Table 42: ADT maturity model indicator changes V2

4.3.4 Other Feedback

This section describes feedback for the establishment of the prototype assessment instrument, future work opportunities or feedback about suggested changes that are not considered. The first feedback which will be discussed are remarks about the prototype of the assessment instrument: according to E3 and E4, the prototype should be an Minimal Viable Product (MVP) version based on the minimal requirements of the system, proposed in the Introduction section of this research. More advanced requirements retrieved during the evaluation interviews could be implemented if there is any spare time for the prototype. In addition, E5 and E7 suggested arranging the assessment questions per aspect and first briefly describing the aspect and its sub-aspects. E5 mentioned that it could be helpful to show the progress of the questionnaire in percentages to inform the person answering the questions what their progress is. Furthermore, E2 and E3 proposed to add a validation check to the assessment questions to check if a given score is possible based on earlier scored assessment questions on the same sub-aspect. E6 indicated that it would be helpful to add a text box next to the assessment questions to enable people who fill in the assessment to give remarks about their answers. As a result, a consultant can understand the thought process behind the answer. In addition, E7 suggested adding the ability to the prototype to let several people from the same organization fill in the assessment.

Three feedback comments categorized as future work opportunities are mentioned during the evaluation interviews: E4 suggested looking into flexible indicator weights that will be different depending on the context of the organization performing the maturity assessment. This was suggested since the weight of indicators might vary depending on the industry. Furthermore, E5 and E7 proposed changing the scoring of indicators from a qualitative way, by scoring 1 to 5 based on experience, to a quantitative way, by determining scores based on available information inside the organization. This would improve the precision of the maturity assessment. Finally, E6 mentioned that it is helpful to show an improvement roadmap based on the results of an assessment. This improvement roadmap serves as a guide on how to reach higher maturity levels. This has been labelled as future work since it is outside the scope of this research.

Finally, other feedback comments about changes that the researcher neglected will be discussed: E6 mentioned that adding a maturity level description to the maturity levels will be beneficial. This provides a better understanding of the maturity level appointed and the exact meaning of a maturity level. However, as E1 and E3 stated, it is hard to determine the exact description of the maturity level since there are gaps in the indicators. As a result, the structure of the ADT maturity model makes it very difficult to provide an exact maturity level description. Thus, this proposed change has been discarded. In addition, E4 noticed an overlap between the indicator ”self-organized teams” in the ”internal organization” aspect and the ”willingness to make decisions” sub-aspect of the ”culture” aspect. This change has been discarded, as the meaning of both indicators differs from each other. Self-organized

teams indeed lead to an increase in making decisions yourself, but not to the willingness of it necessarily. There is a difference between how the internal organization is built and the organization's culture on this subject. Furthermore, E4 noticed an overlap between the indicator "defined responsibilities" in the "internal organization" aspect and the sub-aspect "willingness to make decisions". This change has been rejected for the same reason as described above. E7 proposed to add a new indicator, "agile framework", to the "agility" aspect. However, the "agility" aspect already consists of indicators indicating parts of the agile way of working. As a result, adding an indicator to this aspect would be superfluous, asking the assessment question to what extent an organization is adopting an agile framework. Thus, this change has been rejected by the researcher. E7 suggested using the ADT maturity model figure in the dashboard tab by showing the maturity levels of each aspect and sub-aspect by filling each block with the corresponding colour. This change has been rejected, as the other experts agreed on different ways of showing the results in the dashboard tab. As a result, the researcher has chosen to reject this change. Finally, E6 proposed to remove the colours, describing the relations between DT and agile, from the Excel tabs. This change has been discarded, as it remains the only source displaying the relation between DT and agile in detail.

4.3.5 Results of ADT Maturity Model Evaluation

This section describes the result of the evaluation phase of the ADT maturity model. It displays the ADT maturity model figure and screenshots of the detailed ADT maturity model Excel sheet.

The ADT maturity model figure depicts a high-level overview of the ADT maturity model displaying the aspects and sub-aspects of ADT. One significant change to the first version of the figure is removing the 'agility' aspect and the colours displaying relations between the DT and agile sub-aspects and indicators. These colours and relations are still displayed in the detailed Excel sheet, but it has been removed from the ADT maturity model figure for clarity reasons. The ADT maturity model is displayed in Figure 30.

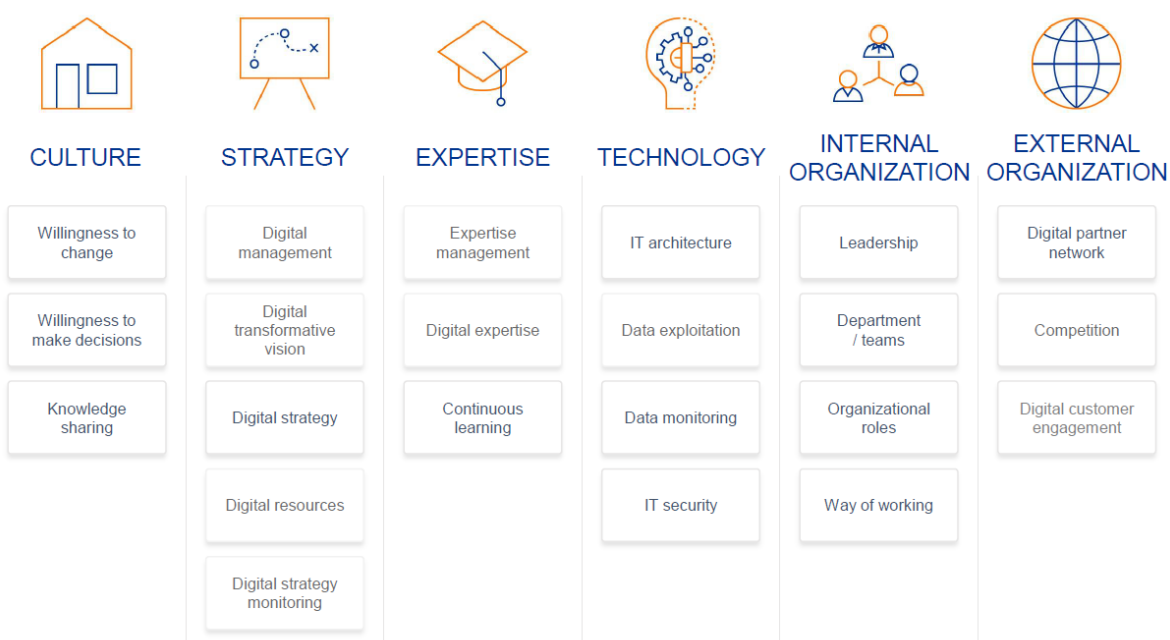


Figure 30: The ADT maturity model V2.

The Excel sheet has a mock-up introduction tab, which is displayed in Figure 31, a tab for every ADT aspect which provides details on the sub-aspects, indicators, assessment questions and maturity

level scores of each aspect and a mock-up of a dashboard tab, which is displayed in Figure 33. In addition, at the bottom of each tab, the score and desired score of the concerning aspect is displayed. The culture mock-up tab is displayed in Figure 32. The second version of the mock-up in Excel will be used as a starting point when developing the ADT assessment instrument in Section 4.4. The changes made based on the first version of the mock-up Excel have been stated in **bold** and can be observed in the figures.

Introduction: This Excel details the 'agile digital transformation maturity model'. This maturity model serves as an instrument to assess how mature an organization is in performing digital transformation in an agile way. It does this by going through 7 aspects of 'agile digital transformation' and scoring each indicator with a score between 1 and 5. **The scale is defined as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree**. Afterwards, the maturity level will be calculated based on the given scores **to the indicators** by the organization**, on a 5 point Likert scale,** multiplied by the indicator weights. **The higher the number, the higher the weight of the indicator. Indicators with the same number have an equal weight. This will result in a number of points which can be linked to the corresponding maturity level.** This will determine the maturity of an organization in the field of performing digital transformation in an agile way. In addition, it can calculate the maturity of the one 'agility' and six digital transformation aspects seperately to come up with those individual scores as well. The maturity levels are displayed next to the figure of the 'agile digital transformation maturity model'. **The point intervals and maturity level names are retrieved from an already existing digital transformation maturity model found in literature.**

The figure to the right of this text displays the 'agile digital transformation maturity model figure' which describes the maturity model on a high level. The 6 main aspects of 'agile digital transformation' are displayed in the dark orange blocks and contain the aspects: culture, strategy, expertise, technology, internal organization and external organization. **The 'agility' aspect is not displayed in the figure, as agile mostly runs through each digital transformation aspect, but on the other hand differs from it significantly. This is displayed by giving some indicators of sub-aspects the same colour. If an indicator of the digital transformation aspects has the same colour of an indicator of the 'Agility' aspect, there exists a relation between them.** Each aspect has several sub-aspects which describe the sub categories of each main aspect. All the sub-aspects are assessed by answering assessment questions based on indicators of a certain sub-aspect. These indicators and assessment questions are not in the figure for clarity reasons, but are incorporated in **tab 2-8** of this Excel file. Finally, indicators and sub-aspects with the same colour describe the relation between them. This is done to show how agile sub-aspects and digital transformation sub-aspects are related with each other. Sub-aspects without an colour (in white) have no relation with any agile sub-aspects, these sub-aspects are purely related to digital transformation.

Next to calculating the current maturity levels of the 'agile digital transformation' aspects, the model asks you to fill in a desired maturity state. This allows for a quick overview of the as-is and to-be state state of an organization's digital transformation in an agile way.

In the end, on the bottom of **tab 2-8**, the maturity level score and the desired maturity state are displayed for the specific 'agile digital transformation' aspect.

Maturity levels:	Point interval:
Agile digitally minimalist (1)	0-30
Agile digitally conservative (2)	31-50
Agile digitally pragmatist (3)	51-70
Agile digitally advanced (4)	71-90
Agile digitally trailblazing (5)	91-100

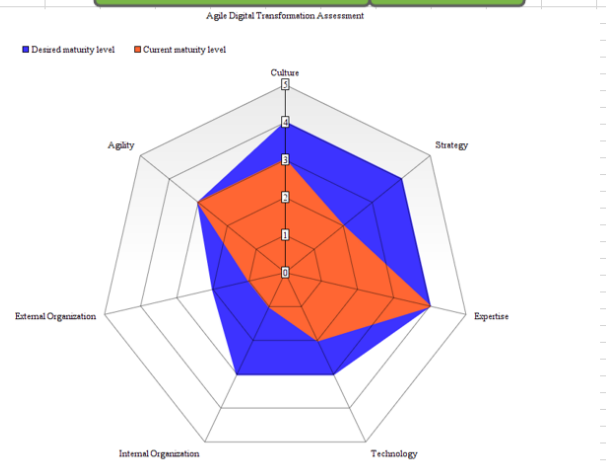


Figure 31: The introduction mock-up tab of the ADT maturity model V2.

Aspect	Sub-aspect	Ref	Description	Indicator	Weight	Ref	Description	Assessment question (ranked 1-5 Likert scale)	Maturity level	Score	Desired maturity level	Score
Culture	Willingness To Make Decisions	2, 4, 5, 6	The culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities **throughout the whole organization**.	Everyone is allowed to make decisions	5	P4, P5, P6	Decision making is possible throughout all levels of the organization.	To what extent does there exist a culture which allows employees **throughout all levels of the organization** to make his/her own decisions?				
				No blame culture	4	P4	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports **the knowledge sharing between employees and the decision-making**?				
				Open environment	3	P2, P5	Environment where it's supported and encouraged to make decisions and pitch them.	To what extent does there exist an open environment **which enables and encourages knowledge sharing between employees and decision-making**?				
				Multicultural disciplinary team	**1**	E1, E2, E3	**A team with different cultures and skills helps to provide a range of unique knowledge which helps to make decisions.**	**To what extent do there exists multicultural disciplinary teams where people from different cultures with different skills come together in one team to support the willingness to make decisions based on a broad range of knowledge?**				
				Transparant environment	2	P5, P6	Environment where it's supported to make decisions, since all knowledge is availalble **and understandable** to everyone.	To what extent does there exist a transparant environment by making knowledge available **and understandable** throughout the organization?				
	Willingness To Change	1, 2, 9	The culture of change which should be in the veins of the employee - think change, do change.	Accept and expect change throughout the whole organization	3	P1, P2	Not only accept change, but expect it and even think about things you can change.	To what extent does there exist a culture where employees are accepting change and think in change?				
				Teams encouraged to embrace technological excellence	2	P1, R2	Be open to new developments in the technology area and make sure your team is up to date.	To what extent does there exist a culture in which employees are open to technologies and embrace them?				
				Teams encouraged to embrace innovation	1	P1, R2	Be open to innovation and change your team based on innovative ideas.	To what extent does there exist a culture in which employees are open to new innovation and embrace new digital advancements?				
	Knowledge Sharing	2, 3, 4, 5, 6, 7, 9, 11, 13	Between the employees there exist an environment of teamwork to increase knowledge sharing to keep learning from each other.	Business - ICT trust	2	R4, R6	The business and IT department should trust each other and wanting to collaborate.	To what extent does there exist a culture where the business & IT trust each other and share knowlegde?				
				Constant communication	1	R2	The employees of an organization have a mindset of constant communication.	To what extent does there exist a culture where knowledge sharing is encouraged by constant communication **mindset of** employees?				
				Identify, share, apply learnings to projects	3	P2, P3, P5, R2	The employees are focused on learning from expercies during projects and identify, share and apply these learning to new projects.	To what extent does there exist a culture where learnings from experience are identified, shared and applied to other projects?				
				Open environment	6	P2, P5, P7	Environment where it's supported and encouraged to share knowledge.	To what extent does there exist an open environment which **enables and encourages** knowledge sharing between employees **and decision-making**?				
				No blame culture	5	P4	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports **the knowledge sharing between employees and the decision-making**?				
				Transparant environment	4	P5, P6	Environment where it's supported to share knowledge, since all knowledge is availalble **and understandable** to everyone.	To what extent does there exist a transparant environment by making knowledge available **and understandable** throughout the organization?				
									Score Willingness to Make Decisions:		Desired Score Willingness to Make Decisions:	
									Score Willingness to Change:		Desired Score Willingness to Change:	
									Score Knowledge Sharing:		Desired Score Knowledge Sharing:	

Figure 32: The culture mock-up tab of the ADT maturity model V2.

Dashboard: This page should present a dashboard based on the results of the assessment. There should at least be a score overview present on the dashboard screen describing the scores and desired scores. In addition, a visualization of the assessment results should be available in the form of a spider chart displaying the results per aspect and in total.

Remark: This is a mock-up version and the final dashboard version will be made in the prototype.

Aspect	Maturity level	Desired maturity level	Gap
Culture	3	4	-1
Strategy	5	5	0
Expertise	4	5	-1
Technology	3	3	0
Internal Organization	4	4	0
External Organization	2	4	-2
Agility	2	3	-1

Aspe	Sub-aspec	Maturity level	Desired maturity level
Culture	Willingness to make decisions	2	3
	willingness to change	4	5
	Knowledge sharing	3	4

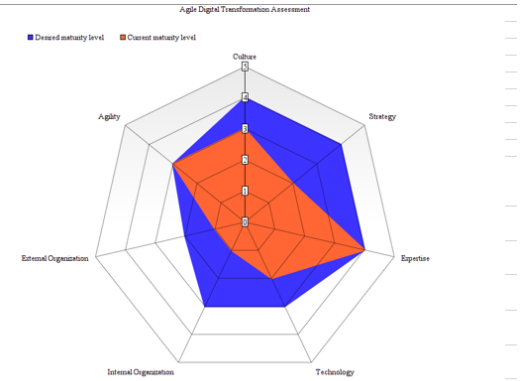


Figure 33: The dashboard mock-up tab of the ADT maturity model V2.

4.4 ADT Assessment Instrument Prototype

This section will describes the development of the ADT assessment instrument prototype based on the second version of the ADT maturity model. This prototype serves as a tool to operationalize the ADT maturity model. First, the activity diagram of the assessment process and the storyboard based on this activity diagram will be discussed. Second, the ADT assessment instrument prototype will be discussed by displaying screenshots. Finally, implementation choices will be discussed, and future work opportunities for the ADT assessment instrument are formulated.

4.4.1 Activity Diagram & Storyboard

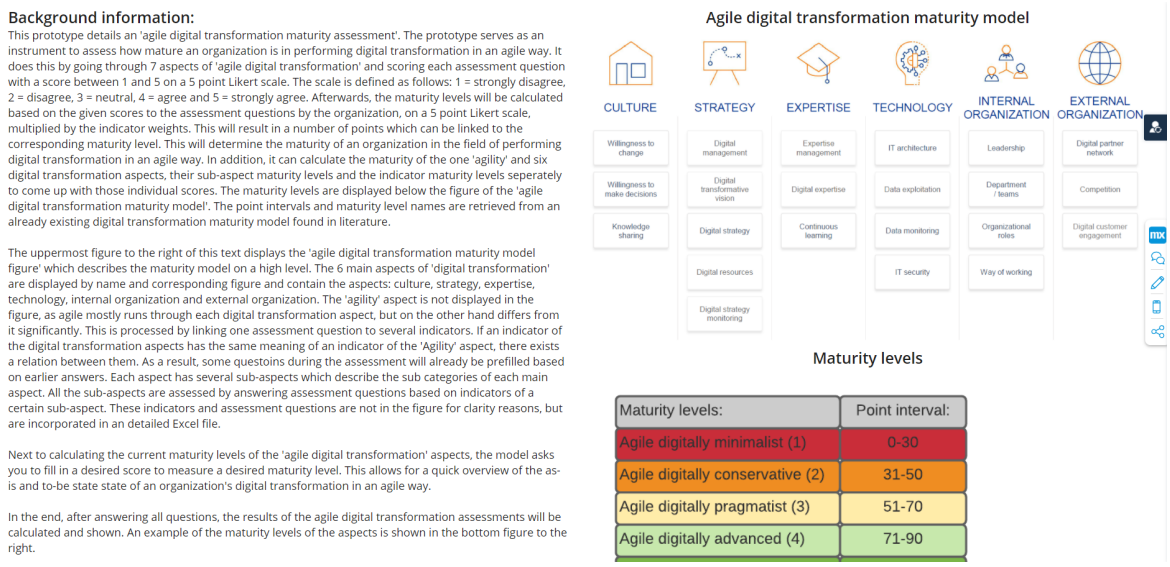
Before the prototype of the assessment instrument has been built, an activity diagram and a storyboard have been established. The activity diagram has been created to visualize the assessment process based on the functional requirements discussed in Section 1.2.2. As a result, the minimum steps to be included in the assessment instrument prototype have been visualized. Partly based on the activity diagram, the storyboard for developing the assessment instrument prototype was created. This storyboard contains all the user stories which have to be completed before the assessment instrument prototype is finished. The storyboard was used to keep track of the development progress and ensure the prototype contained all the needed functionalities. The storyboard consists of the minimal viable product (MVP) and non-MVP stories. This distinction is made to distinguish between the functionalities that need to be implemented to fulfil the MVP and the recommended functionalities for further development of the prototype (non-MVP). The non-MVP user stories are mainly proposed during expert evaluation interviews, case studies, or the researcher himself. The activity diagram can be found in Appendix I1 and the storyboard in Appendix I2.

4.4.2 Prototype contents

This section discusses the ADT maturity assessment prototype. The prototype has been created on the Mendix platform, which enables rapid software development through a low-code graphical user interface. The prototype can be run locally on a laptop or in the cloud. The latter is used during the observational case studies where the prototype has been demonstrated in practice. Furthermore, the assessment instrument prototype has role-based views: user view and administrator view. The user only has access to the questions page and a limited assessment results page. The administrator has access to all pages and functionalities. In the remainder of this section, the pages and functionalities of the assessment prototype will be discussed in detail, together with the design choices made by the researcher.

The starting page of the prototype is the 'background information page'. This page details the background information of the ADT maturity model and the ADT assessment instrument. It contains the textual and graphical information mainly identical to the 'introduction tab' displayed in Figure 31. The main difference between Figure 31 and the 'background information page' is the bar chart figure in the 'background information page' instead of the spider chart. This design choice has been made, as there did not exist a Mendix widget which made it possible to create spider charts easily. As a result, the researcher decided to create a bar chart which was possible using the bar chart widget. This page introduces the ADT maturity model and ADT assessment instrument and is thus the starting page of the assessment instrument prototype. The top of the page is displayed in Figure 34. Underneath the maturity levels image on this page, the bar chart image is displayed. This image can be reached by scrolling down.

By clicking on the 'next' button on the bottom of the Figure 34 page, the second page of the assessment instrument prototype can be reached. This 'instructions page', displayed in Figure 35, serves as a guideline for someone who will perform an assessment. It describes the assessment procedure step by step and provides an example assessment image as an example. The researcher decided to add this page to the assessment instrument prototype to increase the ease of use and self-efficacy. Two different buttons can be found at the bottom of this page. The 'back' button allows the



Background information:

This prototype details an 'agile digital transformation maturity assessment'. The prototype serves as an instrument to assess how mature an organization is in performing digital transformation in an agile way. It does this by going through 7 aspects of 'agile digital transformation' and scoring each assessment question with a score between 1 and 5 on a 5 point Likert scale. The scale is defined as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. Afterwards, the maturity levels will be calculated based on the given scores to the assessment questions by the organization, on a 5 point Likert scale, multiplied by the indicator weights. This will result in a number of points which can be linked to the corresponding maturity level. This will determine the maturity of an organization in the field of performing digital transformation in an agile way. In addition, it can calculate the maturity of the one 'agility' and six digital transformation aspects, their sub-aspect maturity levels and the indicator maturity levels seperately to come up with those individual scores. The maturity levels are displayed below the figure of the 'agile digital transformation maturity model'. The point intervals and maturity level names are retrieved from an already existing digital transformation maturity model found in literature.

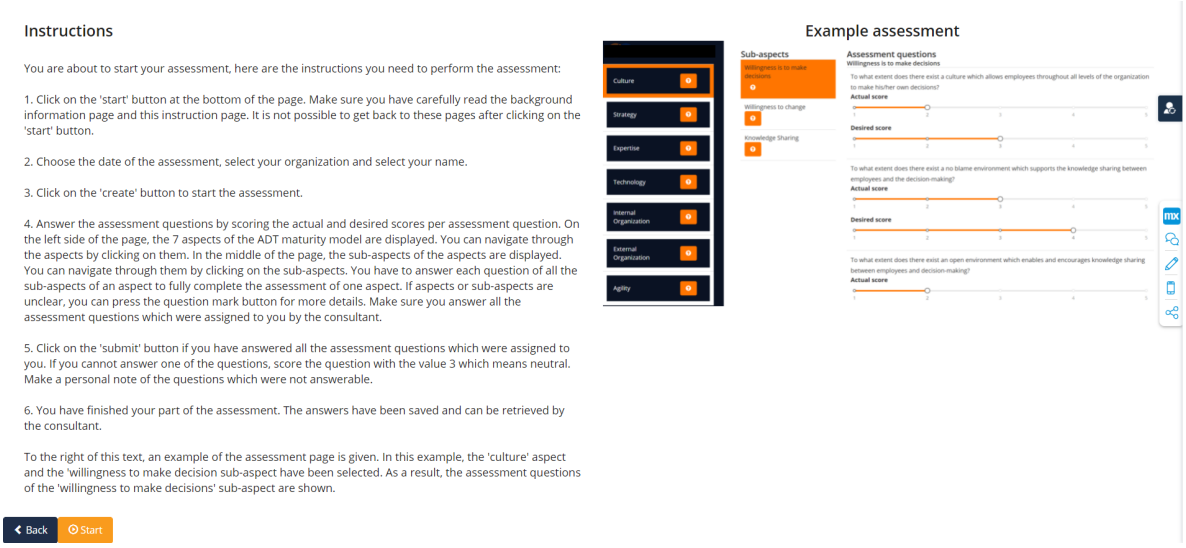
The uppermost figure to the right of this text displays the 'agile digital transformation maturity model figure' which describes the maturity model on a high level. The 6 main aspects of 'digital transformation' are displayed by name and corresponding figure and contain the aspects: culture, strategy, expertise, technology, internal organization and external organization. The 'agility' aspect is not displayed in the figure, as agile mostly runs through each digital transformation aspect, but on the other hand differs from it significantly. This is processed by linking one assessment question to several indicators. If an indicator of the digital transformation aspects has the same meaning of an indicator of the 'Agility' aspect, there exists a relation between them. As a result, some questoins during the assessment will already be prefilled based on earlier answers. Each aspect has several sub-aspects which describe the sub categories of each main aspect. All the sub-aspects are assessed by answering assessment questions based on indicators of a certain sub-aspect. These indicators and assessment questions are not in the figure for clarity reasons, but are incorporated in an detailed Excel file.

Next to calculating the current maturity levels of the 'agile digital transformation' aspects, the model asks you to fill in a desired score to measure a desired maturity level. This allows for a quick overview of the as-is and to-be state state of an organization's digital transformation in an agile way.

In the end, after answering all questions, the results of the agile digital transformation assessments will be calculated and shown. An example of the maturity levels of the aspects is shown in the bottom figure to the right.

Figure 34: The background information page of the ADT maturity assessment prototype.

user to go back to the 'background information page'. In addition, the 'start' button allows the user to go to the next page and start creating an assessment. By reading the 'instructions page', the person who wants to perform an assessment will be better prepared to assess independently.



Instructions

You are about to start your assessment, here are the instructions you need to perform the assessment:

1. Click on the 'start' button at the bottom of the page. Make sure you have carefully read the background information page and this instruction page. It is not possible to get back to these pages after clicking on the 'start' button.

2. Choose the date of the assessment, select your organization and select your name.

3. Click on the 'create' button to start the assessment.

4. Answer the assessment questions by scoring the actual and desired scores per assessment question. On the left side of the page, the 7 aspects of the ADT maturity model are displayed. You can navigate through the aspects by clicking on them. In the middle of the page, the sub-aspects of the aspects are displayed. You can navigate through them by clicking on the sub-aspects. You have to answer each question of all the sub-aspects of an aspect to fully complete the assessment of one aspect. If aspects or sub-aspects are unclear, you can press the question mark button for more details. Make sure you answer all the assessment questions which were assigned to you by the consultant.

5. Click on the 'submit' button if you have answered all the assessment questions which were assigned to you. If you cannot answer one of the questions, score the question with the value 3 which means neutral. Make a personal note of the questions which were not answerable.

6. You have finished your part of the assessment. The answers have been saved and can be retrieved by the consultant.

To the right of this text, an example of the assessment page is given. In this example, the 'culture' aspect and the 'willingness to make decision sub-aspect have been selected. As a result, the assessment questions of the 'willingness to make decisions' sub-aspect are shown.

Back Start

Figure 35: The instructions page of the ADT maturity assessment prototype.

After the user has clicked the 'start' button and created an assessment by choosing its organization and name, the 'assessment questions' page will be shown. The researcher decided on using two wizards on this page: an aspect and a sub-aspect wizard. These wizards allow users to click through the ADT maturity model components and score each corresponding assessment question. As a result, the user stays on the same page for the entire time, and this decreases confusion and increases ease of use by, for example, clicking through different pages instead of using the wizards. The wizard containing all the aspects of the ADT maturity model is displayed on the left of the page. In addition, the wizard of the sub-aspects can be found in the middle of the page. The assessment questions corresponding to the selected sub-aspect can be found on the right of the page. Figure 36 displays an example of the 'assessment questions page'. In this example, the 'expertise' aspect and 'expertise management' sub-aspect has been selected. Thus, the assessment questions corresponding with the 'expertise management' sub-aspect are displayed. If a user has scored the assessment questions of all the sub-aspects of a specific aspect, the maturity level of this aspect and corresponding sub-aspects can be measured. A 'submit answers' button can be found on the bottom of the page, which has to be clicked when a user has finished scoring their assigned assessment questions.

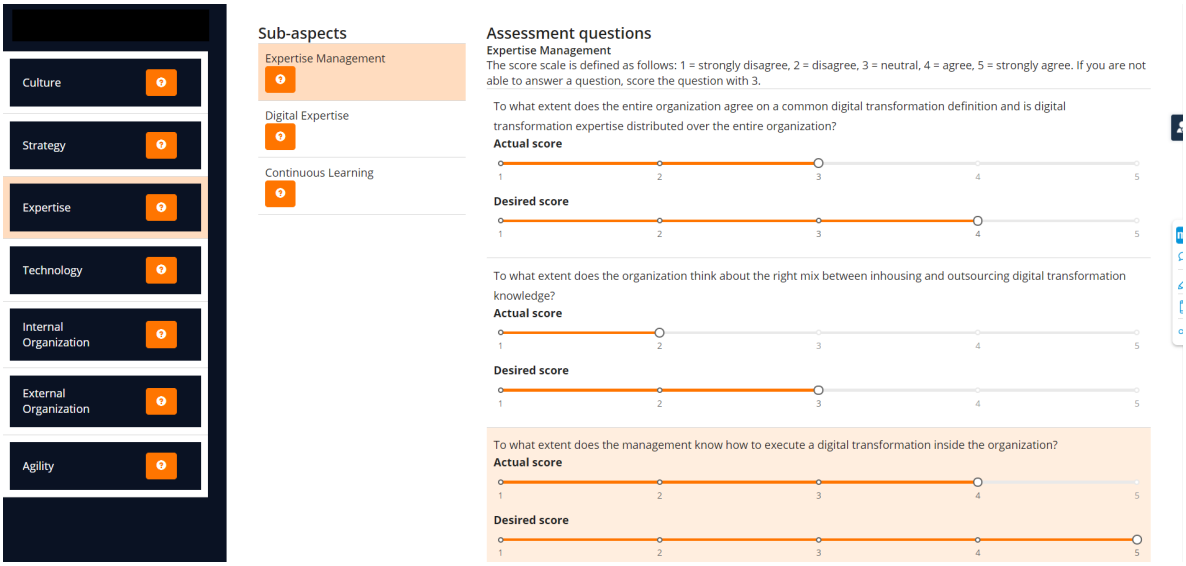


Figure 36: The assessment questions page of the ADT maturity assessment prototype.

After a user has completed an assessment, the assessment will appear on the 'assessment results page'. This page is accessible for users and administrators with different views. The user is only able to see and use the 'search' and 'edit' buttons, displayed in Figure 37. By clicking on the 'edit' button, the user can get back into their assessment and make changes if needed. The administrator has additional functionalities, and an overview of a page through the administrator's eyes is displayed in Figure 37. First, an administrator can delete specific assessments by clicking the 'delete' button. This design choice has been made, as the administrator might want to delete out of date assessments to keep a clear overview. In addition, the administrator can select an assessment and click on the 'calculate' button. This button will trigger logic that calculates four types of maturity levels: the total level, the aspect levels, the sub-aspect levels and the indicator levels. If the maturity levels have been calculated, the status will switch from 'no' to 'yes' and inform the administrator that an assessment's maturity levels have been calculated. Finally, the administrator can select an assessment and click on the 'dashboard' button. Typically, the 'assessment date', 'organization', 'name' and 'status' are filled in and displayed, so the administrator knows which assessments have been performed. In this case, the 'organization' and 'name' fields are empty for privacy reasons. This allows the administrator to show the dashboard of an individual assessment that has calculated maturity levels. The design choice has been made to show the user a limited view of the 'assessment results page', as the user only has to answer the assessment questions, and the consultant has to calculate maturity levels and show a dashboard. This can be found in the activity diagram in Appendix I1.

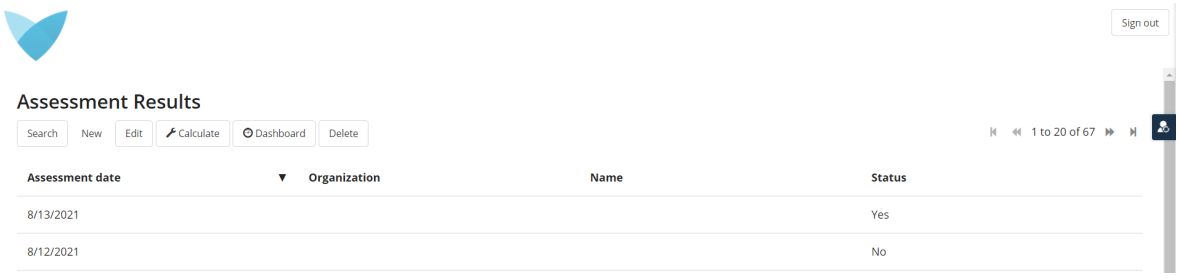


Figure 37: The assessment results page of the ADT maturity assessment prototype.

The final page which will be discussed is the 'dashboard page'. This page serves as an overview of the results of an assessment. The top part of the 'dashboard page', displayed in Figure 38, shows the total actual and desired maturity level. It has been decided to put this level in the upper left corner, as this maturity level gives a concrete indication of the maturity of an organization on their ADT. Next to the total level, a textual explanation of the 'dashboard page' and a figure with the maturity level structure is displayed. The textual explanation and the figure support the consultant and client in understanding the working and contents of the dashboard page. Furthermore, the bottom part of the dashboard page shows the remaining three maturity levels: the aspect levels, the sub-aspect levels and the indicator levels. On the top left of Figure 39, the aspect wizard is displayed. This wizard allows the user to select a specific aspect. The corresponding sub-aspect levels and the gap are displayed on the bottom left if the user selects a particular aspect. Next to the aspect wizard, the aspect levels are displayed and visualized in a bar chart. The actual level is displayed in blue, the desired level in green and the gap between the actual and desired level in red. It has been decided to only visualize the aspect levels in a bar chart, as the bar chart widget is static. Displaying many bar charts on the dashboard page will result in a chaotic and unclear overview of the maturity levels. Observing the bar chart allows for quick observation of the maturity levels of the seven aspects of ADT. The red bar shows the gap between the actual and desired level and can be used to determine where the organization wants to emphasize and increase their maturity. In the bottom left, the sub-aspect maturity levels and the gap of the selected aspect in the aspect wizard are shown. In addition, the indicator maturity levels and the gap

of the selected sub-aspect are shown in the bottom right. The design choice is made to colour the gap scores. zero is the best possible gap score, as the actual and desired level is the same, indicating that the organization is satisfied with its level of maturity. Minus five and five are the worst possible gap scores an organization can have and is indicated by a red colour. A score of minus five can occur when an organization realizes they have not yet started on an indicator but realize that it is essential and has to be prioritized immediately to reach the maximum maturity level. The gap levels are ordered by displaying the highest gaps on the top and the lowest gaps on the bottom. Combining this with the colours, an organization can quickly observe the indicators and sub-aspects which should be focused on first. The researcher decided not to colour the actual and desired maturity levels. This reason has been made because displaying these colours will result in a chaotic and unclear overview. Furthermore, the design choice is made to make the sub-aspects clickable. As a result, a user can click through the sub-aspects of the selected aspect, and the corresponding indicator maturity levels are shown accordingly. This allows for a less crowded dashboard page that displays all the necessary maturity levels on just one page.

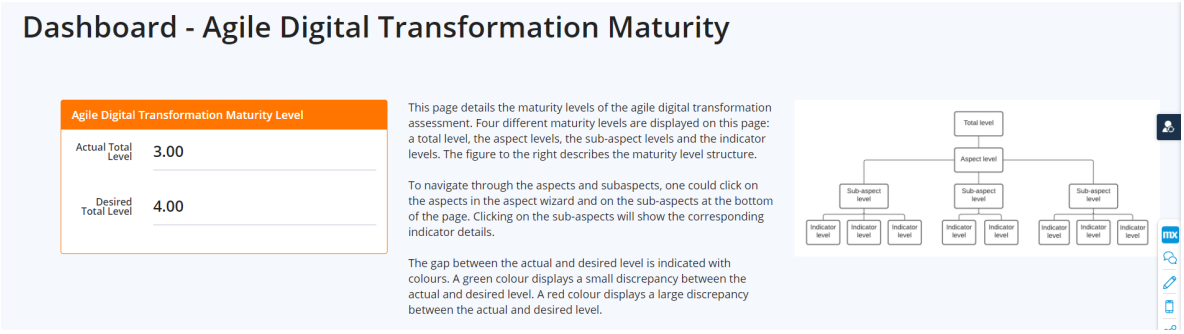


Figure 38: The upper part of the dashboard page of the ADT maturity assessment prototype.

Figure 39: The bottom part of the dashboard page of the ADT maturity assessment prototype.

4.4.3 Further Development Recommendations

In this section, recommendations for further development of the assessment instrument prototype will be discussed. Due to time constraints, the researcher decided to scope the assessment instrument prototype to satisfy the functional requirements. As a result, the prototype is MVP, but additional functionalities can increase the value of the prototype. These functionalities will be described in the remainder of this section.

The storyboard in Appendix I.2 displays MVP and non-MVP user stories. The user stories marked in green have been implemented in the assessment instrument prototype. The user stories marked in orange are proposed by experts or thought of by the researcher. These user stories will be proposed as recommendations for further development of the assessment instrument prototype. The following user stories are proposed as recommendations:

- **Show progress of an assessment:** The ADT assessment instrument contains a significant number of questions. As a result, an expert proposed to add a progress bar to the assessment instrument to display current progress. This helps the user obtain knowledge on the progress of the assessment and helps the user to indicate how much time is still to be spent on the assessment. In addition, a user can check if all questions are scored by looking at the progress bar. If the progress bar does not show 100%, there are still questions to be scored.

- **Validation alert incorrect value:** An expert proposed to build a functionality that can indicate an incorrect value scored by a user by comparing the answer to earlier given similar answers. This increases the accuracy of an assessment.

- **Additional explanation text box:** One of the experts proposed to add a text box next to the questions to be able to add additional explanations to a given answer. This way, the consultant can better understand a given score based on the additional information instead of asking the client why a specific score is given.

- **Flexible indicator weights:** Currently, the assessment instrument prototype has static indicator weights, which are used for every assessment for every organization. An expert proposed adding functionality to adjust indicator weights based on the organization and its context, as some indicators may be more important for company A than company B.

- **Multiple people edit assessment at the same time:** At this moment, the assessment instrument prototype does not correctly function when multiple users edit the same assessment at the same time. It is recommended to develop functionality to do this so that users can score different assessment questions in the same assessment at the same time.

- **Dashboard - click indicator, show assessment question:** On the 'dashboard page', it is not possible to see the assessment questions that are related to the indicators. One expert proposed developing functionality to click on an indicator and show the corresponding assessment question in a pop-up screen. This will increase the understandability of the indicator if the indicator is unclear to the user.

- **Improvement roadmap:** The assessment instrument prototype is not able to determine an improvement roadmap. However, it can order the maturity levels so that the aspect, sub-aspect or indicator with the highest priority is listed on top. One of the experts proposed to add an improvement roadmap with general recommendations based on the outcome to the assessment instrument. This was outside of the project scope but would increase the value of the assessment instrument prototype significantly.

- **Compare different assessment results:** Currently, the assessment instrument prototype is not able to compare different assessments with each other. This functionality will be interesting to have when you want to keep track of the maturity levels of an organization over time or if you want to compare maturity levels of different departments of an organization. Thus, this functionality is added as a recommendation.
- **Indicator gap score priority list:** Currently, indicator maturity levels of a corresponding sub-aspect are displayed by ordering the list based on the gap scores. However, it is impossible to get an ordered complete list with all the indicators and corresponding gap scores. This functionality will add the ability to have an overview of all the indicator maturity levels at the same time and helps in creating an improvement roadmap.
- **Option to fill how much time it takes to increase maturity level by one:** Currently, the improvement prioritization is based on observing the critical aspect and sub-aspect maturity levels, which are two or lower, and the gap between desired and actual maturity level. The researcher thinks that adding functionality to appoint the time it takes to increase the maturity level of an indicator by one is helpful to improve the improvement prioritization. As a result, it is easier for the assessed organization to create improvement plans based on critical values.
- **Option to indicate 'no answer':** In the current version of the assessment instrument, it is not possible to answer with 'no answer'. However, adding this functionality allows consultants to observe difficulties during an assessment immediately. In addition, questions that are currently scored with a three, as the participant does not know the answer, are included in calculating the maturity levels. Adding the option 'no answer' and excluding these answers in the calculation result in more representative scores.

4.5 Observational Case Studies

This section describes the type 3 evaluation approach obtained from Helgesson et al. (2012). This approach consists of using the maturity model in a practical setting. In this case, the maturity model is applied in a practical setting by letting practitioners use the assessment instrument prototype and performing an ADT assessment. To establish a type 3 evaluation, the observational case study theory by Wieringa (2014) has been used as a guideline. According to Wieringa (2014), an observational case study investigates a real-world case without performing an intervention. It is used to obtain information about the working of individual cases. As a result, it applies to this research, as the process of using the assessment instrument prototype needs to be observed to check if using the assessment instrument prototype results in the desired outcomes. These desired outcomes consist of complying with the functional requirements described in the Introduction. Hence, the main goal of the observational case studies is to **check if using the assessment instrument prototype results in the desired outcome by meeting the functional requirements.** Appendix J3.1 displays an overview of the combined results of both case studies. The remainder of this chapter will discuss the case study participants, the case study protocol, and the case study results per case.

4.5.1 Case Study Participants

Two cases have been selected for the observational case studies: a consultancy and a logistics company. Both companies want to improve their ADT and have knowledge of DT and agile. Thus, the case companies suit the context where the ADT maturity model should be applied. In addition, the logistics company is a functional beneficiary of the ADT maturity model. This case has been selected to represent a client of CAPE Groep B.V. Furthermore, the case studies contain an introduction session, an individual assessment moment, a general discussion of the results, and a short evaluation of the usage of the assessment instrument prototype. Table 43 displays all the participants of the two performed case studies. The Identity Document (ID) in **bold** show the participants who attained the general discussion

of the results. Unfortunately, it was not possible for all the participants of the second case study to attend this meeting due to planning issues. Furthermore, for the first case study, all the aspects were assessed once. For the second case study, the 'culture' aspect was assessed by six participants, the 'expertise' aspect by three participants, the 'strategy' aspect by three participants, the 'technology' aspect by two participants, the 'internal organization' aspect by five participants, the 'external organization' by four participants and the 'agility' aspect by two participants.

ID	Case	Role	Aspects assessed	Assessment date
C1.1	1: Consultancy	Manager finance & control	Culture, strategy, IO	11-08-2021
C1.2	1: Consultancy	Program manager	EO, agility	11-08-2021
C1.3	1: Consultancy	Solution architect/Senior consultant	Technology	11-08-2021
C1.4	1: Consultancy	Teamlead customer support	Expertise	11-08-2021
C2.1	2: Logistics	Release train engineer	IO	23-08-2021
C2.2	2: Logistics	Senior agile coach	Culture, IO, agility	20-08-2021
C2.3	2: Logistics	Digital consultant/Agile coach	IO, EO	16-08-2021
C2.4	2: Logistics	Agile Next lead	Culture, strategy, IO, EO	23-08-2021
C2.5	2: Logistics	Chief technology officer	Technology	20-08-2021
C2.6	2: Logistics	Program director IT	Technology	21-08-2021
C2.7	2: Logistics	Senior agile coach	Culture, expertise, EO	16-08-2021
C2.8	2: Logistics	Director strategy	Strategy	17-08-2021
C2.9	2: Logistics	Agile Next lead	Culture, IO, agility	19-08-2021
C2.10	2: Logistics	Program manager HR	Culture, expertise	20-08-2021
C2.11	2: Logistics	Director digital transformation	Strategy	23-08-2021
C2.12	2: Logistics	Program manager HR	Culture, expertise	24-08-2021
C2.13	2: Logistics	Manager customer experience	EO	24-08-2021

Table 43: Case study participants

4.5.2 Case Study Protocol

According to Wieringa (2014), the researcher should design a case study protocol before the case study is performed. The case study protocol elaborates on the context, research problem and design of the case study. The case study context consists of the user taking the consultant role and applying the ADT maturity model through the assessment instrument prototype. Furthermore, the case study organizations do not know their ADT maturity, and therefore it will be measured. During the case studies, the researcher observes the usage of the assessment instrument prototype and details essential findings. These critical findings can be found in Appendix J.2. In addition, the design of the case study can be found in Appendix J.1.

4.5.3 Case Study 1: Consultancy

The first case study is CAPE Groep B.V. itself. CAPE Groep B.V. is a consultancy firm that consults companies on how to improve their DT and help them in their journey. Four employees participated in the case study, a manager finance & control, a program manager, a solution architect/senior consultant, and a team lead customer support. The aspects were divided among the participants appropriate to their knowledge within the company. The case study was performed in person and on the same day in a session of two hours. The results are displayed in Figure 40. It has been decided to display the total maturity level, aspect maturity level and sub-aspect maturity level. Indicator maturity levels have been omitted for clarity reasons. However, the indicator levels of critical values are displayed in Figure 41. In addition, Appendix J3.2 displays screenshots containing the indicator levels of critical values of the dashboard page in the ADT assessment instrument.

Observing Figure 40, the total actual maturity level of the ADT of case 1 is three, and the total desired maturity level is four. This indicates that case 1 already started its ADT and is in the middle of the maturity level scale. In addition, it indicates room for improvement by having a higher desired level compared to the actual level. Analyzing the aspect levels of Figure 40, five aspects have an actual level of three and a desired level of four. This is in line with the total ADT maturity levels. However, the 'strategy' aspect has an actual level of two and a desired level of four. As a result, the 'strategy' aspect is the weakest ADT component of case 1. If we look into the details of this aspect, it can be observed that the 'digital transformative vision' and the 'digital resources' both score an actual level of two. In addition, the 'monitoring' sub-aspect even has an actual level of one. Moreover, this can be observed by analyzing the gap scores of these sub-aspects, which is minus three. A high gap score often indicates much room for improvement, as can be observed by subtracting the corresponding desired level from the actual level. Furthermore, the 'expertise' aspect has a higher actual and desired maturity level than the total ADT maturity level. The 'expertise' aspect has an actual level of four and a desired level of five. This can be explained by the high actual level of four by two of the three sub-aspects and the desired level of five by all three. Figure 41 displays the critical values of case 1 together with the corresponding indicators. A critical value exists if the actual maturity level of the aspect or sub-aspect is two or lower. Observing Figure 41, looking deeper into the critical values of the aspects and sub-aspects, there exist four indicator maturity levels with an actual level of one. In addition, ten indicators have an actual level of two. The company should focus on the actual indicator levels one and two to increase their ADT maturity. Besides, the gap scores can be used by the organization to determine their improvement prioritization. For example, the organization should start by working on the indicators with the largest gap, in this case, minus four. As a result, the organization should first work on their 'security' and 'CI/CD'. Appendix J3.2 displays screenshots of the dashboard of the ADT assessment instrument prototype to give an overview of how these values are displayed in the established tool. These specific screenshots are displayed since they contain the critical values for case 1. These values are significant, as there exists the most prominent window for improvement.

	Case 1: Consultancy		
	Actual level	**Desired level**	**Gap**
Total ADT level	3	4	-1
Culture	3	4	-1
Willingness to make decisions	3	4	-1
Knowledge sharing	3	4	-1
Willingness to change	4	4	0
Strategy	2	4	-2
Digital transformative vision	2	5	-3
Monitoring	1	4	-3
Digital strategy	3	5	-2
Digital resources	2	4	-2
Digital management	3	4	-1
Expertise	4	5	-1
Continuous learning	3	5	-2
Expertise management	4	5	-1
Digital expertise	4	5	-1
Technology	3	4	-1
IT Architecture	3	5	-2
Data monitoring	2	4	-2
Data exploitation	3	4	-1
IT Security	3	4	-1
Internal Organization	3	4	-1
Leadership	3	4	-1
Department/Teams	3	4	-1
Organizational roles	3	4	-1
Way of working	3	4	-1
External Organization	3	4	-1
Digital partner network	3	4	-1
Digital customer engagement	3	4	-1
Competition	4	4	0
Agility	3	4	-1
Technical excellence	2	5	-3
Plan and deliver software quality iteratively	3	5	-2
Embrace change to deliver customer value	3	4	-1
Human-centric	3	4	-1
Learning	3	4	-1
Customer collaboration	4	4	0

Figure 40: The case study 1 results.

	Case 1: Consultancy		
	Actual level	**Desired level**	**Gap**
Strategy	2	4	-2
Digital transformative vision	2	5	-3
Clear digital transformation end point	2	5	-3
Clear digital transfformation start point	2	4	-2
Digital transformation roadmap to determine the path from start to end	3	5	-2
Execute your digital roadmap based on your culture and internal organization	3	4	-1
Monitoring	1	4	-3
Monitor the execution of your roadmap	1	4	-3
Establish KPIs and metrics to monitor execution	1	4	-3
Monitor execution progress of your strategy	2	4	-2
Digital resources	2	4	-2
Budgetting for digital transformation	2	4	-2
Time management	2	4	-2
Technology	3	4	-1
Data monitoring	2	4	-2
Data monitoring based on KPIs	2	5	-3
Functionality based data monitoring	2	3	-1
Technological based data monitoring	3	4	-1
Agility	3	4	-1
Technical excellence	2	5	-3
Security	1	5	-4
CI/CD	1	5	-4
Design principles	2	5	-3
Monitor using KPIs	2	5	-3
Validation of code	2	4	-2
Quality of code	4	4	0

Figure 41: Overview of critical values of case study 1.

4.5.4 Case Study 2: Logistics

The second case study is a logistics company focusing on DT and is working in an agile way. Thirteen employees participated in the case study. The roles of the participants within the company are displayed in Figure 43. In comparison to the first case study, multiple people assessed the same aspect in the second case study. For instance, the 'culture' aspect has been assessed by six different employees. This choice has been made to create a broader qualitative view of the actual and desired score of the indicators. In general, an aspect has been assessed by at least two employees of case 2. The case study protocol has been followed as described in Appendix J1. The case study was performed online, first individually and later collectively. The participant IDs in bold in Figure 43 display the participants who participated in the joint meeting to determine a common score per assessment question and the joint meeting to discuss the results of the ADT assessment. The results are displayed in Figure 42. It has been decided to display the total maturity level, aspect maturity level and sub-aspect maturity level. However, the indicator levels of critical values are displayed in Figure 43. In addition, Appendix J3.2 displays screenshots containing the indicator levels of critical values of the dashboard page in the ADT assessment instrument.

Analyzing Figure 42, the total actual maturity level of the ADT of case 2 is three, and the total desired maturity level is four. This indicates that case 2 has already started its ADT and is in the middle of the maturity level scale. In addition, it indicates room for improvement by having a higher desired level compared to the actual level. Analyzing the aspect levels of Figure 42, five aspects have an actual level of three and a desired level of four. This is in line with the total ADT maturity levels. However, the 'internal organization' aspect has an actual level of two and a desired level of four. As a result, the 'internal organization' aspect is the weakest ADT component of case 2. If we look into the details of this aspect, it can be observed that the 'leadership' and the 'organizational roles' both score an actual level of two. Moreover, this can be observed by analyzing the gap scores of these sub-aspects, which are minus three and minus two. A high gap score often indicates much room for improvement, as can be observed by subtracting the corresponding desired level from the actual level. Furthermore, the 'technology' aspect has a higher actual and desired maturity level than the total ADT maturity level. The 'technology' aspect has an actual level of four and a desired level of five. This can be explained by the high actual level of four by two of the four sub-aspects and the desired level of five by three of the four sub-aspects. In addition, the 'IT security' sub-aspect even has an actual score of five. Figure 43 displays the critical values of case 2 together with the corresponding indicators. A critical value exists if the actual maturity level of the aspect or sub-aspect is two or lower. Observing Figure 43, looking deeper into the critical values of the aspects and sub-aspects, there exists one indicator maturity level with an actual level of one. In addition, 13 indicators have an actual level of two. The company should focus on the actual indicator levels one and two to increase their ADT maturity. Besides, the gap scores can be used by the organization to determine their improvement prioritization. For example, the organization should start by working on the indicators with the largest gap, in this case, minus three. As a result, the organization should work on their 'leadership vision', 'democratic leadership' and 'employee dedicated to one team 5-9' first. Appendix J3.2 displays screenshots of the dashboard of the ADT assessment instrument prototype to give an overview of how these values are displayed in the established tool. These specific screenshots are displayed since they contain the critical values for case two. These values are significant, as there exists the most prominent window for improvement.

	Case 2: Logistics		
	Actual level	**Desired level**	**Gap**
Total ADT level	3	4	-1
Culture	3	4	-1
Willingness to make decisions	2	4	-2
Knowledge sharing	3	4	-1
Willingness to change	3	4	-1
Strategy	3	4	-1
Digital transformative vision	3	4	-1
Monitoring	3	4	-1
Digital strategy	3	4	-1
Digital resources	4	5	-1
Digital management	4	5	-1
Expertise	3	4	-1
Continuous learning	3	4	-1
Expertise management	3	4	-1
Digital expertise	2	4	-2
Technology	4	5	-1
IT Architecture	4	5	-1
Data monitoring	3	4	-1
Data exploitation	4	5	-1
IT Security	5	5	0
Internal Organization	2	4	-2
Leadership	2	5	-3
Department/Teams	3	4	-1
Organizational roles	2	4	-2
Way of working	3	4	-1
External Organization	3	4	-1
Digital partner network	3	3	0
Digital customer engagement	3	4	-1
Competition	3	4	-1
Agility	3	4	-1
Technical excellence	4	5	-1
Plan and deliver software quality iteratively	3	4	-1
Embrace change to deliver customer value	3	4	-1
Human-centric	2	4	-2
Learning	3	4	-1
Customer collaboration	3	4	-1

Figure 42: The case study 2 results.

	Case 2: Logistics		
	Actual level	Desired level	Gap
Culture	3	4	-1
Willingness to make decisions	2	4	-2
Everyone is allowed to make decisions	2	4	-2
Open environment	2	4	-2
No blame culture	3	4	-1
Multicultural disciplinary team	3	4	-1
Transparant environment	3	4	-1
Expertise	3	4	-1
Digital expertise	2	4	-2
Business knowledge	2	4	-2
Digital transformation execution knowledge	2	4	-2
Personal knowledge	2	4	-2
IT knowledge	3	4	-1
Team roles knowledge	3	4	-1
Digital processes knowledge	3	4	-1
Internal Organization	2	4	-2
Leadership	2	5	-3
Leadership vision	2	5	-3
Democratic leadership	2	5	-3
Comfortable work environment	3	5	-2
Organizational roles	2	4	-2
Defined roles	2	4	-2
Defined responsibilities	2	4	-2
Agility	3	4	-1
Human-centric	2	4	-2
Employee dedicated to one team 5-9	1	4	-3
Defined responsibilities	2	4	-2
BizDevOps	3	5	-2
DevOps	2	4	-2
Development team size of 5-9	2	4	-2
Define agile roles	3	4	-1
Collaboration between teams/departments and management	3	4	-1
Self-organized teams	3	4	-1
Distributed agile network	5	5	0

Figure 43: Overview of critical values of case study 2.

4.5.5 Cross Case Analysis

This section discusses how the ADT assessment instrument prototype holds up to the functional requirements. In addition, it discusses significant remarks from the coded transcriptions of the case studies. This has been established by performing cross case evaluation where both cases are treated equally. This part is segregated from the other results, as the other results present maturity levels per organization. On the contrary, this section describes results by evaluating both cases equally. As described in Section 4.5, the goal of the observational case studies is to test if the ADT assessment instrument prototype meets the functional requirements stated in the Introduction. Observing the figures in Appendix J3.2, the ADT assessment instrument prototype can calculate a total maturity level, aspect maturity levels, sub-aspect maturity levels and indicator maturity levels. In addition, a gap between the current and desired level is automatically calculated. As described in Sections 4.5.3 and 4.5.4, an improvement prioritization can be made by analyzing gaps between the desired and actual level and prioritizing the most significant gaps. Finally, the ADT assessment instrument prototype can assess the six DT aspects and the 'agility' aspect. Thus, the assessment instrument prototype can assess the DT and agile capabilities of an organization. As a result, the ADT assessment instrument prototype meets the five functional requirements stated in the Introduction.

Although the ADT assessment instrument prototype meets the functional requirements, the researcher noted several relevant remarks about the functionality during both case studies. According to Wieringa (2014), it is crucial for observational case studies to create a case study log or diary with essential remarks about the execution of the case studies. The case study log of both case studies can be found in Appendix J.2. In the remainder of this section, remarks for evaluation will be discussed based on the case study log.

- **Long questions:** during the case studies, a participant mentioned that several assessment questions are relatively long. The participant stated that the questions were clear, but much attention had to be spent carefully reading the questions.
- **No functionality to work together in one assessment at the same time:** the current prototype does not offer the functionality to work together in the same assessment at the same time. This does not impede the compliance of the functional requirements. However, adding this functionality will provide a smoother assessment procedure.
- **Answer duration of the questions:** the researcher observed that the assessment questions were answered relatively quick during case 1 compared to his expectations. However, the discussion to come to one general answer to the assessment questions in case 2 took considerably longer. As a result, the completion time of an assessment differs depending on the number of participants.
- **Consciousness about ADT maturity among participants:** the participants mentioned that performing an assessment led to an increase in consciousness about ADT aspects and its maturity. This indicates that using the ADT assessment instrument prototype results in the desired state of mind intended by the researcher.
- **No assessment questions in the dashboard:** a participant asked why the assessment questions are not visible in the dashboard of the ADT assessment prototype. According to the participant, displaying the assessment questions in the dashboard will increase the understanding of the indicators which are displayed in the dashboard. Moreover, the participant stated that he is not familiar with the indicators, as these are not displayed when scoring the assessment questions. As a result, displaying the assessment questions when clicking on an indicator will increase understanding of the assessment instrument prototype.

- **Improvement prioritization and roadmap based on literature:** several participants asked if the ADT assessment instrument prototype was able to provide a roadmap based on the literature on how to improve agile and DT aspects. Currently, this is out of scope for this research project. However, this functionality will dramatically increase the usefulness of the ADT assessment instrument. As a result, this will be further discussed in the Future Work section.

- **Appointing a score can be difficult:** several participants noted that appointing a score between one and five can be challenging, as it is purely subjective reasoning. For example, should a score of three or four be given for this assessment question and what is the exact difference? In addition, participants mentioned that they did occasionally score a three when they were unsure of the exact score. These remarks are significant for the validity of the case study outcomes and should be taken into account.

- **Desired score misinterpretation:** the researcher observed that during case 2, several participants misinterpreted the desired score. These participants indicated that the desired score almost always should be a five, as you want to be as mature as possible in every aspect. As a result, these participants scored most assessment questions with a 5. However, the desired score functionality has been established to indicate which indicators should be focused on in the short term. Thus, the explanation of the desired score should be explained more carefully in the ADT assessment instrument prototype. Finally, these remarks are significant for the validity of the case study outcomes and should be considered.

- **Assessment question misinterpretation:** during the second case study discussion, the researcher noticed that it could occur that the participants interpreted the same assessment question differently. Due to this misinterpretation, the assessment question was answered with a different score. As a result, these assessment questions should be revised to increase the understanding of the ADT maturity model.

5 DISCUSSION

This chapter discusses the results of this research project. First, the created artifacts, the ADT maturity model and assessment instrument, are discussed. Second, a reflection on the chosen research methodologies is given. Finally, the limitations of this study are discussed to inform the reader about threats to validity.

5.1 Reflection on the ADT Maturity Model and Assessment Instrument

This section serves as a reflection on the ADT maturity model and assessment instrument. This research resulted in two artifacts: the ADT maturity model and the corresponding assessment instrument. First, the ADT maturity model has been created by combining findings from the literature, by conducting an SLR and doing market research, and by findings from practice, by conducting expert interviews and a brainstorm session. Afterwards, the ADT maturity model has been evaluated by seven experts by organizing expert evaluation interviews. During these interviews, feedback was obtained to create a second version of the ADT maturity model. In addition, the non-functional requirements have been tested by asking the expert evaluation interview participants to score the UTAUT statements on a 5 point Likert scale. Next, the second version of the ADT maturity model has been created by observing the feedback proposed by the experts. The next step in this research existed of creating the ADT assessment instrument prototype in Mendix. The assessment instrument has been created to make the ADT maturity model operationalizable in practice and test its practicality. Finally, after creating the ADT assessment instrument, the assessment instrument was demonstrated in practice through two observational case studies. Significant findings observed during these case studies have been noted in the case study log and discussed.

As mentioned before, the ADT maturity model has been evaluated by asking seven experts to score the evaluation criteria based on UTAUT. The average scores for the criteria are between 3.4 and 4.3. This indicates that the ADT maturity model adheres to the non-functional requirements to a large extent. However, there is still room for improvement, and several discussion points about the ADT maturity model and assessment instrument will be discussed in the remainder of this section.

The first discussion point covers the qualitative scoring mechanism of the ADT maturity model. The choice has been made to let assessed organizations score the assessment questions of the ADT maturity model on a 5 point Likert scale. This is a qualitative form of scoring and is based on the knowledge and experience of the assessed employees of the assessed organization. This is a subjective approach and common in the field of maturity models. However, this approach is not the most exact way of appointing scores to indicators. Moreover, this approach can be a limitation if the assessed participants cannot agree on a common score for an indicator. As a result, case 2 has been designed so that two employees at least assessed the seven aspects of the ADT maturity model. In addition, a general discussion meeting was planned to discuss the scores and get to one common score for each indicator. This approach is valuable, as it discusses the current and desired states based on the outcomes. However, this is a time-intensive approach and could have been avoided by appointing the maturity levels more quantitatively.

The second discussion point encompasses the ADT maturity model and assessment instrument not including a concrete improvement roadmap. It has to be noted that this is not necessarily a limitation, as it is not included in the functional requirements of this research. However, several experts mentioned the absence of a concrete roadmap providing a general way of improving ADT capabilities. To increase the ease of use of the ADT maturity model and assessment instrument, it would be helpful to add this functionality. In the current situation, an improvement prioritization of the ADT capabilities can be established by observing the critical values and the corresponding gap scores. Thus, a starting point has been made to create an improvement roadmap, but there is a large window for improvement. For example, automating the before mentioned improvement prioritization.

Furthermore, the ADT maturity model indicators have a weight attribute. The indicator weights

have been established in a brainstorm session together with three experts. The sample size of the brainstorm session is relatively tiny, and asking additional experts might result in different indicator weights. This is an important note since the indicator weights are used to calculate the sub-aspect maturity levels. In addition, the three experts who participated in the brainstorm session all belonged to the same organization. Experts from other organizations might have a different opinion on the importance of the indicators based on their working environment. As a result, this limitation should be considered, and for future work, flexible indicator weights might be preferable. This way, the consultant can discuss the importance of indicators with the client organization which wants to be assessed. A different discussion point about the indicator weights relates to the indicators being the only construct of the ADT maturity model which have established weights. If we look into the retrieved maturity models during the SLR, this is often the case and not necessarily bad. However, it might be interesting to look into sub-aspects weights and use them to calculate the aspect levels. The same principle applies to the weights for the aspects and the calculation of the total level.

A fourth discussion point is that the ADT maturity model's scope covers all found DT and agile aspects. The researcher decided to cover all DT and agile aspects found during the systematic meta-model comparison. However, this resulted in a large scope and made it difficult to detail every aspect of the ADT maturity model. As a result, the indicators are not always as detailed as could be possible. For example, one of the indicators is: "management focus on change management". This indicator could be further split up into indicators that detail change management practices. Due to the time limitation of six months for the research project, it has been decided to not go into excessive details. However, the researcher could have focused on one or a couple of DT and agile aspects to prevent this problem. This way, the aspects in scope can be further detailed. However, the researcher has chosen to focus on all aspects since the main goal is to create an ADT maturity model that can measure how mature an organization is in its DT in an agile way. The researcher thinks leaving out certain DT or agile aspects do harm this goal by not covering the whole ADT field.

A fifth discussion point consists of the fact that different knowledge is needed to complete one ADT assessment. The ADT maturity model contains seven aspects that are not all closely related to each other. As a result, several employees of an organization are needed to perform an assessment. This can easily be observed by the number of participants needed for the first case study. In the first case study, four employees were needed to assess the seven aspects one time. This is not easy to avoid, as the topic of DT is broad. For example, it is hard to find an employee with perfect knowledge about technology, expertise and internal organization. All three subjects are entirely different, and different roles within an organization are often created to cover them. Although this is not necessarily harmful to the ADT maturity model, it can be complicated to get together several employees to perform an assessment. In addition, if you want the aspects to be assessed at least twice, even more employees are needed.

A sixth discussion point of this section covers the frequent appearance of a maturity level of three. According to the 5 point Likert scale, this indicates a neutral opinion. Observing both case study results, five out of seven aspects scored an actual maturity level of three, and the total actual maturity level of both cases is three. This can be explained by participants scoring a three since they have a neutral opinion about the assessment question. However, it can also be the case that the participant does not know the answer and thus scores a three. If this happens often, it will harm the results of an assessment and is thus a threat to the validity of the case study results. Another explanation for a score of three contains the possibility of participants often scoring two and four, which results in an average of three. This can be the case if participants are hesitant to give an extreme score of one or five. As a result, an aspect or sub-aspect maturity level of one, two, four or five might be worthier to observe further.

Lastly, the ADT maturity model has an explicit focus on agile. Moving the ADT maturity model to organizations that are not working agile will be difficult. For example, an organization might have a waterfall way of working or a hybrid form of waterfall and agile. On the one hand, the 'agility' aspect will still be interesting to assess in a hybrid organization. This way, the agile indicators present in the

organization can be measured and improved if needed. On the other hand, assessing the 'agility' aspect in an organization that is not agile will not be possible. For this organization, it can still be relevant to measure the DT aspects. With the current version of the ADT maturity model, this is possible. As a result, the research believes that even when a company is not working the agile way, it is still possible to generalize the DT aspects of the ADT maturity model.

5.2 Reflection on the Research Methodology

This section serves as a reflection on the used research methodologies in this research. Several different research methodologies are used to develop, evaluate, and demonstrate the artifacts established in this research. This choice has been made to ensure the development, evaluation and demonstration are executed in a structured and validated manner. The section is structured by going through the research methodologies in chronological order.

The research, in general, followed the design science research methodology by Hevner and Chatterjee (2010). This research methodology allowed for creating and evaluating the ADT maturity model and assessment instrument artifact in its organizational context concerning the stakeholders and their goals. Furthermore, the development of the ADT maturity model was facilitated by the research methodology of Becker et al. (2009). This research methodology is established explicitly to create maturity models and is in line with the design science research methodology. As a result, this suits the general research methodology of this study.

The ADT maturity model has been established by using a top-down approach. First, the aspects have been established by performing the systematic meta-model comparison. This meta-model comparison allowed for the comparison between the four DT maturity models and the five agile maturity models. As a result, the main parts, named aspects, of the maturity model have been determined. Afterwards, the sub-aspects and indicators have been determined by conducting expert interviews and performing a small market research on the topic ADT. Thus, this displays the approach of starting on a high level or at the 'top and' slowly adding the details and going 'down'. This approach has been taken, as the topic of ADT is still relatively unexplored. This makes it challenging to start with determining the indicators of the maturity model based on indicators found in practice since little information is available on ADT. At this point, the researcher thinks this approach is the most suitable. However, using a bottom-up approach will be possible in the future when the ADT field has increased in maturity. Therefore, the researcher thinks creating an ADT maturity model using a bottom-up approach adds value because it will be based on ADT practices used in practice.

Furthermore, the ADT maturity model has been developed using a multi-method development strategy. This strategy consists of performing a systematic meta-model analysis, expert interviews, market research and a brainstorm session. These four research methods are used to balance the findings from literature with findings from practice. According to the researcher, this is a sufficient approach, as the practice can be ahead of literature, specifically regarding a novel topic. In addition, using multiple research methods allows for solving limitations of a particular research method by using an additional research method. For example, experts could be biased towards certain agile practices used in their organization but not in other organizations. By performing market research on ADT, sources are found and used to describe essential agile practices for ADT. As a result, both findings will be included in the ADT maturity model to prevent this bias.

Besides, the ADT maturity model and assessment instrument have been evaluated using a multi-method evaluation strategy. The evaluation methods are chosen based on their occurrence in current maturity model development literature(Helgesson et al., 2012). The evaluation methods chosen are: expert evaluation interviews and observational case studies. Combining both evaluation methods allows for an evaluation of the first version of the ADT maturity model by end-users of the system and a demonstration of the ADT assessment instrument prototype to demonstrate its usage in practice. Just conducting expert evaluation interviews disregards the evaluation in a practical setting. In addition, ex-

pert evaluation interviews only allow for an evaluation with the end-user stakeholder group. Adding the observational case studies to the mixed-method evaluation strategy allows for an additional evaluation with the functional beneficiaries stakeholder group.

Finally, the chosen research methodology for the research project, in general, is design science research. In the beginning, this research methodology seemed the most suitable for this project. However, during the progress of the research project, the research methodology started to incorporate parts of action design research, as discussed by Sein et al. (2011). The main difference between design science and action design research is the fact that in design science, the design and evaluation phases are separated and sequenced (Sein et al., 2011). Action design research acknowledges the importance of building the artifact or a part of it and afterwards evaluating it immediately. It does this by an iterating process of building parts of the artifact and evaluating it. In this research, a first version of the maturity model was built. Afterwards, this version was evaluated, and a second version was built. This shows that the design and evaluation phase are not sequenced, as in traditional design science. In addition, after creating the second version of the ADT maturity model, the research decided to start another design phase by creating the ADT assessment instrument based on the second version of the ADT maturity model. Afterwards, the ADT assessment instrument was demonstrated in practice by performing observational use cases. Thus, an evaluation phase had started. This again shows that the design and evaluation phases are not sequenced and not separated. Therefore, the researcher decided to shift to action design research, as it seemed illogical to build the ADT assessment instrument based on the first version of the model, as it would still change based on the expert evaluation interviews. Moreover, due to the time constraint of six months, this approach is favourable.

5.3 Limitations

This section describes the limitations of this study. These limitations can threaten the validity of this research and thus should be made transparent to ensure a proper interpretation of the results. The section is structured chronologically, starting with limitations about the SLR and ending with limitations about the evaluation phase.

First, the limitations of performing an SLR will be discussed. One of the main limitations when performing an SLR is the absence of possible relevant keywords missed by the author in the planning phase. As a consequence, relevant studies might be missed in the conducting phase of the SLR. This may affect the quality and reliability of the performed SLR and this study. However, this common problem is mitigated by having a second person reviewing the keywords and the search query. This has been proposed by Kitchenham and Charters (2007) as a proper mitigation technique to this problem and is thus applied in this study. Secondly, the search was mainly conducted on online databases. Some literature, in particular grey literature, was not accessible. This was due to, for instance, books without a free version or direct access. A third limitation regarding the SLR is the possibility of missing literature published after the manual search on the online database and before the end of this study. The manual search on the online databases was performed at the start of March 2021. As a result, relevant studies might be missed published after the beginning of March 2021.

Second, limitations of the expert interviews during the design & development phase will be discussed. The sample size of the expert interviews is relatively tiny. Seven experts have been interviewed to confirm the DT aspects, gain additional information about the DT aspects, and learn what is important of agile for DT. The expert interviews were used to perform qualitative content analysis. In this case, the number of interviews is not necessarily significant, as the information retrieved from the expert interviews is more critical than the number of interviews. The researcher made sure to select experts with significant knowledge and experience in the field of agile and DT. In addition, experts from two organizations are used to broaden the view on both topics. Observing the qualitative content analysis and according to Hennink and Kaiser (2020), the saturation was not fully achieved. On the one hand, additional expert interviews led to more experts describing identical

sub-aspects and indicators. On the other hand, additional expert interviews led to new findings and thus new sub-aspects and indicators. This can be observed by analyzing the references noted behind an indicator in the tables of Section 3.2.6. The degree of saturation can be explained by the broad meaning of DT and agile. Although saturation is not fully achieved, the researcher believes that the ADT maturity model completeness is sufficient, as the gain of new information in the last interview is relatively small (Hennink and Kaiser, 2020). However, future work should focus on interviewing additional experts of different organizations specialized in the field of DT and agile to find potential additional indicators.

Furthermore, limitations of the expert evaluation interviews exist. The sample size for the expert evaluation interviews is seven as well. Again, this is a relatively small sample size. In addition, the ADT maturity model is evaluated with only one stakeholder group, the consultants of CAPE Groep. As explained above, a rather small sample size for qualitative interviews is not necessarily harmful. However, evaluating the ADT maturity model with additional experts might result in new findings and changes, especially if experts from different organizations are involved in the expert evaluation interviews. In the end, the consultants of CAPE Groep will use the maturity model and thus, the researcher decided only to involve them in the evaluation. It has to be noted that the ADT maturity model is relatively large. During the expert evaluation interviews, participants acknowledged this as a hurdle and indicated they might miss some flaws. As a result, it is advised to evaluate the ADT maturity model with additional experts for future work.

A fourth limitation consists of potential bias of the researcher or sponsor of the research. The researcher could be biased if he/she has experience, prior to this research, in the field of DT and agile. This knowledge could unconsciously steer the researcher into a specific direction during the development of the ADT maturity model. However, the researcher is no expert in the field of DT or agile. Before conducting this research, the researcher only performed an SLR on both topics and attended several lectures on the agile topic. The researcher believes that the acquired knowledge during these activities is not significant enough to lead to unconscious bias. In addition, the researcher can be biased, as it strives to obtain a high grade. However, a predefined list of evaluation criteria is used to test the non-functional requirements, preventing bias. In addition, the coded transcriptions of all interviews and the case studies have been added to the Appendix. This way, the development choices of the ADT maturity model can be justified. Regarding sponsor bias, this research was sponsored by CAPE Groep. It could have happened that the researcher unconsciously has been exposed to bias towards developing the ADT maturity model. However, the researcher tried to be as objective as possible to prevent development decisions in favour of CAPE Groep. The researcher believes that the practical supervisor did not influence the direction of this research.

The final threat to validity is regarding the generalizability of the results of this research. The author of the thesis performed two case studies to evaluate the ADT maturity model in context. The evaluation results, of course, could not be used to derive universally generalizable claims. However, we think that the results are indicative (Seddon and Scheepers, 2012). According to Wieringa (2014) and Seddon and Scheepers (2012), it is possible to think that our results might be observable in other organizations with the same context as the contexts of the case study organizations. This is because similar organizations might well experience similar organizational mechanisms while adopting an artifact, which could lead to similar effects. In line with this, the author of this thesis believes that the ADT maturity model could be used effectively in other organizations that share some contextual characteristics as our two case study organizations: namely, experience in agile and in DT, maturity-oriented thinking, process-oriented thinking and strong interest and commitment to improve maturity level of ADT. As the author demonstrated the ADT maturity model through its use in two organizations in the Netherlands, it is possible to assume that other Dutch organizations would also be able to use it, provided they share the mentioned characteristics of context. In addition, the maturity models found during the SLR and used to create the ADT maturity model, all originated from Europe. Moreover, the ADT maturity

model has been demonstrated in a consultancy firm and a logistics firm. While these two sectors are somewhat different, we observed that the ADT maturity model was equally successfully applied in both. This strengthens our believe that the artifact of this research is transferable to a large extent to organizations in Europe that have a degree of experience in the field of agile and DT, and that think systematically about their maturity level and want to improve it. We think that our evaluation results from the two case studies provide serious enough reasons for DT managers in other similar but different organizations to consider the ADT maturity model as a candidate approach, if they wish to advance in their agile DT endeavor.

Lastly, moving the ADT maturity model to other parts of the world might be difficult. One of the aspects of the ADT maturity model 'culture'. The working culture of an organization in, for example, the US can be completely different. The researcher has no experience with the working culture in parts of the world outside of Europe. However, the researcher knows that working cultures can differ. This can result in specific indicators of the ADT maturity model not being applicable or not being critical in other parts of the world. For example, it might be that an open environment is not usual in the US, and thus the score of this indicator will be 1. As a result, the researcher thinks that not all aspects of the ADT maturity model are generalizable to the whole world due to the difference in working culture between different parts.

6 CONCLUSION

This final chapter concludes this master thesis research. Seven research questions were investigated in this research. Investigating these seven research questions led to the ADT maturity model and assessment instrument artifacts.

This chapter first discusses the answers to the research questions. Afterwards, the contributions of this research to research, practice and practitioners of CAPE Groep B.V. will be discussed. Finally, this chapter ends with implications for researchers, practitioners and lines for future work.

6.1 Answers to the Research Questions

This research investigated seven research questions: six sub-questions and the main question. This section first answers the sub-questions and eventually answers the main research question.

RQ1: *What is an agile way of working and how can this be leveraged by companies?*
According to the Background Information Section, an agile way of working focuses on agility and adaptability. It does this by short iterative development cycles to satisfy customer requirements. Agile was first only applied as a software development method to teams within an organization. In a later stage, it was scaled to large organizations. Currently, business agility is a term used for scaling agile to organizations as a whole instead of just software development teams as it once started.

The core purposes of agile are incorporated in the 'agile manifesto' and are the following:

- Individuals and interactions over processes and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following a plan.

In addition, the 'agile manifesto' presents core agile principles which are listed in Section 2.1.2.

A company can leverage an agile way of working by adopting an agile framework. Agile frameworks describe how agile roles and responsibilities can be defined. Examples of agile frameworks are: Scrum, SAFe, LeSS and DAD. Effectively incorporating an agile framework inside a company allows for leveraging the benefits of working agile. Besides, DevOps practices can be adopted by companies as an extension to the agile practices. Many variations of DevOps can be incorporated into a company depending on their needs. Current variations are: BizDevOps, DevSecOps, CloudOps, MLOPs, and Intelligent DevOps. These are described in Section 2.1.3.

Furthermore, the SLR resulted in 24 agile guidelines which can be followed to become more agile. These 24 guidelines are divided into four groups: recommendations, frameworks, and processes. A company can leverage the agile way of working by following an appropriate guidelines for their company. Section 2.6 describes the different characteristics of these 24 agile guidelines. These characteristics are: type, application domain, guideline name, guideline number, guideline order, and assessment method. These characteristics have to be considered by companies that are planning to adopt an agile way of working.

RQ2: *What is digital transformation and how is its maturity assessed?*
DT can be defined as a broad term that refers to the customer-driven strategic business transformation which requires organizational change and implementation of digital technologies. According to the Background Information Section, DT can be explained by observing its external drivers, phases and strategic imperatives. Moreover, DT is the final phase and digitization and digitalization have to be achieved beforehand to be able to properly perform a DT. The external drivers are:

- Digital technology
- Digital competition
- Digital customer behavior

The phases are:

- Digitization
- Digitalization
- Digital transformation

The strategic imperatives are:

- Digital resources
- Organizational structure
- Growth strategy
- Metrics and goals

To assess the maturity of DT, maturity models are used. Four DT maturity models are found in literature during the SLR. Comparing the dimensions of these DT maturity models, the following DT maturity aspects are found and can be used to assess DT maturity:

- Culture
- Strategy
- People
- Technology
- Customers
- Resources
- Learning
- Governance

RQ3: *Which Agile maturity models and Agile guidelines with regard to digital transformation are provided in literature?*
This sub-question has been investigated during the SLR of this research. The SLR resulted in nine agile maturity models with regard to DT. Analyzing the nine maturity models, four out of the nine maturity models largely focused on DT:

- MMEO
- ARE-MMI4.0
- Maturity Index 4.0
- DMM

The other five maturity models were mainly regarded to agile:

- SAFe maturity model
- Agile CMMI Framework
- AgilityMod
- SAMI
- AMM

Comparing all nine agile maturity models with regard to DT resulted in 59 found different attributes. In addition, comparing the attributes, eight distinct constructs were found in total. Observing the five agile maturity models, only five distinct constructs were found. However, analyzing the four DT maturity models, eight distinct constructs were found. These eight constructs are presented by first listing the common agile term used for the construct and afterwards the common DT term used for the construct. The eight constructs are:

- Embrace change/Culture
- Plan and deliver software quality/Strategy
- Human centricity/People
- Technical excellence/Technology
- Customer collaboration/Customers
- Resources
- Learning
- Governance

The nine found maturity models are analyzed by looking into several characteristics of maturity models. These characteristics are: levels, attribute names, assessment method, quality identification, improvement prioritization, and attribute number. The findings for each maturity model on these characteristics are presented in Section 2.6.

Furthermore, a total of 24 agile guidelines were found during the SLR. These guidelines are divided into three different categories. These three categories are:

- Guidelines
- Frameworks
- Processes

Guidelines propose general recommendations or solutions, frameworks propose a set of practices that should be implemented, and processes consist of a predefined set of phases, stages or steps which have to be followed. Next to dividing the agile guidelines into categories, the agile guidelines are analyzed by considering the following guideline characteristics: application domain, guideline name, guideline number, guideline order, and assessment method. The three most promising guideline names per category have been discussed in detail to further elaborate on the contents of the agile guidelines. The findings on agile guidelines are presented in Section 2.6.

RQ4: *How to design a maturity model for companies which adopt an agile way of working and engage in digital transformation?*
According to the Maturity Models Section, a maturity model is often designed by two different parts. The first part consists of the 'design structure maturity models', and the second part defines the 'measurement instrument'. On the one hand, the 'design structure maturity models' part often includes a certain number of levels describing the path to maturity, a certain number of dimensions which are assessed, sub-dimensions of each dimension, and detailed descriptions of these dimensions and sub-dimensions. On the other hand, the 'measurement instrument' part generally includes assessment questions, sub-dimensions, dimensions, and a maturity score or level.

Concerning the design of a maturity model for companies which adopt an agile way of working and engage in DT, a conceptual model, Figure 19, has been established. This was the result of the performed SLR of this research presented in Section 2.4. According to the conceptual model, the following points have to be considered:

- Agile and DT dimensions have to be assessed.
- There consists around five different agile dimensions and eight different DT dimensions.
- Most maturity models include a quality identification.
- Most maturity models include an improvement order.
- Most maturity models include five maturity levels
- The maturity levels can be based on agile and DT practices retrieved from guidelines.

For the creation of the ADT maturity model, the maturity model development theory of Becker was adapted and used (Becker et al., 2009). The multi-method development strategy consisted of a systematic meta-model comparison, expert interviews, market research on ADT and a brainstorm session to determine the indicator weights. The systematic meta-model comparison allowed for comparing the constructs of the found agile and DT maturity models in the literature. After enhancing all the DT and agile aspects and afterwards combining them, this resulted in the seven final aspects of the ADT maturity model: culture, strategy, expertise, technology, internal organization, external organization and agility. Afterwards, expert interviews and market research was conducted to obtain additional information about agile and DT practices for the seven aspects. By performing qualitative content analysis, these findings were translated into indicators. Besides, these indicators were grouped into corresponding sub-aspects of the aspects. Finally, a brainstorm session was conducted to determine the indicator weights and obtain a increased precision in the determination of the sub-aspect maturity levels. This resulted in the first version of the ADT maturity model displayed in Section 3.3.

Afterwards, the first version of the ADT maturity model was evaluated through expert evaluation interviews. A total of 10 open questions were asked during the interviews to gain feedback on the current version of the maturity model. A second version of the ADT maturity model was established based on this feedback by again performing qualitative content analysis. This resulted in a final ADT maturity model consisting of seven aspects, 28 sub-aspects and 132 indicators displayed in Section 4.3.5.

RQ5: *How to operationalize the Agile Digital Transformation maturity model?*
The ADT maturity model can be operationalized by creating a 'measurement instrument' as presented in Section 2.3. A 'measurement instrument' should include assessment questions on the bottom line to be able to assess each sub-aspect of the aspects. This way the maturity levels can be calculated on each construct level of the model and eventually a total ADT level can be calculated. The first step

in operationalizing the ADT maturity model consisted of creating assessment questions based on the 132 indicators. As a result, each indicator of the ADT maturity model could be assessed. A qualitative approach was chosen to score each assessment question based on the knowledge and experience of the assessed organization's employees. A point interval could be calculated by appointing a score of one to five, based on a 5 point Likert scale, combined with the indicator weights. The researcher obtained maturity levels from an existing maturity model found during the SLR to translate the point intervals into a maturity level. The five maturity levels with their corresponding point intervals are: agile digital minimalist (0-30), agile digitally conservative (31-50), agile digitally pragmatist (51-70), agile digitally advanced (71-90), and agile digitally trailblazing (91-100). The maturity levels with their corresponding point intervals are displayed in Figure 25. This way, after an organization answered all the assessment questions, the maturity levels for the indicators, sub-aspects, aspects and a total level could be calculated. In addition, the researcher decided to assess the actual state and desired state of the indicators. Each assessment question has to be scored twice to obtain an actual and desired score during an assessment. As a result, the gap score was calculated by subtracting the actual level from the desired level. This gap score can be used to determine the improvement prioritization of an organization's ADT capabilities by focusing on the largest gaps first.

Furthermore, a second step in operationalizing the ADT maturity model was achieved by determining relations between DT and agile sub-aspects and indicators. During the research, the researcher noticed a significant overlap between agile and DT practices. As a result, the researcher indicated these overlaps by appointing the same colour to agile and DT sub-aspects and indicators. Figure 26 and Appendix D display these relations. Determining these relations allowed certain assessment questions to assess multiple indicators, such as an agile indicator and a DT indicator that are overlapping. As a result, similar assessment questions for DT and agile indicators did not have to be asked twice, but an automatic coupling was established.

The final step in operationalizing the ADT maturity model is creating the ADT assessment instrument in Mendix and has been described in Section 4.4. Using the ADT assessment instrument allowed organizations to answer the assessment questions. Afterwards, the ADT assessment instrument automatically calculated the maturity levels and can show the results on a dashboard page. The dashboard page showed the indicator, sub-aspect, aspect, and total maturity level(s).

RQ6: *How effective are the Agile Digital Transformation maturity model and assessment instrument in practice?*

During the evaluation & demonstration phase of this research, the effectiveness of the ADT maturity model and assessment instrument was tested. Expert evaluation interviews evaluated the ADT maturity model. During these interviews, evaluation criteria based on UTAUT were scored to test the non-functional requirements stated in the Introduction section (Venkatesh et al., 2003). The tested evaluation criteria are: performance expectancy, effort expectancy, attitude towards using technology, facilitating conditions and self-efficacy. Several evaluation criteria were omitted from the UTAUT checklist as these lacked relevance. The outcomes of the evaluation criteria were relatively positive. On the one hand, the lowest average score is 3.4 for the performance expectancy. On the other hand, the highest average score is a 4.3 for attitude towards using technology. All the scores are displayed in Figure 34. These results indicate that using the ADT maturity model in practice is valuable and effective.

Furthermore, the effectiveness of the assessment instrument in practice was observed by performing two observational case studies. In both cases, the assessment instrument was successfully applied in a real-world context. As a result, this indicates that the ADT assessment instrument can be effective in practice under certain circumstances. The cross case analysis presented in Section 4.5.5, indicated important remarks for evaluation based on the case study log presented in Appendix J.2. In addition, recommendations for further development of the ADT assessment instrument are established since the current version has been built according to the MVP principles. As a result, the ADT assessment

instrument complies to the functional requirements stated in the Introduction section but is still a basic version. The recommendations can be implemented to increase the effectiveness of the ADT assessment instrument in practice even further. These recommendations are based on expert remarks during the expert interviews or thought of by the author. The recommendations are elaborated on in Section 4.4.3. Both evaluation remarks and recommendations should be taken into account to further increase the effectiveness of the ADT assessment instrument in practice.

Main RQ: *How to design a maturity model which allows companies to assess and improve their agile and digital transformation practices?*
In this research, the ADT maturity model and assessment instrument have been created to allow companies to assess and improve their agile and DT practices. The ADT maturity model consists of seven ADT aspects: culture, strategy, expertise, technology, internal organization, external organization, and agility. Each aspect has its sub-aspects (28) and each sub-aspects is build upon indicators (132). Answering the assessment questions, which are linked to their corresponding indicator, allows for an assessment of a companies agile and DT practices. Applying the ADT assessment instrument in two case organizations successfully showed the fulfilment of the functional requirements presented in this research. Using the ADT assessment instrument allows organizations to score their actual and desired agile and DT capabilities states. By analyzing the gap and critical values, the organization can establish an improvement prioritization to improve its agile and DT capabilities. The critical values with the largest gap between the actual and desired maturity level should be focused on first before concentrating on other improvement points.

As mentioned before, the ADT maturity model has been evaluated by the normal operators of the systems, the DT consultants. The results of the evaluation were promising and indicated an acceptance of the proposed ADT maturity model.

6.2 Contributions of this Research

This section describes the contribution of this research. Contribution to research, practice, and practitioners at CAPE Groep B.V. are given. These contributions indicate the relevance of the established artifact for research, practice, and practitioners at CAPE Groep B.V.

6.2.1 Contributions to Research

This section presents the contributions to research. The following contributions to research are made:

- The first research contribution is an aggregated view on the state of the art in maturity models and guidelines for DT in agile. This aggregated view became the fundamental part for the maturity model proposed in this thesis. This aggregated view was achieved through an SLR. The SLR provided in this research investigates existing agile maturity models with regard to DT. In addition,the SLR presented agile guidelines concerning DT. Thus, state of the art is presented on agile guidelines, agile maturity models and DT maturity models. Based on the findings of the SLR, a high-level conceptual model was established, depicting an approach on how to design a maturity model which combines the agile way-of-working and DT. The SLR is presented in Section 2.4.

- The second research contribution of this research is the proposed methodology which consists of a multi-method development a multi-method evaluation strategy. This proposed methodology can be followed by other researchers to create their own maturity models. The multi-method design approach consisted of a systematic meta-model comparison, expert inter-views, market research and a brainstorm session. The multi-method design and development method is presented in Chapter 3. Besides, the multi-method evaluation approach included expert evaluation interviews and observational case studies. Both multi-method approaches can be used by other academics to

construct maturity models and evaluate them. The multi-method evaluation approach is presented in Chapter 4.

- The third important contribution is the final artifact of this study: the ADT maturity model and assessment instrument. This maturity model is novel two aspects. First, the ADT maturity model allows for assessing DT aspects and agile aspects which are important for DT to get to a total ADT maturity level. Second, the ADT maturity model allows for the calculation of DT capabilities and agile capabilities separately. This novelty has been established by first enhancing the four DT and five agile maturity models found during the SLR and afterwards combining the synthesized maturity models into on maturity model. Besides, the synthesized agile maturity model has been combined with the synthesized DT maturity model by adding an additional 'agility' aspect to the six DT aspects. As a result, a total ADT maturity level can be calculated and the DT and agile capabilities can be calculated separately.

- The fourth theoretical contribution is the empirical evaluation of the newly proposed artifact in a real-world context. This research conducted a multi-method evaluation involving DT consultants, the normal users of the model, and organizations, the functional beneficiaries of the model. Seven experts attended the expert evaluation interviews and scored UTAUT statements with promising scores. In addition, the ADT assessment instrument was successfully applied during two observational case studies. As a result, the ADT maturity model and assessment instrument seem promising in practice. After this evaluation, it is concluded that the ADT maturity model is complete and clear from the perspective of the involved practitioners. Both evaluations are described in Chapter 4.

6.2.2 Contributions to Practice

This section presents the contributions to practice. The following contributions to practice are made:

- The first practical contribution is the maturity model which provides indication that it is applicable and suitable for use. As pointed out in the evaluation chapter, This maturity model can be used in practice when discussing ADT components of an organization and comparing them to the model. The ADT maturity model's design and development are explained in Chapter 3.

- This research provided an assessment instrument prototype to operationalize the ADT maturity model and use it in practice. This assessment instrument complies with the functional requirements and allows for assessing an organization's agile and DT capabilities. Besides, an improvement prioritization can be established by observing critical values and the gaps between desired and actual state. The assessment instrument, together with design choices, is described in Section 4.4. Recommendations for further development of the ADT assessment instrument are displayed in Section 4.4.3. These recommendations are based on expert remarks and the thoughts of the author.

6.2.3 Contributions to Practitioners at CAPE Groep B.V.

This section describes the contribution to CAPE Groep B.V. The following contribution to practitioners at CAPE Groep B.V. are made:

- As part of this research, the author prepared guidelines on how to use the assessment instrument, on how to conduct an assessment in a client organization, and on improving the ADT assessment instrument with new functionalities. The guidelines on how to use the assessment instrument are made in PowerPoint and include a screenshot of every page of the assessment instrument with explanation on how to use the functionalities. The guidelines on how to conduct an assessment are presented in PowerPoint as well. The guidelines describe the assessment procedure of the second observational case study which has been executed in this research. Finally, the guidelines

on improving the ADT assessment instrument with new functionalities is established in list form. This list includes new functionalities mentioned by experts or the author of this master thesis.

- The second contribution to practitioners at CAPE Groep B.V. is the presentation of the author about vital findings obtained during the research. This presentation is given during an IQ session where employees of CAPE Groep B.V. are present.

- The third contribution to CAPE Groep B.V. is the technology transfer service which is provided to assure the ability to use the ADT maturity model in the future. The author established the assessment instrument in Mendix and transferred the Mendix project to the laptop of a CAPE Groep B.V. employee. The author provided documentation about the application when needed.

6.3 Implications for Research and Practice

This section addresses the implications of this research. It presents implications for researchers, for practitioners and presents future work opportunities.

6.3.1 Implications for Research

This section talks about the research implications and presents lines for research in the future.

Regarding the implications for academics, the ADT maturity model is currently in its second version. It has been evaluated once together with seven experts during expert evaluation interviews. Additional evaluation has to take place to get the ADT maturity model to the next level. In addition, the ADT assessment instrument has been demonstrated through two observational case studies in two different organizations. This is just the start of testing the model in practice, and other appliances to real-world contexts should be made in the future. The following topics might be interesting for future research:

- Automating the appointment of actual scores quantitatively. The ADT maturity model presented in this research relies on a qualitative approach for appointing the actual levels. For future work, it might be interesting to quantify certain indicators that allow for automating the appointment of an actual level. For example, the indicator 'loose coupling between layers' can be measured quantitatively by observing the number of connections between different layers in the IT landscape. Based on the number of connections, an actual score could be appointed automatically.

- The use of flexible indicator weights. Three experts established the current indicator weights during a brainstorm session. These experts are all from the same organization. Asking other experts from different organizations to order the indicators on importance might result in totally different indicator weights. Future research can be conducted to compare the difference in indicator weights between organizations or even market sectors.

- Sub-aspect and aspect weights. The ADT maturity model determined weights for the indicators. However, no weights are appointed to the sub-aspects or aspects of the ADT maturity model. For future research, it is interesting to look into the importance of the several ADT aspects: culture, strategy, expertise, technology, internal organization, external organization and agility.

- Additional research into the ADT aspects. The ADT maturity model has a large scope. As a result, the aspects were not thoroughly investigated individually. This leaves the opportunity to further investigate one or several ADT aspects and investigate what is essential to measure its maturity. This might result in additional or different findings which can benefit the ADT maturity model.

- Apply the model in more organization. The assessment instrument has been applied in two organizations which already started their ADT. It might be interesting to apply the model to other

organizations for future work to increase its validation. In addition, applying the assessment instrument to an organization which not yet started its ADT might result in different findings.

- Keep improving the model based on developments in the field of ADT. Both agile and DT are important fields for research and practice. As a result, it is advised to keep improving the ADT maturity model based on new developments. This can be established by analyzing literature or performing expert interviews. This results in findings from both practice and research.

6.3.2 Implications for Practice

This section presents the implications for practitioners. First it presents implications for practitioners in general and concludes with an implication for CAPE Groep B.V.

As a consequence of this research, practitioners in the field of agile and DT are now able to assess their ADT maturity. Currently, a shift towards using agile in your DT is increasing in popularity. The ADT maturity model incorporated the crucial components from agile for DT, according to experts and market research, into one maturity model together with all DT aspects found in four DT maturity models. Since the ADT maturity model is prescriptive, it allows for creating an improvement order based on observing the gaps between the desired and actual state of ADT capabilities. Focusing on the most significant gaps and critical values, an organization can improve their ADT capabilities using the ADT maturity model and assessment instrument.

The author believes that the ADT maturity model is most useful when an organization focuses on DT and applies agile methods. However, the ADT maturity assessment instrument can calculate the agile and DT maturity levels separately. As a result, organizations not applying the agile way of working can also apply the model to measure and improve their DT capabilities. In addition, an organization that has not yet started its ADT or just started its ADT can also use the maturity model and assessment instrument. These organizations will score low maturity levels but can use the ADT maturity model and assessment instrument in an exploratory way. As a result, the organizations get acknowledged with essential aspects of ADT.

Furthermore, the author supposes that any practitioner with a degree of knowledge on agile and DT can apply the model. According to the evaluation scores of the UTAUT statements, the model is relatively easy to use and understandable. The only point of attention is that completing one complete assessment might take a considerable amount of time. Moreover, involving an increasing number of employees in the assessment increases the complexity of the assessment.

Concerning the implications for CAPE Groep B.V., this research presents recommendations for further developing the assessment instrument. The current version is based on MVP user stories and the requirements stated in this research. However, the researcher has added non-MVP user stories to indicate additional functionality, which increases the assessment instrument's performance, effectiveness, and ease of use. In addition, it is advised to regularly revise the ADT maturity model and assessment instrument as ADT is an upcoming field of study.

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APPENDIX

A SYSTEMATIC COMPARISON

Aspect (synthesis)	Description (synthesis)	Maturity Index 4.0 (Pivot model)	Description	Explanation	ARE-MMI4.0	Description	Explanation	MMOE	Description	Explanation	DMM	Description	Explanation
Culture	The **culture of change** which should be in the veins of the employee - **think change, do change**. Between the employees there should exist an environment of **trust, openness, no blame and teamwork** to increase **knowledge sharing** to keep learning from each other.	Willingness to change	To what extent are employees willing to continuously review and adapt their own behaviour in response to a changing environment. Besides, people should look at their own environment with open eyes, recognise when there is an opportunity or a need for change	1 on 1 mapping	People	Openness of employees to new technology, autonomy of employees	Openess to technology is included in think change	Culture	Openness to new technologies, openness to change	Openess to technology is included in think change. Change 1 on 1	Culture	Readiness to take risk, error culture/no blame culture	No blame culture is no blame in communication
		Social collaboration	An environment characterised by trust and social relationships provides the basis for open, uninhibited knowledge sharing between employees	1 on 1 mapping	Culture	Knowledge sharing, open-innovation and cross company collaboration, value of ICT in company	Knowledge sharing	Culture	Open communication, mutual support	Open communication is open knowledge sharing. Mutual support is knowledge sharing/teamwork	Collaboration	Teamwork, knowledge management, flexible working	Teamwork is teamwork and knowledge management partly refers to knowledge sharing
Strategy & Expertise	The digital strategy should be based on facilitating an **information-driven way of working**. Facilitators of this are: **technological features**, such as sensors, which collect data and are able to process data into information, **changes in business models** and **digital competence** of your employees. In addition, the strategy should focus on facilitating structured communication between employee - machine and machine - machine to enable structured data flow. The **digital expertise** of the employees should be sufficient and **continuously improved** to be able to function in an **information-driven** company	Digital capability	Facilitates an information-driven way of working that creates awareness of the real situation on the ground. This approach relies on the process environment. In this environment, technological features must be implemented to enable data collection and to process this data into information. Besides, employees need to be trained and continue to be trained to develop knowledge required for Digital Transformation	1 on 1 mapping	Strategy, People	Implementation I40 roadmap, available resources for realization, adaption of business models ICT competence of employees	Maturity items indicate strategy components for effective digitalization. Available resources can be mapped into technological features, business models to business models and ict competence to digital expertise of employees	Equipment, Employees, Strategy	Equipment with digital devices, software Knowledge/Skills in dealing with digital technologies, usage of devices and services, attitudes, readiness for further learning Existence and implementation of digital strategy, managers promote digitalization with priority,	Equipment and software can be mapped to technological features. Knowledge and skills to expertise, readiness to further learning to continuously improved learning. Strategy to the main aspect in general	Strategy, Product Innovation, Expertise	Strategic innovation, Digital commitment Business segment extension Digital affinity	Digital commitment item descriptions indicate technological features and strategy components. Business segment extension descriptions indicate new business models. Digital affinity is expertise
		Structured communication	Describes the technical approach to communication media for employees and the interfaces between both people and machines and between different machines	1 on 1 mapping	Technology	Existence of modern ICT, utilization of mobile devices, utilization of machine-to-machine communication	Utalization of mobile devices and utilization of machine-to-machine communication 1 on 1 mapping	Digital learning and teaching	Digital platforms, e-learning offerings, working with digital devices in classroom settings, digital education as an overall goal, data driven teaching and learning	Gives an educational mapping onto machine - people and machine - machine communication	Process digitization	Digital marketing communication	Item description indicated similarities to people - machine communication
Information Systems	The **data produced by processes should support the decision-making** within the organization. To what extent does the organization meet the **technical requirments for real-time access** and possess an **infrastructure that enables necessary data processing and seamless information delivery**? Examples: **automation of processes, decentralization of processes, modelling and simulation**, etc. In addition, there should exist an **all encompassing system** integrating all the standalone information systems. Examples: **standards, data quality, IT security, flexibility, etc**	Information processing	Data should be prepared and processed in a manner that supports decision-making. To what extent does the organization meet the technical requirments for real-time access and possess an infrastructure that enables necessary data processing and seamless information delivery	1 on 1 mapping	Products, Operations	Individualization of products, digitalization of products Decentralization of processes, modelling and simulation,	Individualization and digitalization of products help obtain data from products and steer decision-making. Modelling and simulation of data as well. Decentralization of processes 1 on 1	Organization	Sufficient financial resources, technical support, efficient procurement and maintenance, pedagogical support	Technical support can be mapped onto technical requirements	Process digitization	Automation, data-driven business	Automation helps obtain data and steer decision-making. Data-drive business can be mapped 1 on 1
		Integration	To what extent does there exist a platform connecting the different information systems? This requires standard interfaces, flexibility, openness, comprehensive IT security and appropriate data quality	1 on 1 mapping	Governance, Products	Labour regulations for I40, suitability of technological standards, protection of intellectual property product integration into other systems	Suitability of technological standards is standards. Protection of intellectual property is IT security. Product integration is all encompassing system.	Technology	Up-to-date infrastructure, homogeneous technology landscape, standards	Up-to-date infrastructure is all encompassing system. Standards is standards	Information technology	Integrated architecture, IT-expertise	Integrated architecture is all encompassing system. IT-expertise is standards
Internal & External Organization	The leaders should lead by example and show their **willingness to become a digital organization**. The leadership style of the leaders has to change to a **democratic leadership style** and **employees constraints should decrease and their individual responsibility should increase**. Futhermore, the internal organization should work in an **agile way** with **decentralized and flexible teams**. On the other hand, the external organization focuses on the **partner network** of the organization and to what extent the **information exchange in the partner network is more transparant and dynamic due to automated and seamless information exchange**. Besides, the external organization focuses on to what extent **customers and customer data** has been involved/used in the processes to **create customer value**	Organic internal organization	Covers the internal organization of the company which should encourage employees having fewer constraints and a high degree of individual responsibility. Flexible teams, motivational goals, decentralized team and an agile structure	1 on 1 mapping except for leadership part	Leadership, Operations	Willingness of leaders, management competences and methods, existence of central coordination for I40 Interdisciplinary, interdepartmental collaboration	Willingness of leaders is willingness to become a digital organization.	Leadership	Democratic leadership style, creative freedom granted	Democratic leadership style and creative freedom granted leads to less constraints and more individual responsibility	Organization, Transformation management, Information technology	Digital team set-up, organizational agility Governance, performance measurement, management support Agile project management	Organizational agility is agile way. Performance management is motivational goals. Management support is willingness of leaders is willingness to become a digital organization. Agile project management is agile way
		Dynamic collaboration in value networks	Covers the external organization of the company with its market. To what extent enables automated and seamless information exchange between different companies them to cooperate more dynamically and with more transparancy with regard to the market. Besides, to what extent is the focus on creating	1 on 1 mapping	Customers	Utilization of customer data, digitalization of sales/services, customer's digital media competence	Utilization of customer data and customer's digital media competence is customer data used to create customer value.	x	x	x	Product innovation, customer experience, Organization	Innovation capability, customer integration Experience design, analytics Partner network	Customer integration, experience design and analytics is customers/customer data involved/used to create customer value. Partner network is partner network

Figure 44: DT aspect sys com

Aspect	Description	SAMI (Pivot	Description	Explanation	SAFe maturity	Description	Explanation	Agile CMMI maturity	Description	Explanation	AgilityMod	Description	Explanation	AMM	Description	Explanation
Embrace change to deliver customer value	The success of a sofware development effort is based on the extent to which it helps **deliver customer value**. In many cases, the development team, as well as the customer, are in a **continuous learning process** as to the **requirements necessary to realize additional customer value**. Hence, an attitude of **welcoming and embracing change** should be maintained throughout the software development effort	Embrace change to deliver customer value	The success of a sofware development effort is based on the extent to which it helps deliver customer value. In many cases, the development team, as well as the customer, are in a continuous learning process as to the requirements necessary to realize additional customer value. Hence, an attitude of welcoming and embracing change should be maintained throughout the software development effort	1 on 1 mapping	Embrace change to deliver customer value	The success of a sofware development effort is based on the extent to which it helps deliver customer value. In many cases, the development team, as well as the customer, are in a continuous learning process as to the requirements necessary to realize addtional customer value. Hence, an attitude of welcoming and embracing change should be maintained throughout the software development effort.	1 op 1 mapping	Embrace change to deliver customer value	Agile methodologies measure success of a sofware development effort on the extent to which it helps deliver customer value. Since some requirements that realize additional customer value can not be known beforehand, an attitude of embracing and welcoming change should be maintained throughout the software development process. This is reflected in the value of "Responding to change over following a plan" the agile manifesto	1 op 1 mapping	Simple, performing aspect practices	Balance the predictive work and adaptive work, employ minimally sufficient ceremony Perform aspect practices	Mapped, since keeping it simple implies responding to change over following a plan	Adapting	Real change resulting in quality improvement	1 on 1 mappig of the long description
Plan and deliver software quality iteratively	**Early and frequent delivery of working software** is crucial, because it provides the customer with a functional piece of the product to review and provide **feedback** on. This feedback is essential for the process of planning for upcoming **iterations**, as it shapes the **scope and direction** of the software development effort	Plan and deliver software quality	Early and frequent delivery of working software is crucial, because it provides the customer with a functional piece of the product to review and provide feedback on. This feedback is essential for the process of planning for upcoming iterations, as it shapes the scope and direction of the software development effort	1 on 1 mapping	Plan and deliver software quality	Early and frequent delivery of working software is crucial, because it provides the customer with a functional piece of the product to review and provide feedback on. This feedback is essential for the process of planning for upcoming iterations, as it shapes the scope and direction of the software development effort	1 on 1 mapping	Plan and deliver software quality	Delivering working software early and frequently is reflected in the agile value "Working software over comprehensive documentation" from the agile manifesto. This provides the customer with a functional piece of the product to review and provide feedback on, which in turn is essential for planning the scope and direction of upcoming iterations	1 on 1 mapping	Iterative, performing aspect practices	Develop work products in an iterative and incremental way; communicate effectively Perform aspect practices	Mapped iterative 1 on 1. Communicate effectively is needed to extract the right requirements and obtain value	Iterative planning, acceptance criteria	Plan continuously, keeping progress visible and apply reality based feedback to make informed decisions Validation of functional correctness is critical. One of the areas contributing significantly to quality improvement is increasing the fidelity and bandwith of information communicated to the developers just in time for them to develop within an iteration	Mapped, since it describes small iterations with visible value. Feedback is feedback This describes the quality improvement in small interations
Human-centric	The **reliance on people** and the **interactions among them** is a cornerstone in the definition of agile software processes	Human-centric	The reliance on people and the interactions among them is a cornerstone in the definition of agile software processes	1 on 1 mapping	Human-centric	The reliance on people and the interactions among them is a coneristone in the definition of agile software processes	1 on 1 mapping	Human-centric	The reliance on people and the interactions between them is a fundamental part of all agile methodologies	1 on 1 mapping	Human-centric, performing aspect practices	Support collaborative work and shared responsibility, adopt agile leadership styles and adjust the behaviors towards mistakes of people	Mapped, since it highlights the importance on people interactions	X	X	X
Technial excellence	Agile developers are comitted to producing only the highest **quality code** possible, because high quality code is essential in **high-speed development environments**, such as the ones characterized as agile Examples: **refactoring, coding standards, code validates code**, etc	Technical excellence	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments, such as the ones characterized as agile	1 on 1 mapping	Technical excellence	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments, such as the ones characterized as agile	1 on 1 mapping	Technical excellence	High-quality code is essential in an agile, fast-paced development environment	1 on 1 mapping	Technically excellent, performing aspect practices	Incorporate agile engineering methods/practices to the aspect practices, integrate tools to aspects to improve the productivity Perform aspect practices	Mapped, since it mentions agile engineering methods/practices and tools	Engineering excellence, green-bar tests and builds	There are an irreducible set of practices that are necessary to produce high quality software. These processes include refactoring, coding standards, and following S.O.L.I.D principles. Getting other eyes on code is also a high priority Code validates code; development builds are automated. Broken tests and builds are promptly fixed	Mapped, since it mentions agile engineering methods/practices and tools Mentions an agile engineering method
Customer collaboration	Inspired by the original statement of the agile manifesto, there must be significant and frequent **interaction between customers, developers, and all the stakeholders** of the project to ensure that the product being developed **satisfies the business needs of the customer**	Customer collaboration	Inspired by the original statement of the agile manifesto, there must be significant and frequent interaction between customers, developers, and all the stakeholders of the project to ensure that the product being developed satisfies the business needs of the customer	1 on 1 mapping	Customer collaboration	Inspired by the original statement of the agile manifesto, there must be significant and frequent interaction between customers, developers, and all stakeholders of the project to ensure that the product being developed satisfies the business needs of the customer	1 on 1 mapping	Customer collaboration	The agile manifesto value "Customer collaboration over contract negotiation" emphasizes the importance of significant and frequent interaction between customers, developers and all other stakeholders of the project to ensure that the agile project satisfies the requirements of the customer	1 on 1 mapping	X	X	X	Iterative planning	Engage the entire team	Engage the entire team is significant and frequent interaction between customers, developers, and all the stakholders of the project
Learning	Encourage people in the organization to **participate in learning, teaching and improvement**, collect **measures to support learning and improvement**	X	X	X	X	X	X	X	X	X	Learning, performing aspect practices	Encourage people in the organization to participate in learning, teaching and improvement, collect measures to support learning and improvement Perform aspect practices	Pivot	Learning	A focus on improving skills and learning from doing	Mapped, since it both focuses on improving skills over time in a broad manner

Figure 45: Agile aspect sys com

Aspects	Definition	Explanation (mapping to systematic comparison)	Aspects (continued)	Definition	Explanation (mapping to systematic comparison)
Culture	The culture describes the culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities, the culture of change which should be in the veins of the employee - think change, do change and the culture of teamwork between the employees to increase knowledge sharing to keep learning from each other.	1 on 1 mapping compared to the systematic comparison except for the addition of the first part about the culture of seeing opportunities, taking risks and being able to make decions based on them. This has been added based on findings from the interviews.	Internal Organization	The internal organization describes the leadership components for top management in the interal organization, the department/teams components for the internal organization, the components for organizational roles within the organization and the components for the way of working when performing digital transformation in an organization.	Internal organization is split from external organization to decrease complexity. Mapped 1 on 1 compared to the systematic comparison: The department/teams components describe the 'employees constraints should decrease and their individual responsibility should increase' and 'decentralized and flexible teams'. The way of working describes parts of the 'working in an agile way'. Organizational roles is added to put an increased importance on role and responsibility division in the organization, since it was often mentioned in interviews.
Strategy	The strategy describes the management's strategic viewpoint on how to manage digital transformation, the transformative vision of the strategy, the digital strategy itself, the strategic resources needed to transform digitally and the monitoring of the digital strategy.	Strategy is split from expertise to decrease complexity. Information-driven way of working is mapped to the monitoring part of the description and is partly input for creating the transformative vision and strategy --> insights from data. Changes in business models is mapped to the digital strategy which can be continuously adapted based on changes. Structured communication was not mapped, since no interview participants or market research mentioned it here. It is mapped to technology instead.	External Organization	The external organization describes the digital partner network of the organization, the extent to which they are digitally transformed themselves and the collaboration with them. Besides, it describes the competition of the external organization and the digital customer engagement of the external organization which describes how the customer is involved in the digital transformation.	External organization is split from internal organization to decrease complexity. The digital partner network can be maped to the 'information exchange in the partner network' from the systematic comparison. Digital customer engagement can be mapped to 'focuses on to what extent customers and customer data has been involved/used in the processes to create customer value'. Competition has been added, since it was mentioned interviews.
Expertise	The expertise describes the management of digital transformation expertise within an organization, the expertise which is important for performing digital transformation within an organization and the ability of an organization to offer continuously learning opportunities and the ability of employees to continuously learn.	Expertise is split from strategy to decrease complexity. Digital expertise and continuous learning are mapped 1 on 1 compared to the systematic comparison. Expertise management is added, since it was mentioned by interview participants.	Agility	The agility aspect describes the relevant parts of agile to execute digital transformation in an agile way. It's a broad aspect based on the following core agile maturity aspects: embrace change to deliver customer value, plan and deliver software quality iteratively, human-centric, technical excellence, customer collaboration and learning.	Can be mapped 1 on 1 to the systematic comparison of the agile aspects.
Technology	The technology describest the core flexible IT systems an organization needs for digital transformation and their reason to choose them, the building blocks and structure of the IT architecture, the ability of an organization to obtain data from systems and to make decisions based on analysis of the data during digital transformation, the ability of an organization to monitor the obtained data from systems, the measures taken to increase security of the systems and the degree to which core processes inside of an organization are automated.	Changed from information systems to technology based on feedback from the interviews. Mapped 1 on 1 compared to the systematic comparison, different words are used with the same meaning. IT systems have been added, since certain core systems need to exist at an organization to perform digital transformation, according to the interviews.			

Figure 46: ADT aspects

B EXPERT INTERVIEWS DETAILS

This Appendix describes the process of conducting the expert interviews. It describes the interview questions in detail, it provides the used interview protocol which is used during each interview and it provides transcriptions of relevant parts of the interview.

B.1 Interview Questions

1. **Demographic information of the participant.**
   (a) Can you tell me about your work: what is the role in the organization?
   (b) In your last project, what did the term DT mean to you?
   (c) Have you ever worked in a DT project? In how many? And in what capacity?
   (d) What is your exposure to maturity models? Have you ever been involved in the use of a maturity model of some kind?
2. **Discussing the found DT aspects in literature.**
   (a) The found DT aspects are: culture, strategy, expertise, information systems, internal organization and external organization. Do you observe these six aspects in your DT project? Can you relate any of the six aspects to your own organization?
   (b) Are these aspects complete? Would you think some aspects need to be added?
   (c) In your perception, which DT aspects are most important? Would you please rank them in terms of importance?
3. **Assessing the maturity of the aforementioned DT aspects by linking indicators to the aspects.**
   (a) According to you, what would be a good indicator(s) for the culture aspect?
   (b) According to you, what would be a good indicator(s) for the strategy aspect?
   (c) According to you, what would be a good indicator(s) for the expertise aspect?
   (d) According to you, what would be a good indicator(s) for the information systems aspect?
   (e) According to you, what would be a good indicator(s) for the internal organization aspect?
   (f) According to you, what would be a good indicator(s) for the external organization aspect?
   (g) Does your organization measure the maturity of one of the aforementioned DT aspects?
4. **Combining agile and DT aspect into one maturity model to come up with a maturity model for achieving DT in an agile way.**
   (a) If DT needs to be achieved in agile fashion, what would the term “agile” mean, according to you?
   (b) What agile aspects and practices need to be considered for inclusion in order to be able to assess how mature an organization is in doing DT in the agile way?

B.2 Interview Protocol

Before start interview

1. Do you mind if the interview is in English?

   Introduction: Thanks for participating in the interview. I'm very glad you can help me with my research. So, my graduation project is about digital transformation, agile and maturity models. Since I'm not an expert, I wanted to do interviews on digital transformation and digital transformation maturity to obtain additional information about the topic for building my maturity model. In addition, digital transformation is a very new topic and information in practice might be ahead compared to the information in literature. In this interview, we will be going through the six main digital transformation aspects which I found in literature. **Show the slide of how the interview questions are mapped to the model and highlight the top row.** Afterwards, I will be asking questions on how you think these six aspects can be linked to indicators of the aspects. **Show the slide on how the interview questions are mapped to the model and highlight the third layer.** An indicator can be explained as an observable item, which can be answered by yes or no, and belongs to a higher object, in our case the DT aspect. This hasn't to be detailed and every observation from practice is helpful. Finally, I will be asking questions about what agile means in achieving digital transformation in an agile way. **Show the slide on how the interview questions are mapped to the model and highlight the right most column.** I'm asking this questions, since one of the goals of this graduation project is to combine agile with digital transformation into one maturity model. In the end, I will be combining the findings from this interview together with information from literature to fill the contents of the agile digital transformation maturity model. **Show the slide on how the interview questions are mapped to the model and highlight the overall model.**

   (a) Since you are a consultant, you can answer the questions based on experiences with a current project or projects you have ran by clients.

   (b) Since you are the CEO, you can answer the questions based on finished projects at clients organization and based on a leader viewpoint.

   (c) Since you are an employee at company X, you can answer the questions based on the experience at company X.

   After I have completed and validated the model, I will offer you the opportunity to use the agile digital transformation maturity model.

   (a) Since you are a consultant, you can use the model in the future if clients want their digital transformation maturity to be assessed.

   (b) Since you are the CEO, your organization can use the digital transformation maturity model to assess clients maturity on this topic.

   (c) Since you are an employee of company X, your organization can you the digital transformation maturity model within your organization to assess your digital transformation maturity.

   Since I will be asking many questions and the answers of the questions will be difficult to manually write down, I would like to record the interview.

2. Do you agree with the recording of this interview? The recording will be used for transcribing the interview and deleted afterwards.

3. The relevant parts of the transcriptions of the interview will be published in the thesis. The researcher will make sure the participant and the company will remain anonymous. Do you agree with this?

4. Do you have any other questions before we start the interview?

Start interview

5. When reaching question 2: **When talking about DT ask for participant's definition of DT. My definition:** "Digital Transformation is about transforming the whole organization in an digital way, transforming the current traditional business models." **If participants are not familiar with maturity models, give an explanation.** "A maturity model is a tool that helps people assess the current effectiveness of a person or group (digital transformation) and supports figuring out what capabilities (aspects together with indicators) they need to acquire next in order to improve their performance."

6. When reaching question 3 + 4: **Show the slide on the DT aspects and their descriptions to get a better grasp. Walk through the DT aspects 1 by 1 and let the participant answer question 3 and 4 at the same time.**

7. When reaching question 5: **Show the slide on how the interview questions are mapped to the model and highlight the right most column.**

Ending interview

8. Thanks for participating in the interview I learned many new thing which I can use for the maturity model.

9. After I have completed and validated the model, I will offer you the opportunity to use the agile digital transformation maturity model.

   (a) Since you are a consultant, you can use the model in the future if clients want their digital transformation maturity to be assessed.

   (b) Since you are the CEO, your organization can use the digital transformation maturity model to assess clients maturity on this topic.

   (c) Since you are an employee of company X, your organization can you the digital transformation maturity model within your organization to assess your digital transformation maturity.

10. Do you want to join the second interview round where the first version of the full filled in model will be evaluated? This validation round will have the goal to test the content completeness on the one hand. On the other hand, this validation round will test the practicality and usefulness of the system. This feedback will be used to create the second, final, version of the agile digital transformation model.

11. One final question: do you have any feedback on the overall interview? I would appreciate any feedback to improve the overall interview and learn from this experience.

B.3 Interview Transcriptions

Coding category	Transcription
Experience General	Permission to record audio is requested before starting. **[T]:** So let's switch to English. The first question is about the role in your organization. 'X', can you tell me about your work and what you are doing in 'X'? **[I1]:** Yeah, sure. I've been working for 'X' for three and a half years right now. I started originally as a trainee. I completed the traineeship. During my traineeship, I'm still working on various number of IT projects. In the beginning, I think you're most of the time busy with realizing software. But during the time and the more experience you get, you also notice the environments around a realization or an implementation of a software project, and I think, yeah, that's interesting stuff for, in this case, your research. So I think for the first two years, two and a half years, I mainly focused on implementing and realizing software. And I think the last one and a half year I've been working. Yeah, 50%, on making and implementing software. And the rest of the time, I'm busy with project management, and yeah, more the environments around the software products.
General	**[T]:** Then we have question two or section two, which is about experiences with digital transformation, and maturity models inside the organization. I was wondering, in how many projects have you worked with regard to digital transformation? And what was the capacity of those projects? **[I1]:** I don't know if when we execute a project, the real goal is digital transformation. Of course, we want to modernize the IT projects. But I don't know if a company wants a digital transformation, I think the first thing to discuss is the meaning and the definition of digital transformation. **[I1]:** At least for me. What I see with the definition of a digital transformation is that the entire organization of a client is transforming. So of course, the digital mindset and we as 'X' can have a small portion of that digital transformation, of course, we can help the client and will produce, in the end, have a positive result in the digital transformation, but we don't get an assignment for just transforming the entire organization within the digital transformation.
Experience DT	**[I1]:** So I've been working on I think 30 projects. 6,7 or 8 big DevOps teams, I think, in total 60 applications. And a couple of enterprise resource busses.

Example	**[I1];** So a fair amount, the most what I experienced is that there's also a really big difference between corporates, for example, I work for a big client 'X'. What you see over there is that they're really focusing on what is required to for a digital organization. So you also see different roles in an organization as 'X'. If you compare it, for example, to a small transports company where we also work for they're really still focused on their main business for logistics, but the mindset over there is just completely different. I think in those companies also the owner is still most of the time really active. And the owner was really good and doing trades or logistics, and has less interest in IT. And I think for a real good digital transformation. Yeah, the organization really has to change.
Experience MM	**[T]:** And what about the exposure to maturity models? Have you ever encountered or have been involved in the use of such a model? Or do you know what it is? **[I1]:** Yes, for our clients they hired a really big consulting firm. And the consulting firm introduced one Maturity Model. To check on which level the IT landscape was, so I have some experience, but I don't really have experience implementing it or using it. And I think we as 'X'. Yeah, do or do not yet, use it. I think the only one who sometimes uses it is 'X' and the rest doesn't.
IO	**[T]:** Then we go to the questions about the model. The third section is about the digital transformation aspects. So in literature, I found the following ones: culture, strategy, expertise, information systems, internal organization and external organization. **[I1]:** I think the best is to read it over on the main topics, leadership is also a component somewhere?
IO	**[I1]:** On the first thing, culture, I think one really important thing of culture is that you have an example, within your organization. Like culture is really hard to describe because culture, you cannot really measure it. Yeah, maybe with a couple of KPIs, of course, you can try. But leadership by example is I think, also really important for internal organization Yeah, maybe you already described that under the internal organization.
Example	**[I1]:** And it's based on for example, if someone already worked somewhere for 20 years, yeah, their motivation in their head that the company's just works like 'A'. And it's really hard to change, I think.
C	**[I1]:** Culture is important, but therefore, you need people and people need to be really flexible to change.
Example	**[I1]:** because if your company is not yet really adjusted to a digital or digital focus, then if you're already working on finance, for example, and you, you just scan something, you type some invoices, and you click on send, if it is completely transformed, people that have already worked out for 10, or 15 or 20 years, and if they're not flexible that's not really helping.

IO/S	**[I1]:** You need someone in the organization, first of all, to really lead that force, that's leadership, and you need a really good strategy for that, your second factor.
C	**[I1]:** I think culture is essential. And culture is essential on top management, but also on the people from the floor. **[T]:** So, it starts from the top, let's say?
S	**[I1]:** I don't know, if you have someone who's really motivated that has some great examples, for example, worked in a competitor company, and they were already using some digital programs, or Yes, he was used to a manager. Of course, you need top management, you need middle management, and you need you need everything. Like those three levels are essential.
S	**[I1]:** For strategy. I don't know if that was already in the description. But what I see in the strategy is clear vision like you're working towards a new business model, or you're working to obtain more information or you need to learn long term, yeah, point you want to go to. **[T]:** Maybe goal setting or a start position and an end position?
S	**[I1]:** Yeah, exactly. I think that's key for strategy. You need like a point to refer to the strategies, how to come there, and how to execute it properly.
Example	**[I1]:** But that's really important for strategy that you're working. For example, the end 2022 we want to have so many clients entering digital orders or track and trace everything or introduce a new business model. If you work from that, then you also know where your organization is going to, you need to have to have a bigger picture. Because like changing the old habits into new habits, it's really hard when you don't have a clear understanding of the end goal.
Feedback	**[T]:** The next one is expertise. Knowledge, we could say, the expertise aspect describes the knowledge which is important for DT. Besides, it describes the extent to which organizations offer opportunities to keep learning. What do you think is important here? **[I1]:** I think it's already described under culture. But it's good that it's handled separately.
E	**[I1]:** Expertise is essential that's, again, you need the three levels, like top management's middle management, and the people on the floor.
Example	**[I1]:** For example, someone in my team, when he or she got a great idea of a digital proposal she needs or he needs my support, like the management and or the middle management and I in the end need support from 'X' and 'X' that's top management. That's essential to be aligned, to execute it in the end, and then you only are using the knowledge of the team member.

E	**[I1]:** You also need knowledge of executing a digital transformation in the management and in the top management.
Example	**[I1]:** Because you need new expertise, it's not it's not simple. It's completely different. With the example, again, of the logistic providers, some logistic providers still live in an age where they think like, Okay, this is a digital project. This is, for example, 1000 euros, I can buy four trucks from this money. Yeah, that's true, but then you're not making operational excellence by adjusting or using digital forms to make it more efficient.
E	**[I1]:** So I think expertise on an IT department level is really important for digital transformation, because it's mostly lead by someone from IT. But you need it in the top management, you need management, and you need the people on the floor. If they already worked for 30 years with some really old stuff. Yeah, they're not going to adjust. Yeah, some people do, but not most people don't. **[T]:** Yeah, I think so as well. And another thing is that technology or it keeps evolving. If we stop learning, we are going to miss opportunities in a year.
C	**[I1]:** It's willingness to change. I think that's a cultural aspect. I think that's also really important. Of course, you need some people with like, 20 or 30 years expertise, but most of the people need to be flexible. Or just two new, new ways. That was expertise. So I think it's essential. **[T]:** Okay, great. Thanks. Then the fourth aspect is the Information Systems one. This one describes the ability of an organization to obtain and use data. And it means the infrastructure of the processes and applications to facilitate this, besides the it displays to what extent there exists, a system integrating all standalone systems.
Example	**[I1]:** I think it's important information systems, but in the beginning I don't know if you think about the maturity model, for example, a lot of companies understand that, that they can connect different systems to each other and use the data for new business model, for example. That's that, then you already really matured in your levels. So I think some companies should have, of course, some systems but they're not aware of the capabilities, connecting it to each other.
T	**[I1]:** So maybe a second level is connecting the data use master data and then the I think, third or fourth level is, use that data to do analysis with big data or something else. And in the end, you also have AI, but then you already have to have a really good understanding of how data works and what you can use with it.
T	**[I1]:** Yeah, I think it's really good for digital transformation, you need systems, but it's, by executing a digital transformation, you get more systems or a better understanding. It's not really, I don't know, it's digital transformation has an effect on internal systems. **[T]:** So the more systems there would be the higher your maturity, let's say.

Example	**[I1]:** Yeah, I don't know, sometimes what you would see is that companies buy a lot of applications. And in the end, they think like, yeah, okay, this is also not maintainable.
T/S	**[I1]:** If I want to, so the selection of correct software is also really important. You cannot connect everything to everything and use it for your new business model. So in here, again, your strategy is really important. So what's your goal? And what do you want to obtain? In which year or the final situation and based on that you're going to set up your information systems.
	[T]: Could you maybe give me some examples of core systems you think are important in this aspect?
T	**[I1]:** It depends on the industry. So yeah, of course, you have a financial system, you have a system in where the employees for example, put in their hours or their employee information. You can have warehouse management system WMS. You in the transport sector, we have the TMS transport management system. What nowadays is really important is documents management systems. So, for example, SharePoint or something else.
T	**[I1]:** I don't think this is an essential thing for your research. I think that's completely specific off the industry and the company.
	[T]: Okay, well, that's also a very good finding. So thanks for your explanation on that one. Then we have the fifth aspect, which is internal organization. Besides, it describes the way of working in the organization. What do you think is important here?
IO/A	**[I1]:** Yeah, what you describe is, I think, already a mature organization. If they already can think about agile and already have thought about some leadership or something else. That's really good.
Feedback	**I1]:** But also some organizations really don't understand how to set it up. So maybe your description is a level on the maturity model, but it's not I think the definition.
IO	**[I1]:** I think the definition is more than it's the internal organization is everything that has a relation to the digital transformation and that can also be finance that can be HR that can be the people on the working floor, that can be everything.
	[T]: Okay, so I should make it more general and not focused on the top level.
General	**[I1]:** Yeah, that depends on what you want, what you want to, I think be if you have those aspects or factors, the description of those is just the description of the line. And you can have for example, five levels on a factor or on something else. And under level one is the old school based organization style.

IO/T	**[I1]:** Digital transformation is I think, also introducing IT to all organizations or all internal organizations. But the key essential to be really successful is to adjust or add IT to your core business.
IO	**[I1]:** Digital transformation can be done on every in every organization part, but when you really want to make use of it, and really use it as a, in the end, competitor advantage, then you have to use IT in your core business. And then it's IT has to be it's a couple of internal organizations are related to it. So you can't digital transform with one organization part, I think you need multiple. **[T]:** Okay, that makes sense.
IO/C	**[I1]:** And yeah, then for the internal organization, as I refer you need multiple organizations or internal organizations. So, you need multiple people that lead and projects on every department in every different department, the departments also needs to have an understanding how it works, how much money is involved, how, what leadership is required. They also have to understand that they need to change and why it is required. So every department needs people that understands IT, every department needs to understand or have someone when we can make the connection of business and IT and also gets the opportunity to execute it properly.
EO	**[T]:** Let's move on to the to the last aspect the external organization. So, the external organization aspect describes the external organization and the collaboration with the partner network of the organization. Besides it displays the extent to which customers and customer data is used to create customer value. So partner network could be seen as the as partners you're working together with to create a piece of software. **I1]:** Yeah, in the meaning of I think digital transformation you need like partners to execute the digital transformation.
Example	**[I1]:** In the beginning, you don't have the expertise so you need partners. So to give it a kickstart you need people that understand the digital transformation and that can help you really execute it and during your digital transformation journey you need different suppliers, clients, everything. The entire external environment also needs to be busy with this transformation because that's not key, I think, but if you want to be commonly focusing on the end, the final goal of being an industry leader. Also you need partners, clients, suppliers, everything.
EO	**[I1]:** If you want to connect over there, then you can make a really big difference. So you can have a really good digital transformation for yourself. But to be really successful and make a really difference, then you need also your clients customers everything too. They also need to be able to transform digitally. **[T]:** Okay, so they also have to keep learning and keep evolving.

EO	**[I1]:** Yeah, but that's that differs on the level of the maturity level. So in the beginning, you just need to have some experience. And partners, of course, can help but you mainly need experience to kickstart it within your organization.
	[T]: Okay. I think that's clear. And I think that we have now talked about all six. After talking about all those aspects, do you think there's something missing here?
Score	**[I1]:** I think the expertise is essential.
EO	**[I1]:** I think maybe for nearly every, every aspect, you can use a partner, like the first, the second one was strategy. The first one was culture. Okay, those can be combined.
Example	**[I1]:** For example, I think we as 'X' are a partner for companies that want to change on that level. And then if you have internal external organization, yeah, most of the time, when we go to companies we are we advise them like you have to really watch out to your dev to get a better understanding from this or that.
Completeness	**[I1]:** Do I miss something? No, I think it's, it's good.
S	**[I1]:** Yeah, of course, you need money. Yeah. resources, time, valuable resources.
	[T]: Is that part of your strategy, maybe?
S	**[I1]:** I think the company really has to understand that. This takes years and years to finally achieve and you need a lot of money. Okay, yeah, I think it's you cannot change something in a quarter. Maybe in a year, you can make start. But again, for the strategy and vision, you need to understand that it's required for long term, so five years or something. And setting it up for five years. Yeah, that takes a lot of money.
IO	**[I1]:** And you also need maybe different roles in organizations.
S	**[I1]:** Some companies don't understand that they think they can digitally transform with the old organization. But that's impossible, because they're focused on the old organization. That was not yet digitally transformed.
	[T]: Okay, well, I think that's clear. Let's talk about the fifth one. And that's about including or talking about agile here in digital transformation. Because I think, and my project thinks that's coming up as a maturity model for achieving digital transformation in an agile way, is beneficial.

A	**[I1]:** You know, Agile is great Agile is just a working method. During the 20 past or 30 years, every five years you get a new a new management term focus whatsoever. Yeah, and I think agile was also there 20 or 30 years ago, I don't have the experience of that but what I hear also from my dad from other people that back in the days you also had such models and what's really important in digital transform is that the world is changing, the world is changing around it so the organization's also need to change and the advantage of Agile is that you need to change for example, you have like a PI, a quarter planning, every quarter differs and if you have an end goal of 2021. In the beginning, you think in January we need this, this and that but in the end, maybe you don't need it because something else is way more important. And agile is just understanding change and adapting with the change and agile helps with doing that.
Example/A	**[T]:** Which agile aspects or practices that you just mentioned, should be then included if we want to measure agility or agile? and which aspects are important and for digital transformation? **[I1]:** You if you take a look to SAFe, do you know the SAFe method? I think that's a great example of levels. The first level is the people on the floor and also introducing new roles for people on the floor to be able to work agile and the second level I think is quarter planning. So that there is planned based on three months and the level above is that the management also and multiple software projects or organizations or departments also plan so they are going to communicate and in the end you have top level is that the top management also understand that you need strategic themes and other things.
T	**[T]:** What are strategic themes? **[I1]:** Yeah, for example data creation AI. If you want to use AI, you first need data and to create data, you need applications.
E	Permission to record audio is requested before starting. A small part of the start of the transcription is missing, due to audio issues. **[I2]:** De academy is een belangrijk hulpmiddel om continu te blijven leren en leerervaringen te delen. En ook een open mindset te hebben om te kunnen leren. Dat stimuleren we ook heel erg in onze mensen dat mensen continu blijven leren. **[T]:** Goed om te weten hoe je hier in aanraking mee komt tijdens de job. Hoe zit dat met maturity models? Gebruikt je die vaak?

Experience MM	**[I2]:** Voorheen had je het CMM, dat was voornamelijk georiënteerd op softwareontwikkeling. Nu zie je dat softwareontwikkeling wat meer samenwerkt met business waardoor je BizDevOps teams krijgt en daardoor die modellen langzaam veranderen. Dus ik kende het oude CMM model wel. Hoe het model er tegenwoordig uitziet, heb ik gezien bij 'X'. Hier kijk je naar hoe doe je softwareontwikkeling, maar dan in de context van hoe verander je de organisatie? Dus de context is beter geworden. Softwareontwikkeling wordt minder gezien als een los ding. Maar die modellen kende ik nog niet. Ik moet zeggen dat die wel degelijk waarde toevoegen en dat ze helpen om klanten mee te nemen in digitale transformatie, omdat digitale transformatie een containerbegrip is en mensen weten niet precies wat het inhoudt, maar iedereen wil wel bewegen in die richting. Dus het kan zeker helpen om een soort van scorecard te bieden en klanten het gevoel te geven waar ze staan.
Feedback	**[I2]:** Wij zijn natuurlijk georiënteerd op het opleveren van werkende oplossingen, dus dat zal ergens in het model opgenomen moeten worden, omdat je anders een scoremodel krijgt wat denk ik niet heel goed gebruikt gaat worden. **[T]:** Goeie tip die ik meeneem. Dit zijn de gevonden aspecten en eigenlijk een hele generieke omschrijving per aspect. Wat nu misschien handig is, is om ze één voor één door te nemen. Jij kan dan aangeven wat er per aspect belangrijk is en wat eronder valt. Die informatie neem ik mee voor het invullen van het model. Bijvoorbeeld: bij cultuur, in hoeverre zijn werknemers in staat om te willen veranderen. En daarnaast, hoe ze samenwerken en of de omgeving dit stimuleert.
C	**[I2]:** Het moet top-down bottom-up zijn. Dus het kan niet zo zijn dat een deel van de organisatie wel meedoet en een ander deel niet.
E	**[I2]:** Er moet duidelijk een lerend aspect inzitten.
IO/A	**[I2]:** Als je kijkt naar de werkwijze die werkt op basis van MVPs. **[T]:** Goed dat je het zegt en dit komt straks ook nog terug bij het blokje expertise.
C/A	**[I2]:** Feedback loops zijn bij cultuur belangrijk en je cultuur moet zodanig open zijn dat feedback ook gedeeld kan worden.
A	**[I2]:** Anders kom je niet verder, scrum en agile zijn ook gebaseerd op snel iets maken, feedback ophalen, verwerken en weer een nieuwe cyclus maken. **[T]:** Dat lijkt me een duidelijk antwoord. Strategy is het tweede aspect en ook belangrijk. Hoe zie je de transformatie voor je en hoe voer je die uit? En daarnaast, hoe communicatie is geregeld tussen applicaties en werknemers en tussen de applicaties zelf. Wat vind jij belangrijk bij een strategy voor digitale transformatie?

S	**[]I2]:** Die moet i.i.g. outside-in zijn. Dus wat gebeurt er buiten en hoe interacteer je daar als onderneming op. Daar begint het mee. Vandaaruit definieer je je strategie en je strategie vanuit je visie/missie die je definieert en die heeft een aantal thema's waarvan je uitgaat wat het verschil is tussen je huidige situatie en je gewenste situatie. Daar komen strategische thema's uit.
T	**[I2]:** En die thema's ondersteun je met IT.
S	**[I2]:** En vanuit daar ga je een portfolio vullen met initiatieven die je zou willen doen. Die zet je op volgorde en je begint met wat het meest belangrijk is.
Example	**[T]:** Wat houden de strategische thema's in? **[I2]:** Een strategisch thema zou kunnen zijn voor een klant bijvoorbeeld: pas geleden was er de Brexit. Dat is echt wel een strategisch thema, een vraagstuk, van daaruit kun je allerlei dingen definiëren die je zou moeten doen. Systemen veranderen, werkwijze veranderen, acties die je moet ontplooien om je klantinteractie te wijzigen. Dus daar komt een heel scala aan dingen uit waarvan IT er één is. Je hebt daar ook veel personen voor nodig die zich daarmee bezig houden om dat thema verder te brengen binnen de organisatie.
S	**[T]:** En moet je je focussen op alle thema's? **[I2]:** Het punt is dat je geen one-trick pony kunt zijn als je een bedrijf leidt of als je in een bedrijf actief bent. Dan doe je één ding heel goed, maar vergeet je de rest en dan heb je geen business meer.
Example	**[I2]:** Dus je zult meer strategische thema's hebben waarmee je mee actief bent en bij ons is dat bijvoorbeeld de commerciële slagkracht, leren en groeien. Want wij leven in een markt die heel veel vraagt en continu wijzigt.
EO	**[I2]:** Daarnaast neemt de concurrentie snel in omvang toe en neemt aan de lopende band bedrijven over. Dus wij moeten ook actief zijn en wat doen wij daarmee?
E	**[I2]:** En één van onze thema's is ervoor te zorgen dat onze medewerkers goed geschoold zijn en blijven door ontwikkelen en dat wij als bedrijf ook groeien en onze medewerkers kansen bieden om snel te groeien. Dus daar zitten meervoudige aspecten aan.
E	**[T]:** Ik merk wel aan het gesprek dat punt 3 erg belangrijk is. **[I2]:** Binnen expertise heb je ook een hele boel domeinen he. Je hebt vakinhoudelijke expertise, commerciële expertise, managerial skills, persoonlijke skills.

	[T]: Heel goed antwoord, want dit kunnen dus precies subonderdelen van het blokje expertise worden. Het vierde puntje gaat over de systemen en de applicaties die aanwezig zijn en of je hieruit data kan halen en wat je hier mee doet. Wat vind jij hier belangrijk onder?
T	**[I2]:** Daar valt denk ik een aantal dingen onder. Ten eerste, een basis infrastructuur om op te kunnen draaien. Dus als je helemaal laag begint, heb je de cloud nodig. Infrastructuur as a service. Daarbovenop heb je systemen nodig om te kunnen integreren, want elke bedrijft heeft meerdere systemen. Dus heb je integratiesystemen nodig met bibliotheken waarin je kan zien welke data in de onderneming aanwezig is. Stap 3 is dat je de data binnen je onderneming moet je ergens in een datalake of datawarehouse opslaan. Dus je hebt een dataopslagmechanisme nodig. Vier is wel dat je richting je keten: klanten en leveranciers, heb je open APIs nodig, zodat je daarmee kan interacteren. Je moet ook events kunnen delen met je ketenpartners. Hierdoor word je onderdeel van de gehele keten en integratiesystemen zijn daarin belangrijk. Meerdere patronen moet je kunnen afwikkelen. Vindbaarheid van data is belangrijk, beveiliging is heel belangrijk. Dat zul je echt moeten toevoegen aan je model. Bij digital transformatie is dit namelijk erg belangrijk en bij digitale transformatie moet je naar de cloud. Maar als je nog on premisses dingen hebt, ben je in veel meer gevaar dan als je in de cloud bent. Ook in de cloud moet het veilig zijn.
E	**[I2]:** Daarnaast moet je nog de kennis hebben in je organisatie om het te doen of in te kopen of om het zelf te doen. Veel klanten blijven een beetje binnen de half half fase hangen. Dus je moet heel erg goed kijken naar hoe de organisatie is rond informatiesystemen en hoe doe ik dat.
T	**[I2]:** Waarbij de ketengerichte applicatie snel bewegen en je interne systemen probeer je zo min mogelijk te veranderen. Daar moet wel een stuk louse coupling tussen zitten tussen de lagen.
	T]: Dat louse coupling is dat er niet teveel connecties zijn met één systeem toch?
T	**[I2]:** Klopt, dus je klanten ontkoppelpunt moet wel ergens zijn, anders heb je last van elke wijziging van de klant.
	[T]: Ik ga security meenemen in dit aspect.
Feedback	**[I2]:** Ik zou het ook meenemen in de descriptie. Bij ons bouw je heel erg onder architectuur, dus de systemen die bij toeval bij elkaar geklikt zijn, vormen op lange termijn grote gevaren.
	[T]: Dan het vijfde puntje, de interne organisatie. Dat kijkt naar hoe alles intern geregeld is. Wat denk jij dat hiervoor erg belangrijk is bij digitale transformatie?

IO	**[I2]:** Ik denk dat het heel belangrijk is dat je alignement hebt tussen strategische doelen en initiatieven. Dat doe je door verschillende events te organiseren. Wij werken met kwartaalritme, dus ieder kwartaal ga je kijken naar wat je gerealiseerd zou willen hebben komend kwartaal.
IO/A	**[I2]:** Elk kwartaal wordt bepaald wat hoofd prio is. Ritme is daarbij erg belangrijk. Als je initiatieven uitzet, is het belangrijk dat je die in een bepaald ritme blijft opvolgen en dat er elke keer nieuwe gebeurtenissen kunnen ontstaan waardoor prioriteiten kunnen veranderen. Het moet belangrijk zijn wie welke rol heeft. Wat je ook ziet is dat er toch al lastig is om acties die gepland zijn werkelijk uit te laten voeren. Dat mensen door de waan van de dag ook met andere dingen bezig zijn en digitaal transformeren is veranderen en dat is wat anders dan day to day operations doen.
General	**[I2]:** Veranderen is lastig als je een lopende operatie hebt waarbij je veranderingen door moet voeren. **[T]:** Het moet er dus eigenlijk naast gebeuren?
IO	**[I2]:** Ja, het wordt ook een beetje gezien als een two way operation die je uiteindelijk op elkaar moet plotten. Dat is best wel lastig, want dat betekent dat je iedereen met dezelfde doelen bezig moet laten zijn. Die focus op waar wil ik naar toe en wat moet de verandering zijn en het gezamenlijk beeld creëren is denk ik voor leiderschap erg belangrijk. Dat je continu moet blijven communiceren wat de bedoeling is. Je moet goed georganiseerd zijn ook. Hier heb je structuur en ritme voor nodig. Ook verantwoordelijkheden goed beleggen bij mensen in je organisatie. **[T]:** Dus ook op teamlevel goed verantwoordelijkheden verdelen?
IO	**[I2]:** Je probeert je kwartaaldoelen te beleggen bij teams en teams bottom up aan te laten geven wat belangrijk is volgens de teams en dat moet bijelkaar komen als gezamelijk doel en dat plan je. **[T]:** Ik denk dat dat duidelijk is. Dan nog externe organisatie, dat gaat over je partner network en wat daarvoor belangrijk is. Maar ook hoe je de customer en customer data gebruikt binnen je organisatie. Wat is daar volgens jou goede aandachtspunten voor als we kijken naar digitale transformatie?
EO	**[I2]:** Wat we over het algemeen proberen is klanten ook mee te nemen in de klantcontext. Dus onze klanten bewegen om hun klanten en leveranciers te betrekken bij de projecten die zij doen en daar een pilotklant of pilotleverancier bij te betrekken.
T	**[I2]:** Als je dat niet doet, ga je dingen bouwen waarbij je denkt dat je het goed doet, maar blijkt achteraf niet zo te zijn. Wat je daarmee ook kan doen is dat je standaarden introduceert, want die geven houvast aan wat er in de branche geaccepteerd zijn en dan kan je zeggen dat je deze standaard ondersteunt. Daarmee wordt de drempel om samen te werken wordt lager.

EO	**[I2]:** Je hebt niet altijd invloed op je externe organisatie, dat ligt aan de machtsverdeling in de keten. Voorbeeld: AH kan zeggen tegen zijn leveranciers als je met mij wilt samenwerken dan doen we dat op deze en deze manier en als je dat niet kan jammer dan, doen we geen zaken.
T	**[I2]:** Kleinere organisaties moeten zich dus eigenlijk vaker aanpassen. Dan heb je dus flexibele informatiesystemen nodig. Dus dan kom je weer op de impact van je rol op de informatiesystemen terecht. **[T]:** Dat klinkt logisch. Ik had standaarden gevonden in de literatuur. Denk je dat er nog een aspect mist?
Completeness/Feedback	**[I2]:** Nee, ik mis geen hoofdzaken, maar ik zou informatiesystemen iets anders vormgeven. Het is nu een wat nauwe definitie. Ik zou het technologie noemen, want het gaat om meer dan alleen informatiesystemen. Zo wordt het breder. **[T]:** Iemand anders zei dit ook al en ik zal deze feedback meenemen.
Example	**[I2]:** Cloud valt bijvoorbeeld niet onder informatiesystemen, maar wel onder technologie. Ik zou dat aspect een beetje veranderen.
Score	**[T]:** Ik had nog een vraag: kan je de aspecten een score geven en ze ranken? **[I2]:** Lastige vraag, maar ik denk dat cultuur sowieso belangrijk is. Als je niet de juiste cultuur hebt, dan kom je niet van je plek. Dan blijf je blauwdrukken en dan ga je niet ook het lerende effect van digitale transformatie krijgen. Strategie is minder belangrijk, dat klinkt denk ik raar. Maar je kan een slechte strategie hebben en deze goed uitvoeren en dan heb je nog steeds succes. Als je een goede strategie hebt en je voert hem slecht uit, dan kom je niet van je plek. Je ziet ook dat voornamelijk het hebben van een goede executieorganisatie bepalender is dan de strategie zelf. Expertise kan je aanvragen of je dit koopt of zelf doet. Maar dan kom je bij het cultuur aspect terecht en moet je interne organisatie wel degelijk agile zijn. Je kunt ook alles zelf doen, maar dan krijg je een ander probleem. In hoeverre ben je al in staat om dit zelf te doen? Expertise is dus zeker belangrijk, maar hangt af van de context. Als je kijkt naar het volwassenheidsmodel; als je geen ervaring met agile hebt, zal ik zeker niet zelf beginnen, maar expertise inkopen. Agile coaches bijvoorbeeld, maar sws extern aan de slag. Technologie is sowieso erg belangrijk, want als je digitaal wilt transformeren kan niet zonder flexibele technologie. Externe organisatie is een gegeven en daar moet je goed op inspelen. Je kunt wel proberen om de externe omgeving te beïnvloeden, maar alleen door goed digitaal te transformeren en de projecten die je draait. Door klanten in je context te trekken. **[T]:** Dat is denk ik ook wel het idee van dit blokje. Dit gebeurt denk ik ook meer bij een hogere volwassenheidsgraad.

EO	**[I2]:** Ja, dat klopt, maar dan ben je ook aligned met de keten. En dan ben je ook event gedreven. Mijn idee is ook dat iedereen naar event gedreven architectuur moet op keten niveau. Zodat je processes bij je klanten en leveranciers in gang zet, maar ook omgekeerd. **[T]:** Duidelijk, deze scores worden meegenomen in het bereken van de volwassenheid. Een laatste vraag: hoe kan je digitale transformatie het beste op een agile manier doen? Is agile noodzakelijk?
A	**[I2]:** Ik denk dat het heel dicht tegen cultuur en interne organisatie aanhangt. Ook wel tegen expertise. Wat wij proberen te doen, en de vier succesfactoren die wij zien: Eentje daarvan is BizDevOps en security. Wat heel belangrijk is, is dat je business & IT samenbrengt in één team en dat een gezamelijk doel geeft. Dat doel probeer je door een productowner te laten uitvoeren. De productowner is verantwoordelijk voor het realiseren van dat doel. Die managed op ROI. Dit is de enige factor die echt belangrijk is. Bij winst doorgaan, bij verlies stoppen. Hoe doe je dat goed? Werken met MVPs. Hier moet de productowner het proces haarfijn kennen en een visie heeft en dat kan vertalen naar hoe je er komt. Dat team moet heel duidelijk gestuurd worden op basis van visie. Je werkt met MVPs. Die MVPs zijn belangrijk, want daarmee haal je feedback op, dus je moet een agile organisatie hebben, waarmee je dat initiatief kan lanceren, feedback op kan halen en de volgende slag mee kan slaan. Dus die feedback moet zowel technisch als procesmatig als visionair zijn. Moet wel volwassen feedback zijn. **[T]:** Dus eigenlijk teamverdeling, rolverdeling en naar wat je maakt en de feedback die je daarop krijgt.
A	**[I2]:** Ja en daar hoort dan nog wel wat bij. Dit is het vierde aspect. Dat is bouwen onder architectuur. Werken met MVPs kan leiden tot het krijgen van incidenteel architectuur. Voorbeeld: ik wil vervoermiddel voor van A naar B te kunnen. Welk vervoermiddel kies ik? Die dingen zijn totaal verschillend en hoe zorg je dat je goed bij het eindproduct terecht komt. Kijk goed naar wat je nodig hebt. Think big, explore, move fast. Wel groot denken, maar klein beginnen. Dat is al een kunst op zich. Je probeert niet teveel te blauwdrukken. **[T]:** Ik denk dat dat voor nu duidelijk is en genoeg informatie.
	Permission to record audio is requested before starting. **[T]:** Okay, let's start with the questions then. Thanks again for having me. So the first question is a bit about your experience in 'X' and your role in the organization. Could you tell me about the role in your organization?

Experience general	**[I3]:** Yes. I almost worked here for 15 years, when we were a small company with four employees, and now we have like 150. So also help the organization in growing, and I did several stuff. I did consulting myself, I did create software, modelling software, did a lot of project management. co-author of our methodology during time, how do we do projects? So how we do Scrum, but also in combination with project management. Set up several departments, like the academy, like digital factory with students. And now I'm team lead responsible for I think, like 25, consultants, and also the customers and the projects in this team. And for some of the projects I also do some kind of project management or helping consultants how they manage their projects. Next to that, I also am a trainer in Academy for a methodology to all the application conversations and responsible for the students for thesis and part time jobs.
	[T]: How many projects have you done on digital transformation and Can you give an estimate, it doesn't have to be that precise?
Experience DT	**[I3]:** 100 projects, I think maybe 15 years, let's say. Yeah, I think.
	[T]: And then the final question here is your exposure to maturity models. Are you familiar with a maturity model and what it does?
Experience MM	**[I3]:** Yeah, what I did a couple of times in the past, I did my own perception of I was asked, okay, we are trying to do digital transformation, but it's not working. Can you do a quick scan? So then I did my own perception of Okay, what do I think? How do I need to be organized based on the experience and our own methodology and say, okay, you have to change this. And that's because it's the way we think it should work. So I created myself some kind of maturity models based on experience. Which is also based on SAFe, Scrum and agile. And what you see, yeah, before all the Scrum stuff, so let's say 15 years ago, I had some experience with CMM levels. That's more about how, how mature is your IT company? I don't know if you know, CMM. And that kind of stuff?
	[T]: Yeah, I know it a bit.
Experience MM	**[I3]:** Yeah. So that's experienced from a long time ago. And what you see now is that we for organization 'X', I think, and also at 'X'. We also work together with 'X' self, which we they have created some kind of maturity model to see a gap.
	[T]: Well, good to hear that you have some practice with the maturity model. So that's fine. And you know, that basic idea of what I'm trying to do, so we can move on to the third section here. And that's about the following digital transformation aspects or parts that I found in literature. So the first one that I found is culture. You already mentioned that the culture describes the extent to which employees are willing to change. And besides the collaboration between employees and their working environment. What do you think is important if you look into culture, if you look deeper into culture, what would be a good indicator of culture when doing digital transformation?

C	**[I3]:** Yeah, you're describing it, they're willing to change and the willing to want to constantly be better.
	[T]: Continuously learning maybe?
IO	**[I3]:** Yeah, and try to do okay, how can we do it in a more optimized way. In culture with digital transformation, also not to be too bureaucratic, that you need everyone's signature for it. I think that's also very important. Maybe also has to do with internal organization, but okay.
C	**[I3]:** It's also about culture, are you willing to take opportunities and risks. So I think that the best is, is that a will to change.
E	**[I3]:** And is there the will to learn. And is there a will to improve.
	[T]: So that's then on culture, I think that's some great explanation. And then I found a second aspect which is strategy. The strategy aspect describes a plan on how to transform digitally. Besides, it describes the structured communication between employees and machines and machines to machines. So what do you think is important when looking at strategy for digital transformation?
S	**[I3]:** I think that it starts with success.
Example	**[I3]:** If let's say we come somewhere at a new customer it would be nice if you have some kind of maturity model, but if they're not yet into the first step of the roadmap of the total transformation strategy for this, then search for a project where you can manage success, so a project with small amount of time, small amount of dependencies where you can make success, where you can see, okay, we can do this. Day one, we had nothing day 14, we have a working application, we have a trained product owner, which was the chief of planning, we do a small project where we can create success, success and success, then you do a bit more of those successes. So people, everybody can see, okay, there were successes there, I want to be part of success.
S	**[I3]:** That's what people think I want to be part of the success. So make the success, bigger, bigger, bigger, and then incorporate the whole organization.
IO/S	**[I3]:** And what you need for this is that you need the management team, they need to give the freedom and responsibilities to do this. If they don't, if there's not a commitment that the management team, you it's doomed, it's doomed.
	[T]: So you start top level and you work down?
S	**[I3]:** So I think this creating success and creating commitment from management, those are the two things to start. And if you have this, then the rest will follow.
	[T]: So it's a slow change management process as well?

S	**[I3]:** It could be but yeah.
	[T]: Okay. I think that's clear.
S/T	**[I3]:** And if you take a look at technical strategy, then if you're going to set up, yeah, if you want to integrate all kinds of processes, then you have to more take a look at the architecture set it up. If you can extract data out of systems that you have microservices, and that's the more technical part of it.
	[T]: Excellent. Okay, great. then going on to the next one is expertise. Expertise describes the digital knowledge of experts and a willingness to keep learning. Besides the aspect describes the extent to which organizations offer opportunities to keep learning. What do you think is important for expertise in digital transformation?
E	**[I3]:** Yeah. So make them part of the success and let them see how this expertise will help you to get the change done. And what I believe is that, okay, let's say we are the experts, and that we, we teach them how to do it, and not only maybe how to build it themselves, but also how to be a good product owner and how to be a good business owner. How do you implement stuff? How do you get your requirements out of your organization? So, what I always say, okay, we do a project, we show it how to do it, then we do it together. And then it's up to them and do it together, it could be that you do five projects together, and then give it over. And during that you're busy with the changes with the implementation of it. They will learn on the job. Again, they need to have the management team to have the opportunity that they can learn, and can learn them. So it's about 10% teaching 70% about go into practice doing together. And 20% of adjusting, reflecting giving feedback on how to do it.
	[T]: Do you think the Academy at cape is a good example of this?
E	**[I3]:** Yeah, but the Academy is, in general, it's the consultants themselves, who teach them do the projects together with them.
	[T]: But that's also sort of Learning Academy keep learning from each other.
E	**[I3]:** Or an academy budget.
E/IO	**[I3]:** Yes, we can we do this, but, it's for the digital transformation more important to teach how to be a good product owner. Well, to be a good business owner. Team roles are important.
	[T]: Okay, very clear. Then the fourth aspect which is information systems. The information system aspect describes the ability of an organization to use produce data to support decision making. And it also describes the infrastructure of processes and applications to facilitate this. Besides it displays if there exists a system, integrating all standalone systems. So what do you think is important here, for the information system?

T	**[I3]:** Now depends a bit on what you're trying to achieve. Okay, as a company, that you have some kind of maturity level in control towers. And which means again, First, you need to have to integrate all the systems that you can build, then you will need you need information systems to optimize the process, then you need to integrate them with each other to get the data structured, then you have data and your data has grown. And then you can do stuff with your data, which you can do you can make decisions, or you can make reports on it. So is there a kind of maturity level here. And how to set up your, your your level of information systems, I have an example model for you for this.
	[T]: Again, very clear story.
S/T	**[I3]:** And I already told you about the strategy setting. You have to also investigate maybe, microservice strategy. So sets, components. So let's say you have an order entry planning and invoicing operation that you need to automate. The order entry could be a separate system as in the planning and invoicing, because they have their own lifecycle. There could be three different applications which integrates neatly, but could also be one system, then it's okay.
T	**[I3]:** So set them all up in small components. So as small as possible
	[T]: Okay, clear. So then would you say microservices is part of the strategy or information systems if you would put it somewhere in a box?
Feedback	**[I3]:** Yeah, I think it's a combination of both.
	[T]: Okay, then enough about this. Then we go to the internal organization. So this describes everything that's inside the organization. What do you think is important looking at internal organization for digital transformation?
IO	**[I3]:** I already mentioned that you need support from management, they need to fully understand and have the full commitment for it. The most important.
C	**[I3]:** Have a way of thinking that you should help each other. So if you have separate teams, which is could be pretty normal, but that that they not like, I want to do better than the other team or I need this feature first. So the company goal should be the goal and not the team goal should be leading.
	[T]: So knowledge sharing should be very important?
C/IO	**[I3]:** Knowledge sharing, but also if someone needs help, think about okay. Okay, I need to lent someone to the other team.
	[T]: So then the structure also has to be flexible that you can use move a team member to another team.

IO	**[I3]:** Yeah, all on the same goal. What is the goal of the company? Notice the goal of the separate teams and make decisions, delegate as low as possible. And create self-organizing teams with some boundaries. **[T]:** Yeah. Maybe this is hard. But do you think, for example, that agile really helps here in digital transformation?
IO/A	**[I3]:** It depends on the maturity of your organization. First, you need to start with projects. So you need project management. But if you are an oiled machine, and then you can be more like DevOps, and then the project management is less hard, less and less needed.
EO	**[T]:** The next aspect is the external organization. So the external organization aspect describes the external organization and describes the partner network. Besides it displays the extent to which customers and customer data is used to create customer value. What do you think is important in your partner network, or with your customers and customer data? **[I3]:** That they're also willing to integrate neatly. **[T]:** So they should focus on actually wanting to work together and integrate.
Score	**[I3]:** Yeah. I think it's the less important one of the digital transformation aspects.
EO	**[T]:** Could you elaborate a bit more maybe on how to use customers or customer data? Maybe for 'X' It's a bit different than for a normal company? Is it very important to listen to the customer? **[I3]:** Always important, but it's more of a company strategy. **[T]:** So maybe that shouldn't even be there? **[I3]:** Yeah, well it should for what I was saying, what I was saying, if you really look at digital transformation, you need also your partners to be digital. And that you can receive digital data and send digital data.
Completeness	**[T]:** Okay. Well, then, the next question is about. First of all, do you miss anything? Miss an important aspect of digital transformation that I didn't cover, or needs to be elaborated on? **[I3]:** No, I think not. **[T]:** That's at least a good start for me.

T	**[I3]:** I said everything and talked about what's important. Yeah, maybe which technology to use. Because you can do digital transformation. Also, with coding high code, you could do it with low code. I think you're more successful with low code. **[T]:** Okay, that's, that's very good insight. Do you think I should add a separate technology aspect? Or should I change information systems to technology and let Information Systems be a part of the technology aspect?
Feedback	**[I3]:** Maybe you get can do it in architecture? So let's say set up a Microsoft architecture, but you can also do this with high code. And technology you say, okay, I do this with low code systems, where you can focus on value, you can get your digital transformation, I said, depends a bit on the market. Because you didn't define and so you need to do all kinds of algorithms stuff then you need high code. **[T]:** Okay, I will make sure that is somehow in the model. But that's a very nice insight, because then indicators, for example, having low code or having the right coding choice.
E/IO	**[I3]:** I'm also thinking about the external organization about what kind of partner does a company need to help them? And as far as I'm seeing is because we are also for 'X', but why are we successful at customers? Because we do this with, with people who study BIT or IEM or BA. So business people will think in processes instead of programmers. **[I3]:** Okay, so it should actually be your should have knowledge of not only IT, but also business combination?
E	**I3]:** Yeah, and I think the business aspect is more important. If you use low code, because then you need to hire knowledge. So maybe somewhere or in expertise, or in external organization, make sure that you hire a company. So let's say a customer will not hire a company which is not a core IT company, but really helps them with business consultancy stuff.
Score	**[T]:** Clear. And about scoring these aspects, which aspects do you think are really important here? And which ones are less important? **[I3]:** Culture is far most important.
C	**[I3]:** If we tell a customer and the culture is open, and I want to improve and we say as a foreigner, you should do this. And they, they will listen to us. And it's not clearly how it goes, but then all the rest will follow. Because those are the experts, they know how to digital transform. So the rest will come. And also the organization will come. So I think that's far the most important one. **[T]:** And about the others? Which are less important?

Score	**[I3]:** The less important one is the external thing. I think expertise you can hire, also what? So I think strategy is the is the second most important. So culture strategy. Maybe then internal organization, and then the information systems. **[T]:** Okay, well, thanks for this insight. So we are now going to the last question. The last question is about the combination of combining agile and digital transformation. If you look at the column, what would be very important, sub-parts of Agile for digital transformation?
A	**[I3]:** I think it depends a bit on the maturity how agile you want to be, or how, yeah. What I was saying, if you start somewhere, you should start with a project and the project is more. It's a bit less agile, but you also have to do some kind of project management. If you did several projects, and then you come into like, some kind of DevOps, then you can be more just more strong into it, everybody believes in it, etc. **[T]:** But, let's say you're using the Scrum framework. Since you have a few projects running what are important scrum parts, to then look at?
A	**[I3]:** The most important ones: Did you focus on creating something visible? Just have a sprint and after the sprint you show some working software. It doesn't have to be go live, of course that would be very nice, but this is make it visible and make something work. So that's important for the implementation change. The second one is the retro is what can we do better to get it faster done get the process better. So the retrospection is very good of Scrum agile. Third point is get everybody aligned. So, you have some kind of sprint meetings, review meetings that you just said, Okay, this is the plan. And this is where we are. And this is for management and for the tester, and every for everybody in between. So alignment, we have like four Scrum values, I think, those apply. **[T]:** Okay, thanks for repeating. Okay. Okay. That's nice. So that's, that's the most important thing. Okay. I think that's clear. Is that all about agile? I think so. **[I3]:** Yeah, I think it's this most important was the core.
Experience general	Permission to record audio is requested before starting. **[T]:** Wat is je rol binnen 'X'? Wat doe je? **[I4]:** Je zei het net zelf al, ik ben een team leader. Daarnaast ook consultant op dit moment.
General	**[T]:** De tweede vraag gaat vooral over jouw ervaring met digitale transformatie en maturity modellen. Wat is volgens jou digitale transformatie? **[I4]:** Ja, in hoeverre een bedrijf bedrijfsprocessen optimaliseert met technologie, bijvoorbeeld applicaties. Maar niet alleen optimaliseren. Het kan ook zijn dat je een bestaand proces dat je dat ondersteunt met behulp van applicaties of technologieën.

	[T]: Dus vooral automatiseren van processen? De definitie die ik hoog level hanteer is dit een onderdeel van, maar ook hoe je jouw organisatie in het algemeen, dus buiten de processen om, verandert zodat je digitale transformatie zo goed mogelijk kan uitvoeren. Bijvoorbeeld dus het veranderen van business modellen, zodat dit beter kan. **[I4]:** Ik ben het ermee eens dat je je omgeving ook geschikt moet maken om het te kunnen doen. **[T]:** Nou dan zitten we daar i.i.g. op één lijn. Hoeveel projecten heb je ongeveer gedaan in digitale transformatie?
Experience DT	**[I4]:** Ik werk hier nu 5,5 jaar denk ik. Dus een stuk of 20 a 25. **[T]:** Dan nog een vraag over ervaring met maturity models. Ben je bekend met het concept van een maturity model?
Experience MM	**[I4]:** Ja, maar ik pas het niet actief toe. Volgens mij is het heel erg om te kijken in hoeverre een bedrijf in staat is om te blijven meebewegen met de omgeving. **[T]:** Dat is in principe zo en vaak zoomt het in op een bepaald onderwerp. Die van mij kijkt bijvoorbeeld naar digitale transformatie en agile. Je hebt verschillende levels en hoe goed je daarin kan zijn. Met het model meet je hoe volwassen je op elk gebied van een bepaald onderwerp bent. Daar komt het op neer. **[I4]:** Jij wilt het dus doen op basis van die 7 blokken? En dan kijken hoe volwassen een bedrijf is op elk van die 7 gebieden? **[T]:** Ja, dat klopt. Laten we naar de digitale transformatie aspecten gaan. De eerste is cultuur en deze beschrijft in grote lijnen in hoeverre werknemers willen en kunnen veranderen. Daarnaast beschrijft het ook de samenwerking tussen de werknemers binnen het bedrijf. Wat vind jij belangrijk binnen het cultuur aspect?
IO	**[I4]:** Even kijken waar dit onder valt. Wat je heel vaak merkt wat beperkend is, is dat een organisatie geen platte organisatiestructuur heeft.
Example	**[I4]:** Binnen 'X' hebben we dit wel, we hebben wel management lagen, maar niet zoveel. Vaak zie je in organisatie, bijvoorbeeld bij 'X', een gelaagde organisatie. Als er een digitale transformatie of verandering doorgevoerd moet worden, dat doordat het over zoveel lagen bepaald moet worden en iedereen zijn zegje moet doen, dat dat het hele proces vertraagt en tegenhoudt. Dat is er wel eentje. Ik weet alleen niet of je die onder cultuur of interne organisatie wil plaatsen. **[T]:** Ik denk die onder interne organisatie voor nu.

C	**[I4]:** Ander ding is, is er een cultuur dat mensen beslissingen durven te nemen. Heel veel mensen hebben vaak een idee, maar durven dat idee niet uit te voeren, omdat ze bang zijn dat het idee niet goed is of ze zijn te laag in hun rangorde om een beslissing te nemen. **[T]:** Goed punt
C	Maar bijvoorbeeld ook, is de cultuur ook dat mensen hun eigen gang mogen gaan. Dus heb je een idee, voer het dan maar uit i.p.v. dat je je idee eerst overal bij mensen moet pitchen. Hier hebben mensen vaak geen zin en tijd voor. **[T]:** Goed punt en ik denk dat dat zeker onder cultuur valt, want denken in verandering is ook erg belangrijk. Dus je ziet iets nieuws en durft dit dan ook door te voeren. Ik denk dat dit voor het eerste puntje een goed antwoord is. Het tweede puntje is strategie. Het houdt in wat je plan is om digitaal te transformeren. Daarnaast, in hoeverre is het mogelijk om data die verzamelt wordt, in te zien. Wat zijn volgens jou belangrijke onderdelen van zo'n strategie?
S	**[I4]:** Wat hier erg belangrijk is, is dat je niet gaat communiceren dat mensen vervangen gaan worden. Ja, ze worden vervangen in de taken die ze op dat moment doen, maar het helpt heel erg om wel een toekomstbeeld te schetsen.
Example	**[I4]:** Bijvoorbeeld: straks kan je dit en dit gaat doen i.p.v. wat je nu doet. Je taken zullen veranderen, maar we gaan jou niet vervangen. Want als je dat doet, dan krijg je tegenstand tegen de transformatie die je wilt gaan maken. **[T]:** Snap ik, die zijn bang dat ze hun baan kwijtraken. Zou je kunnen zeggen dat change management hier dus belangrijk is?
S	**[I4]:** Ja, zeker, zeker. Ja, change management is zeker belangrijk en daarin ook de mensen die met de systemen gaan werken later, meenemen in het proces. Dus niet dat je alleen op de toplaag aangeeft hoe een applicatie eruit moet gaan zien en dat dan over de schutting gooit, want dan is het niet meer hun eigen proces en applicatie meer. Neem ze echt mee in de verandering. **[T]:** Oke, verder nog iets dat bij strategie hoort?
S	**[I4]:** Wat ik vaak merk is dat je het klein moet doen en niet met 30 mensen die dezelfde taak hebben van hey, hoe gaan we dit digitaliseren. Het beste zou zijn om daar één of twee mensen uit te halen die het woord kunnen doen en de meeste ervaring hebben en een goed idee hebben. Die mee te laten beslissen over hoe iets eruit komt te zien. **[T]:** Als dat het is bij strategie, dan stel ik voor na het derde puntje te gaan. Dat is eigenlijk kennis en beschrijft in hoeverre er kennis aanwezig is binnen het bedrijf, maar ook dat je wilt blijven leren. Daarnaast, wordt door de organisatie de mogelijkheid geboden om te blijven leren. Wat valt volgens jou onder het blokje kennis?

E/Example	**[I4]:** Ik zat te denken wat dit zou kunnen zijn, want je zou het ook als kennis kunnen zien van een bepaald proces. Stel je werkt al lang bij een bedrijf en hebt veel kennis van een bepaald proces, dat het lastig is om daar transformatie op te doen. Echter, een nieuw iemand die net binnenkomt binnen een bedrijf en het proces niet kent, dat juist wel kan doen en goed ideeën kan hebben over hoe het proces verbeterd kan worden, omdat hij niet in een vast denkpatroon zit.
	[T]: Dus dat zou je eigenlijk meerdere mensen naar het zelfde proces laten kijken met een nieuwe blik?
	[I4]: Ja, precies.
	[T]: Dat is dan dus misschien ook vooral een valkuil; stel iemand heeft veel kennis en moet dan opeens weg, dan moet die kennis wel overgedragen worden.
E	**[I4]:** Ja, dat is zeker zo en veel kennis zit vaak bij mensen in het hoofd.
	[T]: Hier hebben ze bijvoorbeeld een academy gebouwd waar veel kennis zit.
E	**[I4]:** Hier wordt zeker getriggerd om te blijven leren en jezelf te blijven ontwikkelen en er worden een heleboel dingen aangeboden om dat te faciliteren.
	[T]: Zou je daar wat dingen van kunnen noemen? Wat wordt er allemaal aangeboden bijvoorbeeld?
E/S	**[I4]:** eel veel trainingen, bijvoorbeeld de traineeship. Waar je heel veel verschillende aspecten leert. Maar ook daarna, zijn er veel trainingen die worden aangeboden om jezelf te blijven ontwikkelen met de nieuwste technieken en daarmee bezig te blijven. Niet alleen op techniek, maar ook op mens en proces, alles wat je nodig hebt, stukje zelf ontwikkeling. Het wordt hier ook wel gestimuleerd om jezelf te blijven ontwikkelen en niet stil blijft staan. Ik denk dat het academische wel uniek is binnen een organisatie. Dat zit niet in elke organisatie. Ik denk dat het in heel veel organisaties zal helpen als er een opleidingsbudget is, die je vrij zou mogen uitgeven op dingen die je graag wilt ontwikkelen.
	[T]: Dat zou je dan als een stukje strategie kunnen zien? Dat dat aanwezig is? Duidelijk verhaal. Het vierde aspect is information systems. Hier wordt mee bedoeld in hoeverre een organisatie verzamelde data kan gebruiken om keuzes te maken binnen het bedrijf. Daarnaast, in hoeverre is er een infrastructuur van applicaties aanwezig. Wat denk jij dat hierbij belangrijk is?

T	**[I4]:** Nu lijkt het al alsof een bedrijf ver is in transformatie als ze dit hebben. Systemen die verbonden zijn en data gebruiken in decision-making is, naar mijn mening, al een omschrijving van een erg volwassen organisatie. Ik zit even te denken wat hierin handig is, want dit punt helpt erg mee om ook verder te kunnen transformeren. Als jij een goede architectuur/infrastructuur hebt, dan helpt dat is het makkelijker om verder andere processen te digitaliseren. Maar als jij echt maar net begint, weet ik niet of dit echt een aspect is om digitale transformatie te starten. **[T]:**Het zou inderdaad kunnen zijn dat het helemaal nog niet aanwezig is binnen een bedrijf. Dan krijgt het bedrijf een lage score op dit gebied. Wat zijn bijvoorbeeld binnen 'X' voorbeelden die hierbij zouden kunnen passen?
T	**[I4]:** Naja, wat je ziet is dat 'X' eigenlijk verschillende systemen aan elkaar koppelt. Dat is eigenlijk gewoon een integratieplatform en dat is voor veel bedrijven belangrijk, omdat je vaak informatie uit verschillende systemen nodig hebt. Het is niet handig als mensen informatie gaan overtypen en kan je het natuurlijk ook gewoon pushen richting een applicatie. Belangrijk voor decision-making is denk ik een rapportagetool en uiteindelijk wil je graag één centrale database waar al je informatie van al je systemen in terecht komt.
IO	**[T]:** Oke, dan naar interne organisatie. Dit aspect houdt in hoe alles binnen de organisatie gestructureerd is en hoe werkt het samen. Wat is de werkwijze binnen het bedrijf? **[I4]:** Wat ik net ook al zei ik denk dat een platte organisatie belangrijk is. En ja, er kunnen een aantal lagen tussen zitten, maar als organisatie moet je zorgen dat de lijntjes kort blijven.
Example	In principe zou een bedrijf wel zes management lagen kunnen hebben als jij bijvoorbeeld maar wel makkelijk dingen gedaan krijgt en niet elke laag erboven nodig hebt voor toestemming.
IO/S	**[I4]:** Vaak is dat niet zo. Iemand heeft een idee en dit idee moet snel bij iemand terecht kunnen komen die een beslissing kan maken. Het is belangrijk dat teams zelf leiderschap hebben. Ik denk ook wel dat de leiders binnen de organisatie ook wel een stukje verandering moeten promoten. Ook is dat een stukje cultuur. Ze moeten stimuleren dat mensen met ideeën komen en dat door te durven voeren. **[T]:** Waar zou jij stimuleren van verandering zetten?
Feedback	**[I4]:** ik denk dat dat onder strategie valt. **[T]:** Dan nu even door naar het laatste puntje, de externe organisatie. Dit punt beschrijft vooral het partnerwerk van een organisatie. Daarnaast, in hoeverre je klanten en data van klanten gebruikt om value te maken.

EO	**[I4]:** Heel veel organisaties weten ook niet wat er mogelijk is. Dus als zij naar 'X' als leverancier kijken en dan een bepaalde klant nemen, stukje innovatie binnen 'X'. Je brengt heel vaak nieuwe ideeën naar klanten toe, om te laten zien dit is ook mogelijk en hier zijn we mee bezig. Zo kan een klant na een tijdje gaan denken van hey, dat is ook handig. Dus ik denk dat de invloed van werken met je leverancier wel belangrijk is daarin.
	[T]: Productinnovatie bij de klant dus eigenlijk?
EO	**[I4]:** Je hebt heel vaak bedrijven die denken dat je alleen de leverancier bent en je levert bepaalde spullen en doet wat wij vragen. Maar als je een relatie met je leverancier/klant waar je over en weer ervaringen deelt en in gesprek blijft, je elkaar zeker kan helpen.
	[T]: En is er iets dat hiervoor specifiek aanwezig moet zijn?
S	**[I4]:** Geld haha.
	[T]: Ik moet zeggen dat een andere deelnemer dit ook noemde en dat dit zeker niet een gek antwoord is, want digitale transformatie kost een hoop geld.
S	**[I4]:** Wat ook heel krachtig is, is dat je dat je niet maar één product aanbiedt, maar dat je eigenlijk bij verschillende klanten iets anders aanbiedt. Elke klant heeft een andere vraag die jij oplost. Die ervaring en expertise die je bij zo'n klant opbouwt en iets wat je daar neerzit, kan ook goed van toepassing zijn op een andere klant. Dat je dit meeneemt.
	[T]: Geldt dit ook voor een deel van het proces?
Example	**[I4]:** Stel een HST heeft een WMS systeem nodig en we hebben dit al bij drie andere klanten gebouwd. Als wij daar komen en ze zijn ergens mee bezig en zijn dat dit mist, dan kunnen wij zeggen van hey, daar hebben we het al een keer gedaan en is dit niet ook iets voor jullie misschien?
	[T]: Zou dit ook kunnen vervallen onder information systems en dat je applicatie uit kleine bouwblokken moet bestaan?
T	**[I4]:** Dat zou kunnen inderdaad. Je moet alles uiteindelijke aan elkaar koppelen.
	[T]: Duidelijke antwoord. Als je kijkt naar al deze 6 punten, denk je dan dat er iets mist? Een bouwblok?
Completeness	**[I4]:** Nee, maar ik kan me wel voorstellen dat een bepaald punt zwaarder meeweegt dan een ander punt.
	[T]: Goed punt en dat is ook de volgende vraag. Wat is volgens jou erg belangrijk en wat is er minder belangrijk?

Score	**[I4]:** Wat erg belangrijk is, is cultuur, want daar start het wel. Minder belangrijk is information systems, vooral in het begin. Maar naarmate je volwassener wordt, wordt het ook steeds belangrijker. **[T]:** En dus ook makkelijker zoals je al zei? **[I4]:** Ja en daarom wordt het ook belangrijker. Moet ik hem van 1 tot 6 scoren? **[T]:** Als je daar een idee bij hebt, dan mag dat.
Score	**[I4]:** 1. Cultuur 2. Strategy 3. Interne organisatie 4. Expertise 5. Externe organisatie 6. Information systems. Maar zoals ik al zei, hoe volwassener je wordt, hoe belangrijker information systems wordt en wordt het ook zeker belangrijker dan externe organisatie. **[T]:** Oke, dat neem ik mee. Dan heb ik nog één laatste vraag en deze gaat over digitale transformatie op een agile manier. Stel je nou je wilt je digitale transformatie op een agile manier doen. Wat is volgens jou dan heel belangrijk aan agile tijdens een digitale transformatie?
A	**[I4]:** Ik denk het kort cyclisch opleveren van waar je mee bezig bent. Dit kan een stukje functionaliteit zijn. Wat denk ik ook krachtig is aan agile, is omdat het kort cyclisch is, je ook vaak reflectiemomenten hebt op het proces, op de werkwijze, op de mensen, op de cultuur, op de strategie. Elke keer doe je een retrospective van hey hoe ging het, wat ging goed en wat kunnen we verbeteren? Als je een waterfall model gebruikt, heb je dit minder. Dan zijn er bepaalde specs en lever je 2 jaar later een compleet product pas op. **[T]:** Ja en dan doe je dan ook pas je retrospective. Zo'n waterfall model zie je wel minder en minder toch? **[I4]:** Nou, je ziet vaak bedrijven die zeggen dat ze agile zijn, maar toch nog waterfall zijn. **[T]:** Bedankt voor de antwoorden en het interview.
	Permission to record audio is requested before starting. This interview started at questions 3, since the time window of this interview was shorter compared to the other interviews. **[T]:** Het eerste blokje is cultuur. Wat literatuur zegt dat cultuur inhoudt bij digitale transformatie is dat het aangeeft in hoeverre je werknemers willen veranderen, denken in verandering en daarnaast hoe er wordt samengewerkt binnen je bedrijf. Wat is volgens jou belangrijk bij cultuur bij digitale transformatie?

IO	**[I5]:** Wat je nu ziet is dat wij de business & IT kloof aan het dichten zijn. Je bent met IT altijd aan het digitaliseren en dingen aan het automatiseren en digitaliseren, maar de business kant weet niet altijd de mogelijkheden van digitalisering. Die kloof wordt steeds meer overbrugt en dat gaat dat programma heel erg over.
C	**[I5]:** Om keuzes te maken, de cultuur om keuzes te maken, om open te zijn en transparant over wat belangrijk is en waarde oplevert en wat op korte termijn waarde oplevert. Niet of we daar misschien over 10 jaar is de vruchten van gaan plukken, maar echt een cultuur krijgt van hey, als we iets gaan veranderen, dan moet dat snel waarde opleveren, dat is denk ik heel belangrijk.
A	**[I5]:** en ook dat je niet altijd het heel ingewikkeld maakt, maar het agile in stappen aanpakt. De cultuur was van we gaan iets nieuws bouwen en dat kan pas gebruikt worden als het helemaal klaar is, maar dat je zegt van hey, we gaan dat in stapjes doen en dat is misschien de link tussen digitale transformatie en agile, dat je het in stapjes opbouwt. Ik begin met een MVP en daar ga ik mee werken en daar krijg ik feedback op en dan gaan we een volgende stap nemen. Dit i.p.v. dat hebben wij met het project gedaan, zijn wij eigenlijk een hele tijd onder water geweest en pas na 2 jaar bouwen, zijn we pas het in de praktijk gaan beproeven. Nou, dat was achteraf gezien niet handig, want we konden hele stukken dingen die we gebouwd hadden in de prullenbak gooien, omdat het achterhaald was. Kortom, je wilt hele een korte cyclus hebben die op hele korte termijn waarde gaat opleveren. Dat is denk ik een heel belangrijk aspect van cultuur.
	[T]: Oke, duidelijk antwoord. Dan is het tweede blokje strategie. Wat denk jij dat een belangrijke strategie is bij digitale transformatie?
S	**[I5]:** Je moet een hele duidelijke strategie hebben als bedrijf om te kunnen kiezen waar je mee aan de slag gaat. Er zijn natuurlijk een heleboel initiatieven, iedereen heeft altijd wel verbeterinitiatieven met zijn afdeling. Alleen er is natuurlijk altijd een schaarste aan IT en wat IT afdeling is. Wij hebben zo'n 400 man, dat is best wel veel, maarja de verandering die we kunnen doen is natuurlijk beperkt. We kunnen niet voor het hele bedrijf, voor alle onderdelen en afdelingen, tegelijkertijd automatiseren en vaak is het ook nog heel specialistisch. Dus je moet heel duidelijk zijn van wat zijn mijn prioriteiten en wat is de strategie van het bedrijf en wat ligt daar het dichtstbij.
	[T]: Dus dit komt dichtbij de strategische thema's in de buurt?
S	**[I5]:** Ja, dat klopt.

Example	**[I5]:** Er is ooit een sessie geweest waarin is gezegd, we gaan als 'X' die kant op. Natuurlijk gaan we meer inzetten op de pakketten dan op de brieven, want de brieven worden steeds minder. Dus de strategie is om de pakketten te laten groeien, dus ga je ook initiatieven doen in de richting van de ontwikkeling van de pakkettenafdeling en niet de brievenafdeling. Dat is gewoon een high-level voorbeeld van je strategie, want je strategie helpt je keuzes te maken en dat zie je dan ook terug in de sheet die ik je net liet zien. Dat keuzes maken gewoon heel erg belangrijk is en niet focussen op alles, maar zeggen van dit is belangrijk, dit gaat waarde opleveren daar gaan we mee aan de slag. Zodat je ook je beperkte capaciteit die je hebt om digitale transformatie te doen, gericht kan inzetten. **[T]:** Ja, oke. Ik denk dat dat een duidelijk antwoord is zo. Dan gaan we nu naar het derde puntje expertise. Wat is volgens jou belangrijk bij het puntje expertise voor digitale transformatie?
E	**[I5]:** Ja, daar hebben we als 'X' een transformatie in gemaakt. Wij hadden echt een outsourcingsmodel van oudsher, dus wij hadden de IT helemaal uitbesteed bij partners, zoals 'X'. We zeiden tegen 'X' bouw deze en deze applicatie. Dit zijn de specificaties, bouw het en als het klaar is, dan zien we het wel terug. Nou 3 jaar geleden zijn we begonnen om die ontwikkeling in de teams naar binnen te halen, dus wel met 'X' als partner, maar we gaan in een team ontwikkelen, dus het is niet meer 100% uitbesteed aan een partner. 'X' leverde wel mensen en expertise natuurlijk, maar er waren ook mensen van 'X', dus er waren gemengde teams die als team verantwoordelijk waren voor het bouwen van die applicatie en niet 'X' als leverancier die verantwoordelijk was. Daarvoor was het zo van, nou leverancier bouw een applicatie en we zien wel wanneer het klaar is. Drie jaar geleden zijn we gestart met teams binnen 'X', waar natuurlijk wel expertise van buiten inzat, maar die gewoon als team, als 'X' team, een applicatie bouwde. We zijn ongeveer een half jaar geleden gestart om ook eigen expertise te werven op verschillende gebieden, waaronder op Mendix gebied, dus we willen ook de ontwikkelcapaciteit naar binnen trekken, omdat we denken dat mensen die kennis hebben van en het proces, dus het business proces, dus van 'X' en van het ontwikkelen, dus die direct goed met de business kunnen praten en wat ze weten ook direct in code kunnen omzetten. Dat dat heel belangrijk is, om dat te combineren in personen. Dus niet puur een Mendix expert, die heel veel van Mendix weet, maar die eigenlijk niets van het logistieke weet. Wij willen dus business & IT verenigen door mensen die voor 'X' werken en er veel over weten ook daadwerkelijk direct samen met die business die wensen kunnen omzetten in werkende software. **[I5]:** Dus eigenlijk business & IT bij elkaar brengen? Het liefst zelfs in één persoon?

E	**[I5]:** Ja en natuurlijk heb je superspecialisten en als het over hele technische dingen gaat, moet je misschien je daar misschien ook wel specialisten voor inhuren. Het zal altijd een mix zijn. In mijn team zullen altijd mensen van 'X' zitten, die meer specialist zijn in Mendix dan mensen van 'X'. Maar als je een goede mix maakt daarvan dan denk ik dat je veel slagvaardiger wordt en je veel sneller kan begrijpen wat de business wil, omdat je werkt voor 'X' en je weet gewoon wat er gaande is en als je werkt voor de 'X', behalve dan de mensen die al lang voor 'X' werken, dan weet je gewoon minder dan een intern persoon.
EO	**[I5]:** Maar dat is logisch, externe consultants hebben altijd het voordeel dat ze meerdere bedrijven zien, dus de 'X' zit ook bij de 'X', andere transportbedrijven, bij 'X', dus als je gewoon meer van dat soort bedrijven hebt gezien, is dat ook heel waardevol. Dus dat op het gebied van expertise.
T	**[T]:** Duidelijk antwoord, dan nu information systems. Dit aspect houdt in hoeverre je in staat bent verzamelde data te gebruiken en wat is je integratie/architectuurlandschap?
T	**[I5]:** Ik plot dit zelf vooral naar digitale ketensturing, waarbij je probeert data om te vormen tot informatie om over je hele keten te bepalen wat er gaande is. Waar gaat het goed, waar gaat het niet goed? Waar zitten veel storingen? Waar zit veel vertraging? We hebben iets nieuws ontwikkeld, wordt dit nu echt goed gebruikt?
Example	**[I5]:** Bijvoorbeeld: als wij een nieuw product introduceren, een nieuwe dienst, dan kun je natuurlijk meten, voorheen was het natuurlijk zo van je moet de marketeer op zijn blauwe ogen geloven van o, dit wordt een enorm succes, maar nu kan je gaan meten of het ook daadwerkelijk een succes is. Wordt er veel gebruik van gemaakt of is dat niet zo?
T	**[I5]:** Dus je kunt veel meer met informatiesystemen, als je dat goed inricht, kun je al die data verzamelen uit al die onderliggende systemen en alles wat je gedigitaliseerd hebt en daar kan je dan weer beslissingen op nemen. Nou, dat kan je doen d.m.v. rapportages doen, misschien ook wel door AI te gebruiken door daar autonoom conclusies uit te laten trekken. Waar dingen beter kunnen. Dat kan natuurlijk allemaal. Dus ik denk dat die informatiesystemen op die manier kunnen helpen bij je digitale transformatie. Naja, aan de andere kant bestaat digitale transformatie natuurlijk uit een groot deel uit het bouwen van nieuwe informatiesystemen. Want ja, uiteindelijk is het gewoon automatiseren. Dus ik zou meer in de hoek denken van digitale ketensturing, dat je dan door ketens heen, dus niet losse systemen bekijkt van hey, wat zit er in dit systeem en wat komt eruit, maar dat je op basis van al die data, big data, te werk gaat. Beetje in die hoek.
	[T]: Oke. Je gaf als voorbeeld al AI en ook rapportages. Heb je toevallig een idee van nog wat andere voorbeelden toevallig?
Example	**[I5]:** Als we kijken naar het technische deel, van draaien mijn systemen nou lekker door de keten heen. Dus wat is de uptime van een systeem? Wat is de performance van een systeem? Zitten er ergens bottlenecks?

T	**[I5]:** Want wij hebben vaak ketens van systemen, dus de het ene systeem levert input voor het volgende systeem. Ja, als daar ergens een bottleneck inzit, dan kan je dat detecteren, dit noemen we monitoring.
	[T]: En dan bepaalde KPIs monitoren?
T	**[I5]:** Ja, ja, bepaalde KPIs precies. Maar je kunt natuurlijk ook functionele monitoring doen.
Example	**[I5]:** Hoeveel van het product wordt er nou dagelijks afgenomen? Of hoe lang doet de chauffeur erover om een handtekening te halen van iemand? Of hoe lang duurt het voordat iemand de deur heeft opengedaan? Je kunt van alles meten natuurlijk, van technische dingen tot meer functionele dingen, tot meer het gebruik ervan. Ik heb bijvoorbeeld nu bij Cape Groep een afstudeerder en die kijkt naar hoe je meet hoe een applicatie gebruikt wordt. Of mensen heel veel clicks nodig hebben voor iets? Of dat ze de app helemaal verkeerd gebruiken? Of dat ze heel veel dezelfde handelingen elke dag weer uitvoeren? Dit wordt op de planningsapplicatie geïmplementeerd om te kijken of mensen er wel optimaal mee werken en dat wordt dan door AI gedaan. Dus je voedt gewoon die data over het gebruik aan een model en dan gaat dat model zeggen dat dit en dit opvalt. Dat kan je allemaal met informatiesystemen doen.
	[T]: Oke, dat is duidelijk zo. De volgende is interne organisatie. Je zou het kunnen zien als alles wat binnen de organisatie aanwezig is en hoe dit gestructureerd is. Ook valt hier leiderschap onder. Wat is er volgens jou belangrijk voor een interne organisatie tijdens een digitale transformatie
IO/A	**[I5]:** Ik denk op verschillende niveaus. Je moet goedwerkende teams hebben, dus mensen die in een team samenwerken, dat die goed op elkaar zijn ingespeeld. Dat het duidelijk is dat er een omgeving gecreëerd wordt waar het bij de mensen in het team duidelijk is wat ze moeten doen en moeten ze zelf als agile team ervoor zorgen dat ze snel resultaten kunnen boeken. Dan heb je de samenwerking tussen teams, dat is ook nog wel lastig, want wij werken met verschillende applicatieteams. Soms moeten die dingen samen doen. Soms kan je binnen een team nog wel dingen afspreken, maar als je ineens moet gaan samenwerken met andere teams, dan moet je daar wel goede afspraken over maken en een goede planning, want als dat helemaal uit de pas loopt dat ik vandaag met iets bezig ben en het andere team waar we ook wat mee moeten, die hebben dat over drie weken ingepland, dan gaat hel al scheef. Dan zeg ik van ik wil nu aandacht van jullie, want we moeten samen wat doen, maar dan zeggen zij: ja, maar wij hebben dat pas over 3 weken ingepland.
A	**[I5]:** Dus daarom hebben wij die PI events, die SAFe methodiek, waarbij je per kwartaal kijkt wat belangrijk is en de hoogste prioriteit heeft.

IO/A	**[I5]:** Welke teams gaan daar een rol in spelen en wanneer plannen die teams dat in het kwartaal? Dus als je samen aan iets moet werken, moet je zorgen dat je dat allebei in sprint 2 plant of dat je dat allebei in sprint 3 plant, dat maakt allemaal niet zoveel uit. Maar dat je dat i.i.g. synchroniseert. Daar is eigenlijk die hele SAFe methodiek voor, daar hebben wij onze hele interne organisatie aan opgehangen.
	[T]: Dus daar komt eigenlijk ook een heel groot deel van het agile blokje in voor?
A	**[I5]:** Ja, agile is natuurlijk echt de Scrum teams, die volgens de Scrum methodiek op een agile manier werken.
IO/A	**[I5]:** Dat is dus op het kleinste niveau, dat je de teams samenstelt. Maar als je dan meerdere teams hebt en meerdere business lines, dan zitten de teams samen in een agile release train. Dus dat is onderdeel van SAFe, want die teams werken dan samen en maken samen de planning en zo hebben we eigenlijk de interne organisatie opgetuigd volgens die SAFe methodiek.
	[T]: Dat is een interessante finding.
IO/A	**[I5]:** Dus als je gewoon een plaatje van de SAFe zoekt en hoe dat in elkaar zit met de agile release trains en die functies van Scrum of Scrums en een agile release train engineer en al die functies. Die hebben wij allemaal in place en ook business owners, dus iemand die wat wil. Dan een feature owner, die is eigenaar van features en is verantwoordelijk voor hetgeen wat die wil. Dus als wij iets gaan bouwen en dus bijdragen aan een feature, dan blijft die business owner of die feature owner die blijft verantwoordelijk om aan te geven wat hij nou precies wil en voor het accepteren wat er gebouwd is. Dus die hele methodiek bepaald bij ons de interne organisatie.
Experience general	Permission to record audio is requested before starting.
	[T]: De eerste vraag is of je mij iets meer kan vertellen over de rol binnen je organisatie?
	[I6]: Dus ik ben cluster lead binnen IT pakketten en logistiek. En ik ben cluster lead van operation execution en daar zitten in 4 platformen en die zijn verantwoordelijk voor sorteren, plannen en ritexecutie, field services en integratie. Dat zijn de vier platformen waarvan ik van de laatste ook de productowner ben.
	[T]: Duidelijk, van tevoren had ik geen idee, maar zeker interessant. Dan nu de vraag over de ervaring die je hebt met digitale transformatie en de ervaring met maturity models. Hoe zie jij digitale transformatie voor je en wat betekent het volgens jou?

Experience DT	**[I6]:** Ja, het is niet zo dat ik direct te maken heb met het programma digitale transformatie. Wij hebben een programma digitale transformatie dat heet 'X' en dat moet de transformatie binnen 'X' versnellen. Dat zijn meer programma's waarmee ik mee te maken krijg, omdat dat dan mij als cluster lead of mij als PO van integratie raakt. Dus daar krijg ik wel van mee wat dat programma is, maar ik ben niet degene die dat programma bedenkt. Maar het bestaansrecht als cluster, proberen wij digitalisering van operators te bereiken. Dus ons grote doel heeft alles te maken met digitalisering. Dus hoe zorgen we nou dat we binnen 'X', zo'n 15 operators, een versnelling krijgen in de digitalisering. Ja en daarmee kijken we heel erg naar wat we willen bereiken en waarom willen we dat en hoe gaan we dat op de beste manier doen.
	[T]: Hoe ik digitale transformatie zie is dat je kan digitaliseren bij bedrijven en daar de processen digitaliseert. Dat is een onderdeel van digitale transformatie, maar uiteindelijk is het hoofd-level kijkt, ben je eigenlijk met de hele organisatie bezig, dus niet alleen met het digitaliseren van processen, maar ook met het veranderen van je business model en deze telkens aanpassen op wat de klant wil.
General	**[I6]:** Ja precies, het gaat ook niet om automatiseren, maar om digitaliseren. Vaak zit daar, als je het over maturity hebt, een volgorde in. Je begint vaak met processen standaardiseren, zodat je ze kan automatiseren en dan kan je wel makkelijker de stap maken naar digitaliseren.
Experience DT	**[I6]:** Dat is natuurlijk lastig, want wat is een project. Maar ik werk zo'n 3 jaar bij PostNL in de IT. Ik zou bijna zeggen dat alles wat wij doen een raakvlak heeft met digitalisering, maar je moet je voorstellen dat wij meewerken aan hele grote transformatietrajecten, dus bijvoorbeeld de vervanging van de software bij een bepaalde operator of een heel nieuwe OOM bij een bepaalde operator. Tot aan meer kleinere dingen zoals een feature rondom, dat was laatst ook in het nieuws dat je dan je pakketje op een afgesproken plek kan laten bezorgen, dus dat kan zijn als je bijvoorbeeld niet thuis bent je het dan in de tuin kan laten afleveren. Dat is een kleine toevoeging van een dienst, dus het gaat van heel groot naar relatief klein wat we doen.
	[T]: Maar zeker wel allemaal relevant voor digitaliseren. Dat is duidelijk genoeg. Dan heb ik bij deze sectie nog een laatste vraag: of je bekend bent met maturity models en of je weet wat het inhoudt? Heb je wel eens met een maturity model gewerkt?
Experience MM	**[I6]:** Jazeker, ik gebruik wel vaker een maturity model voor allerlei onderwerpen.
	[T]: Oke, dan zitten we daarmee ook op hetzelfde level en heb je een idee wat ik ermee bedoel. Dan gaan we nu naar de derde sectie vragen. Vraag 3 gaat over de digitale transformatie aspecten. Het eerste aspect is cultuur: wat vind jij belangrijk bij een cultuur als we kijken naar digitale transformatie?

C	**[I6]:** Ik weet niet zo goed of een transformatieproces in zijn algemeenheid of je daar een specifieke bedrijfscultuur voor nodig hebt. Ik denk dus dat, de bedrijfscultuur van 'X' zal wezenlijk anders zijn dan die van 'X', maar beide zouden in staat moeten zijn om een transformatieproces te ondergaan. Dus ik denk dat cultuur, je hebt in elke organisatie ongeacht de cultuur mensen die wel bereid zijn om mee te bewegen zegt maar in een veranderprogramma en mensen die daar gewoon niet van houden.
IO/S	**[I6]:** En tuurlijk hangt het dan heel erg af van wat voor type cultuur bepaalt wat voor type veranderproces je daarbij toepast. Dus als je nou zegt ik heb een hele hiërarchische organisatie waar heel sterk vanuit de hiërarchie directief wordt aangestuurd, dan kan ik me voorstellen dat je een change proces dat je dat meer zo inricht dat je een meer planmatige uitrol doet van je change. Dat je echt gaat bedenken van dit, dit en dit wil ik en dan kom je echt in de uitrol programma's.
C/S/IO	**[I6]:** Terwijl, als je een cultuur hebt beetje zoals bij 'X' waarbij veel meer gaat over is het een goed idee i.p.v. hoeveel strepen je op de mouw hebt, dan zou je ook veel meer kunnen zeggen van, waar moeten we naartoe, dat is altijd zo bij een veranderproces, dat je of een urgentie schept of een droom, daar zou je veel meer een organische change proces kunnen toepassen waarbij je zegt van ik ga proberen al te werken op de nieuwe manier, terwijl we nog niet zo ver zijn in de verandering en dan kijken hoe we naar die nieuwe manier zoveel mogelijk kunnen bewegen. Dat is veel minder planmatig en veel meer organisch. Dus ik denk dat cultuur in die zin niet zegt of het kan, maar vooral hoe je het zou moeten doen. **[T]:** Eens. Dus je kan zowel een hiërarchische als een organische cultuur hebben?
C	**[I6]:** Ja, het kan beide, alleen ik denk dat je je wijze waarop je je change wilt realiseren daar moet je heel goed kijken hoe het binnen onze cultuur wat past. Eigenlijk heb je binnen verandering twee dogma's: één is planmatig en de ander is organisch. Je hebt uiteraard ook allemaal hybride vormen daarvan. Als je die twee als uiterste neemt, past bijvoorbeeld planmatig heel erg bij een hiërarchische cultuur en bij een wat minder hiërarchische cultuur daar past organisch veel beter bij. **[T]:** Oke, duidelijk. En wat past bij een strategie voor digitale transformatie?
S	**[I6]:** Voor ehm strategie, even kijken, ja ik denk vooral, een aantal dingen bij strategie, het is super belangrijk om helder te hebben wat doe je? Wat is de grote droom? Dat je dat weet te vertalen in een aantal sub-doelstellingen. Dat je het helder hebt van wat zijn nou de belangrijke enablers om zo'n doel te behalen. Dat is allemaal waar en allemaal heel belangrijk, maar uiteindelijk denk ik ook dat het heel erg belangrijk is hoe je de strategie omzet naar executie. Dus ik denk dat in zo'n digitale transformatie moet je, tuurlijk moet je die strategie niet onderschatten, maar strategie is ook executie. **[T]:** En wat is dan belangrijk bij die executie?

S	**[I6]:** Dat je het ook daadwerkelijk doet. Het is heel makkelijk om dingen op slides te zetten, want je kan prima een goed consultancybureau inhuren en die kan voor jou fantastische slides maken, maar het echte succes zet in ben je in staat om dat ook daadwerkelijk te implementeren en dat de executeren. Dus je kan wel zeggen, één van onze strategieën, die wij hebben gevolgd is dat we gezegd hebben van naja als we echt van digitaliseren voortgang willen maken, dan moeten we in staat zijn om voor de belangrijkste platformen die onze core processen ondersteunen, moeten we in staat zijn om dat inhouse te ontwikkelen. Waarbij we eerst alles uitbesteden aan partners, waaronder bijvoorbeeld 'X', dat we zeggen dat we in staat zijn met eigen mensen aan te kunnen werken. Dan kan je wel zeggen we gaan een engineering culture aanbrengen en een techbedrijf worden en dat is wat we dan voor ons zagen en we gaan een engineering culture opzetten en we gaan mensen aannemen. Dat kan je allemaal heel mooi opschrijven en in Powerpoint slides zetten, maar uiteindelijk valt het of staat het bij hoe zet je dat om in een goede recruitment campagne, in het aantrekken van die mensen, het onboarden van die mensen. En dat is executie.
	[T]: Hoe pak je dan zo'n executie aan en zou je een voorbeeld kunnen geven wat daarbij helpt zodat het ook allemaal daadwerkelijk gerealiseerd wordt?
S/IO	**[I6]:** Dus je moet ook het ook echt helemaal opdelen in doelstellingen, sub-doelstellingen, wie gaat het doen, rollenverdelingen, transparant maken waar je staat, verantwoording afleggen, zodat je kan bijsturen en dat kost een hoop tijd en energie. Mensen zeggen nou agile transitie, maar een agile transitie gaat wat verder als iedereen cursusje geven over wat is Scrum. Als je het echt wilt, is het echt heel veel werk.
Example	**[I6]:** En dat is zo'n digitale transformatie ook, dus bijvoorbeeld wat ik net zei, wij hebben iemand dedicated op die recruitment gezet en we hebben iemand verantwoordelijke gemaakt voor ons programma en die heeft mensen die helpen bij het neerzetten van recruitmentcampagnes met communicatie. Er wordt van iedereen gevraagd om een bijdrage te leveren, zodat we inzicht krijgen per platform hoeveel mensen we denken te moeten werven, waar staan we, welke competentie hebben we wel en niet. En als je mensen binnen hebt, heb je nog een boardingsprogramma nodig, dat moet allemaal gemaakt worden. Dus je moet echt een programma omheen creëren.
	[T]: Heel duidelijk antwoord, soms vraag ik naar wat extra verdieping.
S	**[I6]:** Die doelstellingen echt ook vertalen naar wanneer hebben we die doelstellingen nou bereikt, wanneer zijn we nu succesvol en hoe ga ik dat nou meten?
	[T]: Duidelijk rond dit punt. Dan gaan we nu richting het kennis punt. Wat vind jij belangrijke kennis voor digitale transformatie?

E	**[I6]:** En dat zit dan in heel veel verschillende dingen. Dat zit in nieuwe kennis zeg maar en dat je je way of working evalueert en kijkt, heb ik de expertise in huis om dat te bereiken wat ik graag wil of niet. Je kan natuurlijk ook zeggen, waar we ook voor hadden kunnen kiezen om op dezelfde manier door te blijven werken, maar wij dachten dat helpt niet in de versnelling van digitale transformatie. Dus daarom hebben we gekeken van oke dan willen we meer expertise in huis halen, maar het is ook heel erg belangrijk om top-down en wij doen dat ook bij 'X', uit te leggen wat bedoel je nou met digitale transformatie. Dus wat betekent digitale transformatie voor 'X' en wat wordt er dan van jou verwacht.
Example	**[I6]:** Wat je dan ziet is dat wij daar een heel learning programma waarbij de top van de organisatie, dat is dan vrij breed ik denk de top 500, wordt getraind in wat wij bedoelen met digitale transformatie. Ze zijn begonnen met de top en daar heeft onze CEO dus ook in mee gedraaid, dus die heeft dezelfde training gehad en dat is gewoon 5 dagen training. **[T]:** Ik hoor ook vaak dat digitale transformatie aan de top begint, maar iedereen moet uiteindelijke meedoen. Als je gewoon een deel hebt die het niet steunt, dan komt het niet lekker van de grond en krijg je uiteindelijk dat bepaalde dingen niet gerealiseerd kunnen worden. Oke en zijn er dan nog bepaalde type kennis die belangrijk zijn voor digitale transformatie? Die je echt nodig hebt als organisatie?
E	**[I6]:** Dat hangt heel erg af van je rol. Als je kijkt naar specifiek voor mij, ben ik natuurlijk een integratieman, dus bijvoorbeeld data is extreem belangrijk, maar als je vraagt aan mij qua data krijg je waarschijnlijk ander antwoord dan van een data scientist of vanuit een manager. Dus het is ook een beetje vanuit welke rol je zit, dus ik denk dat dat lastig is van dat en dat heb je nodig. Je moet alleen wel heel goed kijken van heb je op de verschillende niveaus de juiste mensen die uiteindelijke een goede visie kunnen neerleggen op digital? En dan is dat misschien onze CIO voor op zeg maar digitale transformatie als totaal, tot aan mijn niveau waar ik moet nadenken over digitaliseren van operators. **[T]:** Dat is een duidelijk antwoord. Het vierde blokje is information systems en dit gaat over in hoeverre je data kan verzamelen en gebruiken. Daarnaast kijkt het naar je architectuur/integratie landschap van je applicaties. Wat vind jij bij dit blokje relevant en wat valt eronder?
T	**[I6]:** Ik denk een aantal dingen die belangrijk zijn. Als je kijkt naar data is kwaliteit, vindbaarheid van data en dat je dat makkelijk uiteindelijk beschikbaar en toegankelijk hebt voor mensen. Dus als je kijkt naar digitalisering dat gaat natuurlijk ook heel veel over innovatie, dus kan je nieuwe business modellen en nieuwe services makkelijk toevoegen. Dus dat betekent ook dat je snel nieuwe dingen moet kunnen uitproberen.
T	**[I6]:** Daarnaast moet je ervoor zorgen dat je applicatielandschap modern is. Dus als jij nu nog allerlei on premisse systemen, wat grote monolieten zijn, dat is natuurlijk heel lastig. Terwijl, als jij werkt in modern, veel cloud-native, microservices, dan kan je wel makkelijker dingen aan toe te voegen.

T	**[T]:** Duidelijk denk ik. Dus eerst de data überhaupt goed in kaart brengen, want ik hoor vaak dat pas een hoger level is echt de data gebruiken om verdere stappen te maken. **[I6]:** Ja, maarja goed, je hebt eigenlijk beide nodig. Je kan een super modern landschap hebben, maar als je die data moeilijk kan omsluiten, dan zou je vastlopen en als je je data helemaal op orde hebt en makkelijk kan omsluiten, maar je hebt allemaal grote monolieten, dan schiet je er ook niet veel mee op. **[T]:** Oke, duidelijk voor dit puntje. Dan komt nu eigenlijk interne organisatie. Dit puntje gaat over hoe alles binnen je organisatie geregeld is. Wat denk jij dat hierbij belangrijk is?
IO/S	**[I6]:** Als ik dan kijk naar digitale transformatie denk ik ja, daar is leiderschap heel belangrijk vanuit een visie. Dan heb je het echt over oke wat is mijn strategie? Hoe denk ik dat gegeven onze cultuur wat is daarbij dan de goede veranderaanpak voor? Ja en afhankelijk daarvan heb je dan een bepaalde interne organisatie nodig. Maar dat kan van alles zijn. **[T]:** Dus je kan niet zomaar specifiek hier eigenlijk antwoord op geven, want dat ligt compleet aan andere dingen?
IO	**[I6]:** Ja, ik zou zeggen dat het heel erg cultureel en strategie bepalen is hoe je dit organiseert en je kan het ook niet los van elkaar zien. Je kan niet zeggen van, hetzelfde geldt voor de informatiesystemen, als jij je interne organisatie en IT architectuur als dat niet goed op elkaar aansluit, dan krijg je ook frictie. De één gaat zich altijd zetten naar de ander.
Example	**[I6]:** Dus stel nou dat, dus ik ben verantwoordelijk voor de 4 systemen, we intern zo georganiseerd zouden zijn dat ik wel informeel daarvoor verantwoordelijk ben, maar formeel, qua interne organisatie, die lijntjes heel anders lopen en iemand anders daar verantwoordelijk voor is. Dat gaat niet werken, dan gaat toch die andere persoon die daar eindverantwoordelijke voor is eisen stellen aan de systemen, die anders zijn dan ik wel. Dan krijg je een andere architectuur. Dit is gewoon super afhankelijk van je context.
Feedback	**[T]:** Dus ook een moeilijk blokje om in te vullen, omdat het heel specifiek is. **[I6]:** Ja, dus ik zie het ook niet zo zeer als iets waar je een maturity in kan zien. Van nouja als je in deze fase bent, maar kan me wel voorstellen dat je op een gegeven moment zegt van dat is misschien niet mijn startpunt om een interne organisatie te wijzigen.

Score	**[I6]:** Ik kan me wel voorstellen dat je zeg maar, naar mate je meer mature wordt, dat de urgentie om ook te kijken naar je interne organisatie en die in sync te brengen met de rest en dat kan zijn dat je de rest aanpast op de interne organisatie of de interne organisatie op het andere. Dat dat naarmate je meer mature wordt, meer urgent wordt. Dat kan ik me wel voorstellen. **[T]:** Oke, dan is ook een goede finding en heeft ook te maken met hoe belangrijk elk aspect is. Dan heb ik als laatste blokje de externe organisatie. Dat aspect kijkt vooral naar het partnernetwork en ook deels naar het gebruiken van de customer in keuzes voor je product.
EO	**[I6]:** Ja, ik denk dat dat super belangrijk is in digitale transformatie. Dat is voor mij ook het verschil in automatisering en digitalisering, ben je in staat om de gebruiker centraal te zetten. Zowel intern als extern. **[T]:** Kan je hier iets meer een detailvoorbeeld geven?
EO	**[I6]:** Zeker, bijvoorbeeld stel dat je een platform bent dat rapportages beschikbaar stelt intern, dan kom je er niet mee weg om te zeggen deze financiële rapportage ziet er gewoon zo uit en daar heb je het mee te doen. Dat werkt niet meer in deze tijd. Mensen die zijn gewend om gepersonaliseerde emails te krijgen en gepersonaliseerde ervaringen te hebben. Dan kan je niet zeggen dat als die mensen op hun werk komen, dat ze dan alles maar met standaard dingen te maken hebben. Dat wil niet zeggen dat je alles individueel moet maken, maar wel dat mensen daar nu een bepaalde personalisering toe kunnen passen. Dus dat is zeg maar intern, maar extern geldt hetzelfde. Dus wij kijken nu heel erg naar hoe ziet een customer journey eruit en wat wil die klant? Als je die klant nou centraal zet, wat betekent dat dan voor die customer journey en wat betekent dat dan voor de processen en onderliggende IT systemen. Dus zowel intern als extern heb je daar mee te maken. **[T]:** Oke, duidelijke voorbeelden, dus gepersonaliseerde content, maar ook customer journey.
EO	**[I6]:** Ja, gepersonaliseerde ervaringen in alles. **[T]:** Stel we kijken naar al deze aspecten, denk je dan dat er nog iets mist? Of zou ik aanpassingen moeten maken?
Feedback	**[I6]:** Ja, wat ik nog wel mis is een soort van rapportageblok dat je ook ergens vastlegt waar je nou staat qua maturity. Ik zou straks ook verwachten dat je op al deze aspecten straks een maturity dingen krijgt. Ik kan me voorstellen dat je een soort informatie en reporting blokje krijgt. **[T]:** Als je opnieuw naar de blokken kijkt, kan je dan aangeven welke aspecten erg belangrijk zijn en welke minder?

Score	**[I6]:** Ik denk dat dat heel erg afhangt, zoals ik net zei de internal organisatie is niet onbelangrijk, maar in het begin minder belangrijk. Dus ik denk dat de belangrijkheid van de verschillende blokken qua maturity levels zeg maar verschilt. Dus ik denk dat bijvoorbeeld ook de expertise in het begin veel meer een management expertise is waarbij dat aan het eind veel meer een expertise is in het kader van executie, dan heb je het echt meer over tech. Ik denk dat dat wisselend is. Het belang van de één neemt af, het belang van de ander neemt toe. **[T]:** Dus je moet eigenlijk zorgen dat alles een beetje gelijkmatig omhoog gaat?
Score	**[I6]:** Ik denk dat dat in het begin erg belangrijk is dat je cultuur en strategie duidelijk hebt en dan ga je kijken naar gegeven mijn cultuur en strategie, heb ik mijn informatiesystemen op orde en welke expertise heb ik nodig om dat te doen en wat heb ik dan vervolgens nodig voor de data en dan gaat de interne organisatie knellen, oke wat heb ik dan nodig? **[T]:** Oke, duidelijk, dan nog even naar het agile blokje. Wat is zijn volgens jou de belangrijkste punten van agile voor digitale transformatie?
A	**[I6]:** Agile is voor mij een middel en nooit een doel opzich. Agile komt voor mij bijvoorbeeld heel erg om de hoek kijken rondom als, meer in een transformatieproces an sich, dat je zegt van waar heb ik nou onzekerheden? Daar gaat het heel erg om bij agile. Je hebt een complex probleem met grote onzekerheden en dan ga je agile werken om te kijken of je daar met een goede oplossing voor kunt komen en die ga je valideren. Dus als ik nou heel erg zeker weet, ik heb een bepaalde applicatie en ik weet gewoon dat ik precies hetzelfde nodig heb, maar het enige verschil is het moet van on premisse naar cloud, omdat ik alleen maar moet kunnen schalen, voor de rest heb ik niks anders nodig. Waarom zou ik dat agile doen? Je hebt al 0 onzekerheid. Dus het zit veel meer in als je zegt van, rond het vraagstuk expertise bijvoorbeeld, ik weet eigenlijk niet of het beter is om met eigen engineers te werken. Ah, zullen we dat is een keer toetsen. Dat is goed. Hoe gaan we dat dan doen? We gaan het misschien bij één team starten. Wanneer is het dan succesvol? Wat willen we dan precies valideren? Wat gaan we dan zien? Wat gaan we zien als we niet succesvol zijn? Als we succesvol zijn, hoe gaan we het dan groter maken? Dus als je kijkt bijvoorbeeld naar, wij zijn georganiseerd in arts, dus wij doen SAFe, dus toen hadden we op een gegeven moment zijn we met een wat kleinere art gestart voor een specifieke tool wat we hadden en toen hebben we gekeken van die art werkte heel veel beter als andere arts en waarom is dat dan? Wat kunnen we daarvan leren om het ook bij andere arts te implementeren. Dus agile is voor mij empirisch valideren, maar dan wel van onzekere situaties en niet van dingen waarvan je eigenlijk al de oplossing weet. Er is niks mis met waterfal, er is wel wat mis met waterfal als je zegt ik ga een nieuwe applicatie maken, maar ik weet eigenlijk niet precies wat ik nodig heb. Dan wel. **[T]:** Waarom is agile dan zo fijn bij onzekerheid? Is dat bijvoorbeeld door het snelle aanpassingsvermogen?

A	**[I6]:** Omdat je dan eigenlijk continu valideert wat je maakt en checkt of dat voldoet aan hetgeen wat je nodig hebt, als je het op een goede manier doet.
Example	**[I6:** Dus ik kan je een voorbeeld geven dat niet moet, dus we hadden een keer een nieuw systeem gemaakt voor het registreren van ziekteverzuim en toen hadden we eerst bedacht hoe moeten we die data wegschrijven? Hoe gaan we data ophalen uit bedrijfsonderdelen? En toen hadden we dat helemaal gemaakt en toen gingen we het voor het eerst proberen en toen bleek dat sommige dat registreerde met 1 cijfer achter de komma, een ander met 2, en de één per FTE en de ander op headcount. Toen kon je het helemaal niet bij elkaar optellen. Dus als we nou waren begonnen met één bedrijfsonderdeel en dat helemaal laten maken inclusief hoe haal je dat op helemaal invullen etc, zodat die dat konden rapporteren. En dan een volgende toevoegen, dat had ons een hoop tijd bespaard, want dan hadden we in één keer het goede gebouwd.
A	**[I6]:** Dus de kracht van agile zit hem niet in dat je sneller werkt, maar dat je minder werkt doet wat je uiteindelijk weggooit, dus je voorkomt onnodig werk. **[T]:** Dus eigenlijk misschien door de MVPs en de mogelijkheid om sneller feedback te vragen.
A	**[I6]:** Sneller feedback vragen ja. **[T]:** Dat waren dan de vragen voor het interview. Bedankt voor het interview en dan sluiten we het hier af.
Experience general	Permission to record audio is requested before starting. This interview does not cover each maturity aspect in detail, since the duration time was shorter compared to other interviews. **[T]:** De eerste vragen gaan vooral over jou en je ervaring met digitale transformatie en maturity models. De eerste vraag is: wat is je functie binnen 'X' en wat doe je zoal? **[I7]:** Binnen 'X' ben ik cluster lead, oftewel de chief product owner. Dus er vallen zes agile teams onder mij die samen één product maken.
General/T	**[T]:** Oke, dat is duidelijk. De tweede sectie gaat meer over jouw ervaring met het begrip digitale transformatie en maturity models. Wat is volgens jou de definitie van digitale transformatie? Dan kunnen we kijk of we op dezelfde lijn zitten. Wat denk jij daarover? **[I7]:** Dat vind ik een hele goede vraag en dat weet ik eigenlijk niet. Ik vind het een vage term die in het bedrijfsleven i.i.g. gebruikt wordt als een hype. Dit heette een paar jaar geleden automatiseren. Ik denk dat het uiteindelijk gaat over processes data gestuurd maken. Ook wel digitale waarde creatie. **[T]:** En dan voor de klant bedoel je, die waarde creatie? Of voor het bedrijf?

General	**[I7]:** Ja, of voor partners, dat kan van alles zijn.
	[T]: Ik heb zelf een definitie in literatuur opgezocht en daar zeggen ze vooral dat een groot onderdeel daarvan het automatiseren van processen is, digitaliseren van processen, waarde creëren op basis van wat de klant wil, maar daar dan op een wat hoger niveau je hele business model en hoe je organisatie te werk gaat daarop aanpassen, zodat je snel kan inspringen op veranderingen, inspringen op wat klanten willen, snel korte kleine aanpassingen doorvoeren. Dus die definitie trekt het iets breder naar organisatiegebied. Dat is vooral wat de literatuur zegt en dat hanteer ik een beetje. Vandaar dat die blokken ook een stuk breder zijn dan alleen teams, maar ook de gehele organisatie bevatten. Dus constant kunnen veranderen van je business modellen. Dan weten we nu waar we het beide over hebben, dat is handig voor de vragen straks. Heb je daarnaast ervaring met digitale transformatie? Hoeveel projecten heb je ongeveer gedaan?
Experience DT	**[I7]:** We werken nu meer met features. Ik denk dat ik rond de 10 projecten heb gedaan wat betreft digitale transformatie.
	[T]: Oke, dan zal ik voor nu 10 aanhouden. Ben je daarnaast bekend met maturity modellen?
Experience MM	**[I7]:** Ja.
	[T]: Oke, dan zal ik daar verder niet teveel over zeggen. Duidelijk, ik moet het toch even vragen, want stel we denken er heel anders over, dan krijg je een langs elkaar lopend gesprek. Dan door naar de vragen over het model. Het eerste blok is cultuur en dat beschrijft de willingness van de werknemers om veranderen en informatie met elkaar te delen. Dat is wat de literatuur op hoog level zegt. Wat vind jij hierbij belangrijk?
Score	**[I7]:** Ik denk dat expertise, information systems en internal organization het belangrijkst zijn.
E	**[I7]:** Dus expertise, dat interpreteer ik, ik heb laatst een artikel gelezen over digital capital en de echt superstar firms. Daar zie je eigenlijk, zoals Google en dat soort partijen, zit veel in de techniek zelf, maar nog meer in digital capital: de kennis en kunde van mensen om waarde uit die technologieën te halen. En dat is heel belangrijk.
T	**[T]:** Je ziet ook dat AI wordt voorzichtig ook wel de volgende general purpose technologie genoemd. Als je die expertise niet in huis hebt, dan ga je het gewoon verliezen.
	[T]: Ja precies en dat wordt het ook wel moeilijk om digitaal te transformeren en te automatiseren.

T	**[I7]:** Je kan dan wel automatiseren, alleen de processing power die je met AI voor elkaar kan krijgen en wat je kan doen met AI dat is zo'n andere league dan zonder AI. Je kan eigenlijk dan niet mee met bedrijven die die expertise wel hebben. **[T]:** Je kan die ook als technology zien, dat aspect. Dat heb ik aan de hand van feedback meegenomen.
IO	**[I7]:** De mate waarin je veel legacy meesleept, bepaalt gewoon enorm de snelheid.
Example	**[I7]:** Als je hier kijkt bijvoorbeeld, zit één team in een volledig nieuwe keten, daar kon je heel makkelijk een agile werkwijze neer te zetten en heel snel binnen twee dagen allemaal changes door te voeren en hip te maken. Het ander team, dat eigenlijk op dezelfde manier bestuurd wordt, zit in een keten waarin je aan het begin en achterin data niet meer aan elkaar te relateren is. Het systeem uit de jaren tachtig, ja daar ben je gewoon 3, 4 of 5 jaar mee bezig om een keer het systeem te vervangen. **[T]:** Dus daar heb je eigenlijk dat je te erg in het oude systeem zit en daar eigenlijk een heel nieuw systeem naast moet maken of je oude systeem helemaal moet omzetten. Dat is lastig eigenlijk.
IO	**[I7]:** Ja en daar ben je gewoon lang mee bezig, je kan het oude systeem niet zomaar uitzetten. Het mag niet omvallen, dus de IT is heel belangrijk.
IO	**[I7]:** Internal organization is, hoe ik het lees, dus hoe je georganiseerd bent en of je, één van de belangrijke dingen om dit goed te doen is low-level decision making. Je wilt je organisatie zo inrichten dat je hoog opgeleide, intrinsieke, gemotiveerde mensen de ruimte geeft om hun ding te doen. **[T]:** En dan onderdeel zijn van een self-organized team? Die term kom ik veel tegen.
IO	**[I7:** Ja, dat is belangrijk.
General	**[I7]:** en dat is op bedrijfsniveau wat lastiger, want scaled agile, daar is niet iedereen blij mee. Het is toch altijd een beetje van welk probleem heb je het liefst, daar kiezen we dan maar voor. De mate waarin mensen kunnen functioneren, bepaalt gewoon voor een heel groot gedeelte de context. **[T]:** Dus ook wel een platte organisatie eigenlijk en het feit dat teams zelf keuzes kunnen maken en eigen leiderschap hebben binnen het team.
IO	**[I7]:** Er moet ook een balans inzitten, want als je 100 systemen met elkaar integreert, dat wordt natuurlijk een zooitje als iedereen autonoom is.

	[T]: Dat klopt, ik vind sowieso dat er vaak twee kanten aanzitten. Dan gaat externe organisatie eigenlijk over je partner netwerk zoals je net al zei. Strategie gaat over hoe je nou een digitale transformatie aanpakt. Ik weet niet of je daar nog iets over wilt zeggen? Wat ook nog mag is, wat misschien ook nog wel interessant is en waar je denk ik veel meer over weet, aangezien je zes agile teams leidt. Wat is van agile belangrijk als je digitale transformatie goed wilt doen? Wat is het belangrijkst van agile daarvoor?
A	**[I7]:** Nou, agile gaat natuurlijk over waarde creatie.
A	**[I7]:** Dus als je gewoon de agile principes goed doorvoert met focus, niet te grote teams, beetje die standaard dingen, dan krijg je het natuurlijk voor elkaar om waarde te laten stromen.
S/A	**[I7]:** Wat denk ik dan nog heel belangrijk is om toe te voegen is dat je ook waarde de juiste richting laat stromen en dat je vanuit leiderschap visie vertelt: waar gaan we heen? Wat is belangrijk? Zodat de mensen in de teams in staat zijn de juiste keuzes op het juiste moment te maken.
	[T]: Oke en als je teruggaat naar het eerste punt, die standaard gingen. Zou je die misschien even kort kunnen noemen?
IO/A	**[I7]:** Focus is belangrijk, als je wisselt tussen onderwerpen heb je switching costs, dus iemand zit gewoon in één team, full time dedicated en niet in verschillende teams.
S/A	**[I7]:** Zorgen dat je zo min mogelijk work in progress hebt, dus je maakt eerst dingen af die verder zijn dan dat je iets nieuws begint.
IO/A	**[I7]:** Een team is niet groter dan 9 mensen, idealiter 5 eigenlijk, maar dat wisselt een beetje per studie wat dat is, maar iig niet groter dan 9. Alleen de productowner beslist waar een team aan werkt, dus er zijn geen zijingangen. Er is een boek over volgeschreven wat hiervoor belangrijk is.
	[T]: Prima, ik stelde de vraag even zodat ik het kan meenemen in de ontwikkeling van mijn model.
	[I7]: Dit is wel een beetje de kern denk ik.
	[T]: We hebben het kort gehad over welke blokken nou belangrijk zijn. Je gaf aan dat er drie een stuk belangrijker dan de rest waren. Als je naar deze blokken kijkt, denk je dan dat deze zo compleet zijn of mis je nog iets naast deze zes blokken.
Completeness	**[I7]:** Ik zit even na te denken. Nee, ik denk wel dat, nouja het is een beetje flauw, maar de factor geluk zie ik nergens.
	[T]: Geluk?

General	**[I7]:** Niet werkgeluk, nouja dat is ook belangrijk, maar statistisch gezien. Er zijn eigenlijk geen bedrijfskundige theorieën die voorspellen of een bedrijf het goed gaat doen of niet. Ik verwacht dat de grootste bijdrage die je gaat vinden in je model gaat erom of een bedrijf geluk heeft of niet? Er zijn waarschijnlijk honderden Bill Gates die net zo slim waren en net zo getalenteerd, maar waarom is het hem wel gelukt?
	[T]: Die hebben dan misschien net de goede keuze in uitvoering of aanpak gehad ofzo en dan loopt het precies allemaal goed door.
Feedback	**[I7]:** Precies, net op het juiste moment het juiste product op de markt gebracht. Ik denk niet dat je dat meeneemt in het model.
	[T]: Nee, ik denk dat je dat niet kan meten of nouja moeilijk. Je kan zien of iemand succes heeft, maar ze gaan nooit zeggen dat dat door geluk komt denk ik. Ik snap wel wat je bedoelt, dat komt denk ik een beetje door, je kan het ook anders verwoorden vanuit de strategie kant. Oke, je hebt eerst duidelijk gezegd wat je doelen zijn en hoe je die gaat bereiken. Er komt natuurlijk een stuk geluk bij kijken, maar zeker ook een deel goede planning. Je aanpak moet wel redelijk goed zijn anders heeft geluk niet altijd zin.
S	**[I7]:** Dat sowieso, je aanpak moet goed zijn, maar we hadden bijvoorbeeld bij 'X' eigenlijk geen ruimte om te investeren, toen kwam de Coronacrisis en dat heeft voor heel veel kapitaal gezorgd, waardoor nu een kapitaalinjectie ons digitale programma financiert. En ja, dat Corona er nu is heeft met geen van deze aspecten te maken.
	[T]: Dat is waar, dat is gewoon een externe factor eigenlijk.
	[I7]: Ja en het zou mij niet verbazen als dat de grootst verklarende variabele is in elk bedrijfskundig model.
	[T]: Dus je zou hierdoor ook kunnen zeggen dat geld zeker een belangrijke rol speelt in digitale transformatie?
S	**[I7]:** Ja, ik denk met name investeren in information systems, dat is iets dat veel geld kost. Je ziet ook dat veel van die digitale platform modellen, die hebben eigenlijk nog nooit winst gemaakt, maar zijn kapitalen waard. Dat zit niet in het huidige verdienmodel.
	[T]: Duidelijk, dat zal ik meenemen. Is er nog een aspect waar je iets over kwijt wilt?
Experience general	**[I7]:** Ik wil wel iets kwijt over kennisdeling, want daar ben ik op afgestudeerd. Dat was acht jaar geleden en toen al doods en opgegeven qua literatuurgebied, omdat het heel moeilijk te beïnvloeden is.
newline	**[T]:** Je kan daar op ingaan als je nog weet wat voor kennisdeling belangrijk is.

C	**[I7]:** Mijn onderzoek ging erover of je knowledge sharing als een social dilemma kan zien en daar dan met cost en benefit proberen gedrag te sturen. Dat is eigenlijk heel moeilijk, want je wilt dat mensen er niet opportunistisch mee omgaan. Dat het gebeurt zonder dat ze gaan nadenken van wat is de waarde voor mij en moet ik het bij me houden of niet. Op het moment dat je het gaat belonen of bestraffen, dan werk je juist in de hand dat je opportunistisch gedrag krijgt.
IO/A	**[I7]:** En kennisdeling is in een agile team geen probleem. Daar heb je het al opgelost door het team klein te houden, dan hoef je niet zoveel banden te onderhouden en blijft de kennis in het team. Op het moment dat je gaat schalen naar een bedrijf, kan dat bijna niet meer, dus daar ligt wel een sleutel of eigenlijk een probleem waar niet een sleutel voor is. **[T]:** Ik denk ook dat je dat nu ziet dat dat ook nog wat verder ligt. Daarom is agile ooit ook begonnen op team gebied en probeert bijvoorbeeld scaled agile dit omhoog te trekken, maar is dat in de praktijk lastig. **[I7]:** Nee, check.

Table 44. Expert interview transcripts.

Coding category	Coding category definition
General	A general comment.
Experience general	A comment about the general experience of an interview participant.
Experience DT	A comment about the digital transformation experience of an interview participant.
Experience MM	A comment about the maturity model experience of an interview participant.
Feedback	A feedback comment for the model/research.
Completeness	A comment about the completeness of the digital transformation aspects.
Score	A comment about the score of the digital transformation aspects.
Example	A comment of an example to elaborate.
C	A comment relevant to the culture digital transformation aspect.
S	A comment relevant to the strategy digital transformation aspect.
E	A comment relevant to the expertise digital transformation aspect.
T	A comment relevant to the technology digital transformation aspect.
IO	A comment relevant to the internal organization digital transformation aspect.
EO	A comment relevant to the external organization digital transformation aspect.
A	A comment relevant to the agility digital transformation aspect.

Table 45: Coding categories and their definitions.

C MARKET RESEARCH DETAILS

CohnReznick:

CohnReznick is an advisory, assurance and tax firm. The firm published an article which explains five principles of ADT. These five principles are: start with a transformative vision, focus on building digital customer engagement, support the vision with secure digital platforms and drive insight with data-driven visualization. These principles overlap with the strategy, expertise, technology, internal organization, external organization and agility aspects of the ADT maturity model. The following five principles of ADT together with their characteristics have been stated in the article:

1. **Start with a transformative vision (S/IO)**
    - Have a transformation vision which maps out the digital strategy
    - Ability to measure progress
    - Ability to make real-time adjustments
    - Senior management creates, articulates and communicates the transformation vision
2. **Focus on building digital customer engagement (EO/E/A)**
    - Digital customer engagement
        - Digital technology is built around the front-end customer experience
        - Digital ecosystem that automates the customer experience through social, data, cloud, and mobile
        - Exposure to new growth opportunities
3. **Support the vision with secure digital platforms (T)**
    - Manage risk using smart tools
    - Quickly detect intrusions and respond in real-time
    - Secure interfaces to digital platforms
4. **Drive insight with data-driven visualization (T)**
    - Data visualization to make data more accessible, understandable and usable
5. **Embrace digital agility to create advantage (A/S)**
    - Demonstrate awareness of agile
    - Execute innovation and governance in an agile way
        - Continuously evolve digital strategy
        - Digital innovation framework
        - Centralized coordination of digital programs
        - Monitoring program through KPIs and scorecards

Fintricity:

Fintricity is a consultancy company focusing on advising strategy, innovating, transforming digitally and delivering change. The company published an article about the 10 benefits of an Agile approach

to digital transformation. These 10 benefits are: flexibility, business value comes first, continuous improvement, frequent value delivered, cost control, risk reduction, great communication and engagement, complete transparency, high quality and higher team morale. These benefits overlap with every aspect of the ADT maturity model. The 10 benefits are described below by highlighting them and listing impotant characteristics:

1. **Flexibility (C/A)**
    - Accept and expect change
2. **Business value comes first (S)**
    - Start with the 'why'
    - The approach is aligned and responsive to business' needs
3. **Continuous improvement (E/C)**
    - Expand employee knowledge
    - Identify, share, apply learnings to projects
4. **Frequent value delivered (S/A)**
    - Deliver valuable outcomes in smaller chuncks
5. **Cost control (S/A)**
    - Fixed sprint lengths
    - Ability for regular budget refinements
6. **Risk reduction (C/T/EO/A)**
    - Daily updates
    - Constant communication
    - Regular testing
    - Collaborative feedback
7. **Great communication and engagement (IO/EO/A)**
    - Regular communication
    - Constant collaboration
    - Feedback sessions
    - Continuous stakeholder management
8. **Complete transparency (S)**
    - Track progress and manage expectations at every level
9. **High quality (T/C/A)**
    - Early notice of issues and relevant adjustments to be made quickly
    - Teams encouraged to embrace innovation
    - Teams encouraged to embrace technological excellence

10. **Higher team morale (C/IO/E/A)**
    - Highly motivated, high performing team
      - Level of self-management
      - Encouragement of creativity
      - Time to reflect
      - Regular knowledge sharing
      - Continuous learning

BiZZdesign - HoriZZon:

BiZZdesign is a company which focuses on helping others make smarter decisions and optimize their outcomes. To accomplish this, BiZZdesign developed the tool HoriZZon which brings together strategy, IT architecture, operating models, data, capabilities, change portfolios and ideas into a single, intuitive collaborative business design platform. According to BiZZdesign, this tool helps companies to achieve agile digital transformation and therefore its aspects and capabilities are analyzed. These aspects and capabilities overlap with the strategy, technology, internal organization and agility aspect of the ADT maturity model. The following aspects and capabilities can be identified in the tool:

1. **Models and roadmaps (S)**
   - Capture current state
   - Design future states scenarios
   - Design roadmaps to brigde towards the future
2. **Data integration (T)**
   - Ability to have an all-encompassing integration system
3. **Advanced analytics (T)**
   - Tools enabling self-service analytics utilizing all data and relations
   - Tools enabling advanced scripting, calculations and BI integration
4. **Multi-discipline collaboration (IO/T/A)**
   - Collaboration across roles, disciplines and geographies
   - Tool for data modeling, analysis and decision-making
5. **Governance & Security (T)**
   - Access control
   - Security certification
6. **Business Insight Graph (T)**
   - Central repository of knowledge

Altexsoft:

Altexsoft is a software r&d engineering company which helps in the completion of projects of clients. Alexsoft published an article on business agility practices during digital transformation. It describes how agility can help on three different organizational levels during digital transformation. These organizational levels are: strategic business agility, organizational agility and operational agility. These levels and their characteristics overlap with the strategy, technology, internal organization, external organization and agility aspect of the ADT maturity model. The levels and its capabilities are as follows:

1. **Strategic business agility (S/A)**
    - Awareness of company's business environment
        - System of qualitative and quantitative tracking of metrics and KPIs
    - Data-driven decision-making
2. **Organizational agility (IO/S/A)**
    - Agile mindset of senior executives
        - Agile culture
        - Supported, transferred and maintained by top managment
    - Flattening hierarchy
        - Collaboration between teams
        - Quick iterations
    - Self-organizing teams
        - Team autonomy to make decisions
        - Leaders create a comfortable work environment
    - Breaking down silos
        - Encourage cooperation between business & IT
        - Technology is part of the strategy
    - Distributed agile network
        - Possibility to work remotely and still effective
3. **Operational agility (T/A/EO)**
    - Business management software to automate and manage core business processes
    - Agile framework usage
    - Efficient communication between team, stakeholders and end-users

Intellyx:

is a company which partly focuses on digital transformation. It has released an ADT roadmap poster covering the important aspects of ADT. This poster can be found in the Introduction section in Figure 9. The aspects depicted in the poster are: customer experience, enterprise IT, big data, DevOps and agile architecture. These aspects overlap with the technology, internal organization, external organization and agility aspects of the ADT maturity model. The five main areas with there characteristics are:

1. **Customer Experience (EO/A)**
    - Mobile adoption
    - Customer journey
    - Digital marketing
    - Individualization
    - Customer experience
    - Omnichannel
2. **Enterprise IT (T)**
    - Shadow IT
    - Bimodal IT
    - Enterprise apps
    - Modernization
    - Mainframes
    - APIs
    - Hypermedia & REST
    - Cloud computing
    - Self-service
    - Cybersecurity
    - Next-gen SOA
3. **Big Data (T)**
    - Containers
    - Internet of things
    - Digital diversity
    - Data gravity
    - Data lakes
    - Big data analytics
    - Semantic technologies
    - Machine learning
    - Cognitive computing
4. **DevOps (T/A)**
    - Real-time
    - SecDevOps
    - CI/CD
    - Automated governance
    - Software-defined everything
    - Digital business performance management

    - Microservices

5. **Agile Architecture (IO/A/T)**
    - Self-organization
    - Enterprise architecture
    - Center of digital enablement
    - Complex systems
    - Web scale
    - Streaming data

CAPE Groep - CAPE Moby 2:

CAPE Groep has started to build a maturity tool, called CAPE Moby 2, for their transformation including ADT aspects. This tool is still in child shoes, but since it covers ADT aspects, it is considered as a part of the market research. The aspects in the tool are: management agility, business agility, business - ICT trust, governance, agile continuous delivery, product vision excellence, team agility, learning culture, skills of team, DevOps implementation and data management. These aspects overlap with all aspects of the ADT maturity model. The CAPE Moby 2 tool aspects with their characteristics are:

1. **Management agility (S/A)**
2. **Business agility (A)**
3. **Business - ICT trust (C)**
4. **Governance (IO)**
    - SAFe roles
5. **Agile continuous delivery (T/A)**
    - Performance
    - Quality cocntrol
    - Security testing
    - Monitoring & alerting
    - Dynamic reporting
    - Right technologies used
6. **Product vision excellence (EO/A)**
    - Customer involvement
7. **Team agility (IO/A)**
    - Agile integrated in teams
    - Teamwork
8. **Learning culture (E/A)**

9. **Skills of team (IO/A)**
    - Independent
    - Self-organized
10. **DevOps implementation (IO/A)**
11. **Data management (T)**

D ADT SUB-ASPECTS & INDICATORS V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked 1-5 Likert scale)
Willingness To Make Decisions	The culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities.	Everyone is allowed to make decisions	Decision making is possible throughout all levels of the organization.	To what extent does there exist a culture which allows employees to make his/her own decisions?
		No blame culture	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports the willingness of an employee to make his/her own decisions?
		Open environment	Environment where it's supported and encouraged to make decisions and pitch them.	To what extent does there exist an open environment which supports the willingness of an employee to make his/her own decisions?
		Transparant environment	Environment where it's supported to make decisions, since all knowledge is availalble to everyone.	To what extent does there exist a transparant environment which supports the willingness of an employee to make his/her own decisions and base this decision on importance and value?
Willingness To Change	The culture of change which should be in the veins of the employee - think change, do change.	Accept and expect change throughout the whole organization	Not only accept change, but expect it and even think about things you can change.	To what extent does there exist a culture where employees are accepting change and think in change?
		Teams encouraged to embrace technological excellence	Be open to new developments in the technology area and make sure your team is up to date.	To what extent does there exist a culture in which employees are open to technologies and embrace them?
		Teams encouraged to embrace innovation	Be open to innovation and change your team based on innovative ideas.	To what extent does there exist a culture in which employees are open to new innovation and embrace new digital advancements?
Knolwedge Sharing	Between the employees there exist an environment of teamwork to increase knowledge sharing to keep learning from each other.	Business - ICT trust	The business and IT department should trust each other and wanting to collaborate.	To what extent does there exist a culture where the business & IT trust each other and share knowlegde?
		Constant communication	The employees of an organization have a mindset of constant communication.	To what extent does there exist a culture where knowledge sharing is encouraged by constant communication between employees?
		Identify, share, apply learnings to projects	The employees are focused on learning from expercies during projects and identify, share and apply these learning to new projects.	To what extent does there exist a culture where learnings from experience are identified, shared and applied to other project?
		Open environment	Environment where it's supported and encouraged to share knowledge.	To what extent does there exist an open environment which supports knowledge sharing between employees?
		No blame culture	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports the willingness of an employee to make his/her own decisions?
		Transparant environment	Environment where it's supported to share knowledge, since all knowledge is availalble to everyone.	To what extent does there exist a transparant environment which supports knowledge sharing between employees by making knowledge available throughout the organization?

Figure 47: Culture aspect V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked 1-5 Likert scale)
Digital Management	The management's strategic viewpoint on how to manage digital transformation.	Commitment from top, middle and lower management	All management levels need to be on the same page and support the digital transformation.	To what extent do top management, middle management and lower management all commit to digital transformation?
		Management focus on change management	The management needs to work on how to change the current organization to be a digital organization. Examples: transform the traditional organization into a more flexible organization. Make employees part of the change.	To what extent does the management focus on change management to make sure the organization changes towards the envisioned endpoint and make employees part of this change?
		Top management establishes digital importance	Top management should create awareness around digital transformation.	To what extent does top management support digital transformation to make sure awareness around digital transformation is established throughout the entire company?
Digital Transformative Vision	The digital transformative vision displays the digital transformation strategy and is often established based on a digital transformation roadmap.	Clear digital transformation start point	What is the current situation of your organization?	To what extent does the organization focus on creating clear start points, displaying the current state of the organization, of the digital transformation?
		Clear digital transformation end point	What is the future state of your organization?	To what extent does the organization focus on creating clear end points, displaying the future state of the organization, of the digital transformation?
		Digital transformation roadmap to determine the path from start to end	A roadmap describing the vision on how to come from your start point to your end point.	To what extent does the organization focus on creating digital roadmap envisioning the paths from how to come from your start to end points?
		Execute your digital roadmap based on your culture and internal organization	Choose an execution strategy based on the context of your organization. Example: plan-driven vs agile.	To what extent does the organization choose a strategy which fits the context, for example culture and internal organizatin, of the organization?
Digital Strategy	The digital strategy describes how the digital transformation goals are achieved.	Strategy based on digital transformation goals	The strategy has to be aligned with digital transformation goals/strategic themes.	To what extent is the strategy aligned with the goals/strategic themes of the organization?
		Chosen technology based on digital transformation goals	The choice of technology has to be aligned with the digital transformation goals.	To what extent is the choice of technology aligned with aligned with the goals/strategic themes of the organization?
		Outside-in strategy	Base your strategy on developments in the outside world.	To what extent is the strategy a outside-in strategy, i.e. based on developments in the outside world?
		Prioritization of your digital transformation goals	Have a good understanding of the digital transformation goals and their importance. Base a priority list on this.	To what extent does there exist a prioritization of the digital transformation goals/strategic themes based on importance?
		Oversee all goals and don't become a one-trick pony	Focusing on just one or a few digital transformation goals is not recommended for a digital transformation.	To what extent does the organization establish itself as a one-trick pony, i.e. focuses on performing one digital transformation goal/strategic theme well instead of focusing on all?
		Start with small success and eventually scale	Focus on small success first to increase the awareness and importance of digital transformation.	To what extent does the organization focus on small successes first to establish/increase awareness and importance of digital transformation initiatives?
		Continuously evolve digital strategy	Continously evolve digital strategy based on prior outcomes and program feedback.	To what extent is the organization able to continuously adapt the digital strategy based on prior outcomes and feedback without it being a hurdle?
		Data-driven decision-making	Base strategic decisions on obtained data.	To what extent is the organization able to base strategic decisions on obtained internal or external data?
Digital Resources	The digital resources describe the resources which are important during digital transformation for the strategy.	Budgetting for digital transformation	The company has a budget for digital transformation to make sure money is set aside for it.	To what extent does there exist a budget for digital transformation?
		Time management	The company acknowledges that digital transformation consumes much time and plans accordingly.	To what extent does the organization realise digital transformation is a significantly large topic which needs much time?
Monitoring	Monitoring describes the ability of an organization to monitor the progress of the digital transformative vision and the digital strategy.	Monitor execution progress of your strategy	Monitor the execution of your digital strategy through KPIs and metrics to gain awareness of the progress.	To what extent does the organization monitor the execution of the digital strategy based on well defined KPIs and metrics to know exactly the progress of the digital strategy?
		Monitor the execution of your roadmap	Monitor the execution of your transformative vision to know exactly where you are in your digital transformation.	To what extent does the organization monitor the execution of the transformative vision based on well defined KPIs and metrics to know exactly the organization's current state?
		Establish KPIs and metrics to montitor execution	Relevant KPIs and metrics are determined to monitor execution of strategy and roadmap.	To what extent does the organization determine relevant KPIs and metrics which suit the transformative vision and the digital strategy?

Figure 48: Strategy aspect V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked 1-5 Likert scale)
Expertise Management	The management of digital transformation expertise within an organization.	Digital transformation expertise flows throughout the entire organization	Digital transformation expertise is distributed throughout the whole organization and everybody knows the definition.	To what extent does the entire organization agree on a common digital transformation definition and is digital transformation expertise distributed over the entire organization?
		Inhousing or outsourcing knowledge	The organization thinks about having the digital expertise inside the organization or to hire it from outside.	To what extent does the organization think about the right mix between inhousing and outsourcing digital transformation knowledge?
		Digital transformation execution knowledge	The management has expertise on how to execute a digital transfromation inside the organization.	To what extent does the management know how to execute a digital transformation inside the organization?
		Learning budget	The organization has a budget for learning to make sure money is set aside.	To what extent does there exist a learning budget within the organization to offer the employees the opportunity to keep learning?
Digital Expertise	The expertise which is important for performing digital transformation within an organization.	IT knowledge	Expertise on the technical side of things.	To what extent does the organization have IT expertise to perform a digital transformation?
		Business knowledge	Expertise on the business side of things.	To what extent does the organization have business expertise to perform a digital transformation?
		Digital transformation execution knowledge	Expertise on how to execute digital transformation.	To what extent does the organization have digital transformation execution knowledge to perform a digital transformation?
		Personal knowledge	Expertise about yourself.	To what extent do the employees have personal knowledge which helps them perform a digital transformation?
		Team roles knowledge	Expertise on team roles within an organization and what each role entails.	To what extent does the organization have team roles knowledge to establish the right team for performing digital transformation?
		Digital process knowledge	Digital expertise of employees on processes inside the organization.	To what extent does there exist knowledge about a certain process among more than only one employee?
Continuous Learning	The ability of an organization to offer continuously learning opportunities and the ability of employees to continuously learn.	Having a digital academy	A central place of knowledge or a programm which offers learning opportunities.	To what extent does there exist a digital academy/programm which offers digital transformation learning opportunities?
		Having a learning mindset	A mindset of employees to keep learning and improving themselves.	To what extent does there exist a learning mindset among employees to keep learning and improving themselves?
		Employees keep learning	The employees of the organization keep learning and are pushed to learn.	To what extent do the employees actually keep learning within the organization?
		Providing trainings	The organization offers trainings to keep learning.	To what extent does the organization offer training, such as traineeships or even trainings after the traineeship, to keep learning?

Figure 49: Expertise aspect V1

Sub-aspect	Description	Indicator	Description	Assessment questions (ranked 1-5 Likert scale)
IT Systems	The core flexible IT systems an organization needs for digital transformation and their reason to choose them.	Choose the right systems	The choice of systems is based on need and not just based on randomnous.	To what extent are the IT systems bought based on organizational need instead of buying quantity?
		Financial system	There exists a financial system which is used inside the organization.	To what extent does there exist an established financial system inside the organization?
		Employee information system	There exists an employee information system which is used inside the organization.	To what extent does there exist an established employee information system inside the organization?
		Warehouse management system	There exists a warehouse management system which is used inside the organization.	To what extent does there exist an established warehouse management system inside the organization?
		Transport management system	There exists a transport management system which is used inside the organization.	To what extent does there exist an established transport management system inside the organization?
		Document management system	There exists a document management system which is used inside the organization.	To what extent does there exist an established document management system inside the organization?
		Flexible IT systems	The IT systems are flexible and changes can be made easily.	To what extent are the internal IT systems flexible and can changes be made easily to systems when necessary?
IT Architecture	The building blocks of the IT architecture, the coupling between the building blocks and a tool to visualize the IT architecture for the digital transformation of an organization.	Usage of the cloud	The organization uses cloud services as part of their IT architecture.	To what extent does the organization use cloud services in their IT architecture?
		Integration systems layer	There exists a layer in the architecture which shows the integration between	To what extent does there exist an integrational systems layer connecting systems in the IT architecture of the organization?
		Datalake/datawarehouse	The datalake/datawarehouse saves all the data from systems in one place.	To what extent does there exist a datalake/datawarehouse, which saves data from systems in one place, in the IT architecture of the organization?
		Open APIs	The open APIs ensures that other systems can connect to your system and communicate.	To what extent do there exist open APIs, that ensure systems to connect to your system and communicate, in the IT architecture of the organization?
		Loose coupling between layers	The layers are loose coupled if there are few connections between them and if not everything is depedent on one layer.	To what extent does there exist loose coupling, which means there are only few connections between each layer to decrease dependency of a layer, between the different architectural IT layers of the organization?
		Microservices	The microservice consists of small components of other services.	To what extent are systems build like microservices, the main service consisting of smaller other services, in the IT architecture of the organization?
		Enterprise architecture tool	The enterprise architecture tool helps you envision the IT architecture by making	To what extent does the organization use an enterprise architecture tool to visualize the IT architecture of the organization?
Data Integration	The ability of an organization to obtain data from systems and to make decisions based on analysis of the data during digital	Connecting systems to systems	The ability to connect different systems with each other.	To what extent are systems in the IT landscape connected with each other in the organization?
		Get data from systems	The ability to retrieve structured data from systems.	To what extent is the organization able to retrieve structured data from their systems?
		Do analysis with big data (reporting)	The ability to do analysis on the retrieved data which has grown to big data. Examples: Uptime, performance, bottlenecks, clikcs, etc.	To what extent is the organization able to do analysis/reporting on the retrieved data from the sytems?
		Simulations with AI	The ability to make simulations and do predictions based on analyzed retrieved	To what extent is the organization able to perform simulations/predictions using AI and based on the retrieved data from the
		Make decisions based on data	The ability to make decisions based on the retrieved and analyzed data.	To what extent is the organization able to make decisions based on the retrieved and analyzed data?
Data Monitoring	The ability of an organization to monitor the obtained data from systems during digtial transformation.	Data monitoring based on KPIs	The ability to monitor data based on KPIs. Important KPIs are: quality, findability, etc.	To what extent do there exist well defined KPIs to monitor data from systems inside the organization?
		Functionality based data monitoring	Data monitoring based on how the system is used by customers. Examples: number of clicks, repeated actions, etc.	To what extent does the organization perform functionality based data monitoring, which includes the monitoring of how the application is used?
		Technological based data monitoring	Data monitoring based on the functionalities of your system. Examples: uptime, performance, etc.	To what extent does the organization perform technological based data monitoring, which includes the monitoring of the technical system?
IT Security	The measures taken to increase security of the systems in an organization during digital transformation.	Ratio on cloud/on premise	The ratio between on premise systems and systems in the cloud. On premise systems are less secure compared to cloud systems.	To what extent does the organization have on premise systems instead of systems in the cloud?
		Technological standards	The technological standards describe what is accepted in the market and what not.	To what extent does the organization comply to technological standards in the market?
		Manage risk using smart tools	The smart tools are created to easily identify possible risks and mitigate them.	To what extent does the organization use smart tools to identify and manage risks which could occur to systems?
		Secure interfaces	The interfaces should be secured to prevent intruders. Example: access control.	To what extent does the organization focus on secure interfaces to prevent intruders by, for example, defining access control?
		Intrusion detection	Intruders entering the systems should be detected by a system.	To what extent is the organization able to detect intruders in their IT systems and act based op on intrusions?
		Security testing	The security of your systems has to be regularly tested.	To what extent does the organization regularly test the security of their IT systems?
Process Automation	The degree to which core processes inside of an organization are automated.	BMS to automate and manage processes	Software which is used to automate and manage core business processes.	To what extent does the organization focus on automating core processes within the organization?

Figure 50: Technology aspect V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked 1-5 Likert scale)
Leadership	The leadership components for top management in the interal organization of an organization when performing digital transformation.	Leadership vision	A clear leadership vision which supports, transfers and maintains digital transformation importance and fits the organizational culture.	To what extent does there exist a clear leadership vision at the top management level which supports, transfers and maintains digital transformation initiatives that fit the organization's context?
		Democratic leadership	The leadership style which supports teams and employees to have leadership as well.	To what extent does there exist a democratic leadership style at the top management level which enforces leadership in teams?
		Comfortable work environment	The leader makes sure the work evironment of employees is comfortable and supports productivity.	To what extent does the top management ensure a comfortable work environment for their employees?
Departments/Teams	The department/teams components for the internal organization of an organization when performing digital transformation.	IT in departments	The importance of offering IT capabilities to departments and teams.	To what extent do there exist IT capabilities in departments and teams?
		Connect business & IT	The business and IT are both connected in departments and teams.	To what extent are business and IT connected within departments and teams?
		Communication with top management	The departments and teams communicate with top management to stay on the same page.	To what extent does there exist communication between top management and department and teams to keep each other updated?
		Self-organized	The departments and teams need some level of self-organization to work indepedently.	To what extent are departments and teams self-organized and able to work independently?
		Collaboration between teams	The department and teams are able to collaborate with eacht other to reach common goals.	To what extent does there exist collaboration between department and teams to reach common goals
Organizational roles	The components for organizational roles within the organization when performing digital transformation.	Defined roles	The roles within the organization are defined and clear.	To what extent are roles defined and clear within all levels of the organization?
		Defined responsibilities	The responsibilities within the organization are defined and clear.	To what extent are responsibilities defined and clear within all levels of the organization?
Way of working	The components for the way of working when performing digital transformation.	MVPs	A part of the way of working is creating minimal viable products to create small successes quickly.	To what extent is the way of working inside the organization based on creating minimal vialbe products and thus small, quick successes?
		Planning rhythm	A part of the way of working is to establish a planning rythm which details the period of time after which planned goals have to be reached.	To what extent is the way of working inside the organization based on a planned rythm which details the period of time after which certain goals have to be reached?
		Flexible prioritization	A part of the way of working is to have a flexible prioritization of goals which can be altered when needed.	To what extent does there exist a flexible prioritization of goals which can be altered when needed in the way of working of the organization?
		Two way operations	A part of the way of working is that the new digital transformed way is built next to the normal way and slowly be plotted on each other.	To what extent does there exist a two way operations, which means that the new digital transformed way is built next to the normal way and slowly plotted on each other, in the way of working of the organization?
		Context aligned	A part of the way of working is that it needs to be aligned with the context of the organization (culture).	To what extent is the way of working of the organization aligned with the context of the organization (culture)?

Figure 51: IO aspect V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked between 1-5 Likert scale)
Digital Partner Network	The digital partner network of the organization, how they are able to support the digital transformation and how this can be envisioned.	Partners kickstarting the DT	A partner with knowledge about digital transformation is useful to kickstart your own digital transformation.	To what extent do there exist partners in the digital partner network who can kickstart the digital transformation of the organization?
		Digitally transformed partners	The partner network which is digitally transformed as well, so working together is easier.	To what extent are the partners in the digital partner network digitally transformed?
		Event driven chain architecture	The event driven chain architecture in the partner network which allows to start processes at partners and the other way	To what extent does there exist an event driven chain architecture, which allows the organization to start processes at partners and the other way around, in the digital partner network of the
		Continuous stakeholder management	The continuous management of stakeholders who are included in running projects to ensure quality.	To what extent does there exist continuous stakeholder management in running project to ensure quality within the digital partner network of the organization?
		Collaborative feedback	The collaborative feedback with your partner network to share experiences and improve processes.	To what extent does there exist collaborative feedback exchange to share experience and improve processes within the digital partner network of the organization?
Competition	The competition of the external organization which describes the awareness of the competition and the power chain of the competition.	Competition growth	The growth of the competition which is kept an eye on.	To what extent does there exist awareness of the competition to make decisions based on developments in the competition environment of the organization?
		Power distribution in chain	The order of power in the competitive chain of the organization which can influence the organization's decisions.	To what extent is the organization able to influence decisions made in the external environment of the organization, due to having power in the chain?
Digital Customer Engagement	The digital customer engagement of the external organization which describes how the customer is involved with the organization.	Pull clients in your context	The ability to pull clients in your context to, for example, do a pilot. This helps to improve the quality of the product.	To what extent is the organization able to pull clients in the organization's context by, for example doing pilot projects, to ensure quality is delivered to the customer?
		Customer centricity	The importance of putting the customer central and base decisions on what the customer thinks and wants.	To what extent does the organization put the customer central and base decisions on what the customer wants and thinks?
		Personalized content	The content which is made/shown to the customer can be personalized to his/her likings.	To what extent is the organization able to offer personalized contents to match the likings of the customer?
		Digital customer journey	The digital journey of the customer and the ability to stand in his/her shoes.	To what extent does the organization create digital customer journeys to envision what the customer wants?
		Expose growth opportunities	The digital marketing focused on exposing new growth opportunities to customers and see how the products and services adapt to the customer.	To what extent is the digital marketing of the organization focused on exposing customers to new digital growth opportunities to check how the products and services adapt to the customer?
		End-user communication	The communication with the end-user of the product to make sure the customer is involved.	To what extent does there exist communication with the end-user to ensure product quality?

Figure 52: EO aspect V1

Sub-aspect	Description	Indicator	Description	Assessment question (ranked 1-5 Likert scale)
Embrace change to deliver customer value	In many cases, the development team, as well as the customer, are in a continuous learning process as to the requirements necessary to realize additional customer value. Hence, an attitude of welcoming and embracing change should be maintained throughout the software development effort.	Change based on outside developments	The change is based on developments in the outside world.	To what extent is the change inside the organization based on developments in the outside world?
		Complex, uncertain problem	The change is embraced when working on complex and uncertain problems.	To what extent is the change embraced when working on complex and uncertain problems inside the organization?
		Accept and expect change	Not only accept change, but expect it and even think about things you can change.	To what extent do employees accept change and think in change in the organization?
		Management agility	The management is embracing change and recognizing it.	To what extent is the management thinking and recognizing agile in the organization?
Plan and deliver software quality iteratively	Early and frequent delivery of working software is crucial, because it provides the customer with a functional piece of the product to review and provide feedback on. This feedback is essential for the process of planning for upcoming iterations, as it shapes the scope and direction of the software development effort.	Quater planning (PI)	A part of the planning of software quality is to establish a PI planning which details the period of time after which planned goals have to be reached.	To what extent does there exist PI planning, which details a period of time after which planned goals have to be reached, in the organization?
		Adaptive planning	The planning can be changed based on developments during the implementation period.	To what extent does there exist a adaptive planning, which can be changed based on development during the implementation period, in the organization?
		Priority planning	The planning is based on the prioritization of goals/strategic themes defined in the PI planning.	To what extent is the planning based on prioritization of goals/strategic themes in the organization?
		Defined strategic themes	A part of the planning of software quality is defining the right goals you want to achieve.	To what extent are goals/strategic themes defined in the organization?
		MVPs	A part of the delivery of software quality is creating minimal viable products to create small successes quickly.	To what extent is the way of working inside the organization based on creating minimal vialbe products and thus small, quick successes?
		Feedback loops with stakeholders	A part of delivering software quality is to have frequent feedback loops on delivered products with stakeholders, so the quality can be improved.	To what extent do there exist feedback loops with stakeholders after each iteration to obtain feedback on delivered products and improve the product based on this in the organization?
Human-centric	The reliance on people and the interactions among them is a cornerstone in the definition of agile software processes.	Define agile roles	The agile roles within the organization are defined and clear.	To what extent are roles defined and clear within all levels of the organization?
		Defined responsibilities	The responsibilities within the organization are defined and clear.	To what extent are responsibilities defined and clear within all levels of the organization?
		Collaboration between teams/departments and management	The department, teams and management are able to collaborate with eacht other to reach common goals.	To what extent does there exist collaboration between departmenst and teams to reach common goals in the organization?
		BizDevOps	The business, IT and operations are all connected in departments and teams.	To what extent are the business, IT and operations connected in department and teams of the organization?
		DevOps	The IT and operations are connected to make sure silo's are fading and collaboration is increased.	To what extent are IT and operations connected and are silo's of departments fading in the organization?
		Self-organized teams	The teams need some level of self-organization to work indepedently.	To what extent are departments and teams self-organized and able to work independently in the
		Team size of 5-9	The size of the team which is between 5 and 9 employees.	To what extent are the sizes of the teams in the organization between 5 to 9 employees?
		Employee dedicated to one team	A employee is assigned to one team and fully dedicated to this team and does no work for other teams.	To what extent are the employees in the organization assigned and dedicated to one team only and do not work for other teams at the same time?
		Distributed agile network	The possibility to work remotely and still effective through a distributed agile network.	To what extent are employees able to work remotely from home and still be effective through a distributed agile network of the organization?
Technical excellence	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments, such as the ones characterized as agile.	Security	The security of the IT systems in an organization.	To what extent do there exist security measures to make sure the IT systems are secure in the
		Build under architecture	The ability to build what you really need according to architecture and to avoid incidental architecture.	To what extent is code build under architecture to make sure you build what you need and avoid incidental architecture in the organization?
		Quality of code	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments.	To what extent does there exist a focus on producing the highest quality of code possible in the organization?
		Validation of code	The constant validation of the code you are building for a project.	To what extent is the build code constantly validated based on test and requirements in the organization?
		Monitor using KPIs	The monitoring of the performance of the systems based on well defined KPIs.	To what extent does there exist monitoring of the performance of code based on well defined KPIs in the organization?
		CI/CD	Continuous intergration/continuous delivery of code and part of applications by automating building, testing and deployment.	To what extent does there exist CI/CD pipelines to support continuous integration and continuous delivery of parts of code and application in the organization?
Learning	Encourage people in the organization to participate in learning, teaching and improvement, collect measures to support learning and improvement.	Retrospective	The learning moment after each PI where you look back at what you did and what could have been done better.	To what extent does there exist a learning moment after each PI where you look back at what you did and learn from the experience?
		Continuous learning	The mindset of wanting to keep learning and have the opportunity to keep learning.	To what extent does there exist a continuous learning mindset among employees and does the organization offer opportunities to continuously learn in the organization?
		Monitor agile program	The monitoring of the agile way of working program in the organization.	To what extent is the agile way of working program monitored in the organization?
		Monitor using KPIs and learn	The monitoring of the performance of the systems based on well defined KPIs and afterwards learning from the findings.	To what extent do there exist well defined KPIs to monitor data from systems inside the organization?
Customer collaboration	Inspired by the original statement of the agile manifesto, there must be significant and frequent interaction between customers, developers, and all the stakeholders of the project to ensure that the product being developed satisfies the business needs of the customer.	Digital customer engagement	The digital customer engagement of the organization which describes how the customer is involved with the organization.	To what extent does the organization focus on involving the customer in the creation of their products and new value?
		Communication with end-users	The communication with the end-user of the product to make sure the customer is involved.	To what extent does there exist communication with the end-user to ensure product quality in the organization?
		Customer journey	The journey of the customer and the ability to stand in his/her shoes.	To what extent does the organization create customer journeys to envision what the customer wants?

Figure 53: Agility aspect V1

E BRAINSTORM

E.1 Brainstorm Protocol

1. Thank everyone for joining the brainstorm session and for their time to help me out with my graduation project.
2. Introduce the idea of the brainstorm session:
   (a) To obtain indicator weights where possible.
   (b) To evaluate the maturity model as a whole.
   (c) Mention how their input will be used in the development of the model.
   (d) Small introduction about the model.
   (e) Start with most relevant aspect: Culture, technology and go through them 1 by 1.
3. Ask for permission to record audio. The audio will be used for transcription purposes and for the thesis only. Names and organizations will be anonymized. Audio will be deleted after use.
4. Distribute post it notes, scrap paper, markers and pencils.
5. Ask if there are any questions before we start with the brainstorm.
6. Start with the brainstorm session:
   (a) First, demographic information is asked about the participants.
      i. The role in the organization.
      ii. The experience with digital transformation and agile.
   (b) Second, introduction about the model will be given:
      i. Show introduction tab.
      ii. Explain.
      iii. Evaluation: ask questions to evaluate the introduction tab.
   (c) Going over each aspect 1 by 1:
      i. Short explanation of the aspect, sub-aspects, indicators and assessment questions.
      ii. Evaluation: ask questions to evaluate aspect, sub-aspects, indicators and assessment questions.
      iii. Stage 1: let participants think of the indicator importance individually.
      iv. Stage 2: evaluate indicator importance with the whole group.
      v. Stage 3: decide the indicator importance for each indicator if possible.
7. Indicate the score and desired score input fields and the maturity score output field.
8. Show the mock-up dashboard results tab.
9. Ask the open question about model practicality.
10. Ask the participants to rate the evaluation criteria on a 1-5 scale.
11. End the brainstorm session after two hours.
12. Thank the participants again for joining and shortly mention how their input will be used for the development of the maturity model.
13. Ask for feedback on how to improve the brainstorm process.
14. If not all aspects or evaluation criteria were covered, kindly ask the participants to take another look at home and send suggestions/fill in evaluation criteria.

F EXPERT EVALUATION INTERVIEWS

F.1 Evaluation Interview Protocol

1. Thank the expert for joining the internal expert evaluations and for their time to help me out with my graduation project.
2. Introduce the idea of the expert evaluation session:
   (a) Test non-functional requirements.
   (b) Feedback on the contents of the model for improvement.
   (c) Mention how their input will be used in the development of the model.
   (d) Small introduction about the model.
3. Ask for permission to record audio. The audio will be used for transcription purposes and for the thesis only. Names and organizations will be anonymized. Audio will be deleted after use.
4. Ask if there are any questions before we start with the evaluation.
5. Ask demographic information if the participant did not attend the first interviews.
   (a) The role in the organization.
   (b) The experience with digital transformation and agile.
6. Start with the evaluation:
   (a) First, introduction about the model will be given:
      i. Show introduction tab.
      ii. Explain.
      iii. Evaluation: ask open question 10 to evaluate the introduction tab.
   (b) Going over each aspect 1 by 1:
      i. Short explanation of the aspects, sub-aspects, indicators, assessment questions and maturity level scores.
      ii. Ask open questions 1 and 2 and evaluate the aspect.
      iii. Ask open questions 3 and 4 and evaluate the sub-aspects.
      iv. Ask open questions 5 and 6 and evaluate the indicators.
      v. Ask open question 7 to evaluate the assessment questions.
      vi. Ask open question 8 to evaluate the maturity level scores.
7. Indicate the score and desired score input fields and the maturity score output field.
8. Show the mock-up dashboard results tab.
9. Ask open question 9 about the practicality of the maturity model.
10. Ask the participants to rate the evaluation criteria on a 1-5 scale.
11. End the evaluation session after one hour.
12. Thank the participants again for joining and shortly mention how their input will be used for the development of the maturity model.
13. Ask for feedback on how to improve the evaluation process.

F.2 Evaluation interview transcriptions

Coding category	Transcription
	Permission to record audio is requested before starting.
Maturity level	**[E1]:** Stel je komt bij een klant en ze scoren goed op de laatste twee indicatoren, maar niet op de eerste. Scoren ze dan alsnog 0, omdat ze de lagere levels niet hebben en de hogere levels al wel? Of zeggen we dat er een emmer is en daar gaan alle indicatoren in. Hoe meer indicatoren je uit de emmer hebt, des te hoger is je niveau.
Indicator weight	**[E2]:** De volgorde van de indicatoren zou wel uit moeten maken anders kan je moeilijker advies geven.
Performance expectancy	**[E1]:** Dat is iets wat je wilt inderdaad, maar dan moet dat wel werken. Als je op een model komt wat in de praktijk niet werkt, dan is dat zonde.
Future work	**[E2]:** Nee, dat klopt, maar het moet ook getest worden op klanten. Dit is de eerste evaluatiesessie.
Indicators	**[E3]:** Misschien als je individuele scores, het onderwerp daarvan, zo klein maakt dat het niet zo snel voorkomt dat je hogere level dingen hebt en lagere niet.
Performance expectancy	**[E1]:** Misschien is het ook wel zo dat dat zo is in het huidige model en dat er een logische volgorde inzit. Als we dat tegenkomen dan zou dat inderdaad kunnen.
Future work	**[E3]:** Misschien is een multibox wel een goede validatie voor je schaal om uiteindelijk te kijken van is het heel raar dat je iets op level 5 hebt, terwijl je level 1 niet hebt. Je zou daar een check op kunnen doen.
Future work	**[E2]:** Je zou kunnen zeggen dat je dat onderdeel van de tool maakt van joh let op ik heb een alert, want dit heeft weinig punten, maar hier scoort deze klant heel hoog.
Performance expectancy	**[E1]:** Ik zou toch wel echt overwegen om het op de emmer manier te doen, omdat dat een stuk flexibeler is. Het hangt natuurlijk af hoe de indicatoren met elkaar te maken hebben en over er duidelijk een hiërarchie inzit.
	[E3]: Ja, daar ben ik het mee eens.
Performance expectancy	**[E1]:** Het is ook handiger aangezien het ene bedrijf het andere bedrijf niet is en de context totaal verschillend kan zijn. Dus je komt dat soort dingen wel tegen.
	[T]: Klopt, sommige aspecten zijn ook vooral erg soft en andere weer wat meer technisch. Het is soms makkelijker om bij technische indicatoren meer een structuur te zien, maar dit is bij softe aspecten denk ik een stuk lastiger.
Completeness	**[E2]:** Ik zou hier (culture – willingness to make decisions) misschien nog wel diverse teamsamenstelling. Een multicultureel disciplinaire teamsamenstelling.
	[T]: Dan schrijven we deze erbij op en plakken we die ook op.

Completeness	**[E3]:** Ik denk ook dat dat er inderdaad ergens bij moet.
	[E2]: Je hebt ook niks aan veel dezelfde mensen in het team.
Completeness	**[E3]:** Transparante environment houdt volgens mij in dat niet alleen de kennis aanwezig en gedocumenteerd, maar ook begrijpbaar.
Future work	**[E1]:** Uiteindelijk moet je het model gaan testen door er een klant tegenaan te gooien en te kijken of het overeen komt met wat er volgens jouw model aanwezig moet zijn.
Maturity level/Performance expectancy	**[E3]:** Bij levels, lijkt het soms wel echt of er nog gaten zijn en is het moeilijk om vaste levels te maken voor dit model. Dus de emmer techniek lijkt me toepasselijk.
Maturity level/Performance exptectancy	**[E1]:** Een partij wil al deze indicatoren meten en er daarna aan werken. Dan hebben ze veel minder aan een exact level. Ze willen weten per aspect en sub-aspect waar ze staan en wat ze kunnen oppakken, de indicatoren, om het te verbeteren.
	[T]: En iemand die dit invult, als dat de juiste persoon is binnen de organisatie, die heeft dan echt wel een idee of een indicator aanwezig is of niet binnen het bedrijf. Dan is het hopen dat die persoon het ook eerlijk invult.
	[E1]: Het kan natuurlijk zijn dat een organisatie wel een blame culture heeft en weet dat de resultaten daarna bij de baas komen. Dan vullen ze het misschien niet eerlijk in.
	[T]: Ja, maar dat is ook iets waar ik weinig invloed op kan hebben helaas.
Effort expectancy	**[E1]:** Soms is een indicator vrij breed en moet er wel een duidelijke omschrijving in je tool opgenomen zijn.
Self-efficacy	**[E3]:** Ik vind IT systems erg lastig te rangschikken met al deze verschillende systemen. Zelf zie ik niet voor me hoe dit te doen.
Self-efficacy	**[E1]:** Ik vind het ook erg lastig om deze indicatoren te rangschrikken, maar flexibele systemen en het kiezen van de juiste systemen zou wel kunnen.
	[T]: Passen die laatste twee indicatoren toevallig ergens anders? Dan zou ik het hele sub-aspect weg kunne halen.
Completeness	**[E2]:** Je zou ze onder IT architecture kunnen plaatsen.
Completeness	**[E3]:** Volgens mij is Data integration niet de juiste naam voor het sub-aspect. Ik zou er iets van maken zoals Data exploitation, want het gaat er echt om hoe je de data het best benut.
Self-efficacy	**[E1]:** Process automation wordt erg lastig te meten op deze manier, omdat er maar één indicator is.

	[T]: Zou het ergens anders kunnen passen?
Completeness	**[E1]:** Ik vind het een design principle die onder IT architecture zou kunnen passen. Je kan het zien als hoe je een deel van je processes opzet en inricht. In het sub-aspect IT architecture staan sowieso veel design principles, dus ik zou design principle als een indicator toevoegen daar en ze allemaal dezelfde weging geven.
Completeness	**[E3]:** Waarom risk management met perse smart tools? Ik zou het generieker maken en het manage risks noemen.
Future work	**[E3]:** Probeer het prototype erg MVP te maken en niet bepaalde stukken te gedetailleerd doen en andere afraffelen.
Maturity level	**[E3]:** Je zou een scale van 1 tot 5 kunnen gebruiken om de emmer aan indicatoren te laten scoren door mensen die het prototype gebruiken.
Completeness	**[E1]:** Ik zou two way operations weghalen bij interne organisatie en die naar strategy verplaatsen. Dat gaat namelijk over hoe je het nieuwe en het oude naast elkaar gaat plannen en dat langzaam richting één proces brengt.
Effort expectancy	**[E1]:** De term two way operations ken ik niet en zou niet weten wat het betekent. De description is ook niet duidelijk genoeg.
Effort expectancy	**[E3]:** Ik heb ook moeitze met deze. Misschien de description iets duidelijker maken, zodat het makkelijker te begrijpen is.
Self-efficacy	**[E3]:** Power distribution in chain vind ik een erg neutrale statement, maakt het moeilijk om het ergens te plaatsen en een weging te geven. Deze misschien aanpassen.
Effort expectancy	**[E1]:** Complex, uncertain problem bij 'Agility' vind ik niet duidelijk genoeg omschreven, dat kan beter en duidelijker denk ik.
Completeness	**[E3]:** Misschien dat je hier iets over agile aan toe kan voegen.
Completeness	**[E2]:** Bij 'Human-centric' heb je een blokje 'team size of 5-9'. Ik zou dat 5-9 ook toevoegen voor consistency bij de indicator 'employee dedicated to one team'.
	Permission to record audio is requested before starting.
Effort expectancy	**[E4]:** Zoals je nu de kleuren uitlegt en ook even aanstipt, dan denk ik o ja, nu snap ik wat je bedoelt. Maar het is best een kleurenpalet zeg maar, dus ik dacht eerst wat betekent dat nou. Maar zoals je het nu uitlegt, snap ik hem.
Completeness	**[E4]:** Dus misschien kan je daar visueel optisch nog iets mee. Ik weet zo even niet wat.

Effort expectancy	**[E4]:** Hoe de punten tot stand komen is nog onduidelijk voor mij. Ik zou dat hier ook toelichten.
Completeness	**[E4]:** Ik zou het spinnenweb dat op het dashboard tabje staat ook hier even plaatsen, zodat je kan aangeven waar je naartoe werkt als je dit model invult. **[T]:** Oke, dus hier het al even kort uitleggen en misschien zelfs gewoon een plaatje erbij zetten.
Completeness	**[E4]:** Ja, precies. **[T]:** Oke, dankjewel. Voor mij handig om te weten aangezien de eindgebruiker van het systeem straks moet weten hoe dit model te gebruiken en wat het precies doet.
Future work	**[E4]:** Mee eens, dat het uiteindelijk in het model moet. Maar als jij voor je onderzoek een prototype gaat maken, moet je heel goed kijken wat je nu gaat doen en wat bewijs je ermee, want je bent je tijd zo kwijt. **[T]:** Dus hou het MVP?
Future work	**[E4]:** Ja en wat wil je nou precies bewijzen met je prototype.
Future work/Performance expectancy	**[E4]:** Ik zou in je prototype of in je verhaal meenemen dat de wegingen van indicatoren context afhankelijk zijn en dat het misschien beter is om van tevoren samen met je klant de wegingen van indicatoren te bepalen. Dat je het mogelijk moet kunnen maken, want het zou best kunnen zijn dat in een bepaalde branch, bij verzekeringen is de weging 6 en bij transport is de weging 2. Ik zou dat meenemen in je plan.
Future work/Performance expectancy	**[E4]:** Hoe je het nu gedaan hebt is prima, maar ik zal wel adviseren of het advies maken dat je afhankelijk van welke context, die wegingsfactoren zou kunnen aanpassen. Ik noem nu sector als voorbeeld, maar het zou ook familiebedrijf en corporate kunnen zijn.
Performance expectancy	**[E4]:** Je drukt sommige indicatoren een beetje een hoek in. Neem bijvoorbeeld ”no blame culture”, hier geef je al in de indicator aan dat dat waarschijnlijk beter is om te hebben i.p.v. dat er wel een blame culture is. Dit is een suggestieve benadering, maar denk niet dat dat erg is.
Performance expectancy	**[E4]:** Goed dat je een desired score wil laten invullen. Hierdoor kan je bij de results snel zien waar een klant beter op wil scoren en waar de focus voor verbetering kan liggen.
Completeness	**[E4]:** Ik zit even te kijken, wij hebben natuurlijk al de eerste sessie gehad, daarin hebben wij al de aspecten, sub-aspecten en indicatoren gehad. Die zie ik terugkomen.

Completeness	**[E4]:** Ik ben met name naar structuren opzoek en ik kijk naar hoeveel mensen hebben dan wat gezegd. Ik kijk meer door het model heen. Dat ziet er tot nu toe goed uit (cultuur en strategy gehad).
Completeness/Effort expectancy	**[E4]:** Bij "Do analysis with big data (reporting)" en "simulations with AI", die zie je ook terugkomen bij het "Data monitoring" sub-aspect. Daar moet je nog even naar kijken, want daar zit volgens mij wel overlap in. **[T]:** Heb je advies? Waar denk jij dat het hoort als je een blokje moet kiezen? Of is het simpelweg bij de één weghalen en bij de ander toevoegen. **[E4]:** Dat maakt niet zoveel uit.
Completeness/Effort expectancy	**[E4]:** Bij het aspect "interne organisatie" zie je dat er een stuk cultuur inzit. Bijvoorbeeld het "self-organized", die heb je anders verwoord ook bij cultuur staan in het blokje "willingness to make decisions". Je moet even kijken of dat erg is of niet. Hier snap ik wel dat je ze apart wilt meten, want ze hebben relatie met elkaar, maar betekenen niet letterlijk hetzelfde. **[T]:** Denk jij dat het het model schaadt?
Performance expectancy	**[E4]:** Dat denk ik niet perse, maar ik zou mensen niet 2x dezelfde vraag stellen tijdens de assessment, want straks wordt er twee keer de verkeerde score ingevuld en dan is het niet meer zoveel waard. **[T]:** Goed punt.
Completeness	**[E4]:** Ik heb dit ook een beetje bij "defined responsibilities". **[T]:** Bij het "agility" sub-aspect is natuurlijk ook heel veel overlap te vinden.
Performance expectancy	**[E4]:** Ik zou mensen gewoon één keer de vraag stellen, die overlap bij agility heeft ook meer met het doel van je onderzoek te maken. **[T]:** Ja en dan kan ik alsnog voor zowel het agile als het digitale transformatie de score ermee gebruiken, waar de overlap zit.
Completeness/Effort expectancy	**[E4]:** Ik vind "management agility" veel overlap hebben met wat je bij bijvoorbeeld cultuur al meet bij "willingness to change". **[T]:** Zou je deze indicator dan weghalen?
Completeness	**[E4]:** Ik heb het idee dat deze indicator al met andere blokjes wordt gemeten, dus ik zou het inderdaad uit je model verwijderen.

Completeness/Effort expectancy	**[E4]:** Ik zou ”build under architecture” veranderen in ”design principles”, omdat ik het idee heb dat dat hetzelfde betekent als de ”design principles” in het ”technology” aspect.
Completeness	**[E4]:** Ik zou in het dashboard tab kleuren gebruiken die overeenkomen met je maturity levels.
Effort expectancy	**[E4]:** Ik zou niet zo snel de middelste tabel laten zien, je wilt uiteindelijk wel door kunnen zoomen, maar om het meteen zo uitgeklapt te laten zien, lijkt me niet overzichtelijk. Je wilt het totaal zien in één cijfer en per aspect.
Performance expectancy	**[E4]:** Zo’n spinnenweb vind ik ook zeker interessant om in je resultaten te laten zien.
Future work	**[T]:** Dan zijn we nu door alle tabjes heen, uiteindelijk maak ik aan de hand van de feedback van de interviews versie 2 van het model. Daarna maak ik een prototype aan de hand van deze versie in Mendix. **[E4]:** Ik denk niet dat je het perse in Mendix zou hoeven maken voor je onderzoek, maar het past beter in het technische deel van de organisatie van ons. Daarnaast vind ik het vrij suf als je met het model aankomt bij een klant en zegt dat je gaat helpen met digitale transformatie en dan met een Excel aan komt zitten.
	Permission to record audio is requested before starting.
Self-efficacy	**[E5]:** Ik vroeg hoe je weet wat je moet scoren bij de score. Vul je hier gewoon een 1 in als het er niet is? Dat was me niet helemaal duidelijk. **[T]:** Dit wordt in principe inderdaad op een kwalitatieve manier gedaan, waarin gevraagd wordt aan degene die de assessment invult in hoeverre hij/zij denkt dat er voldaan wordt aan de assessment question. 1 zou je kunnen zien als helemaal niet eens en 5 als helemaal mee eens.
Completeness/Effort expectancy	**[E5]:** Het lijkt me handig als je dit aangeeft in de introductie. Ik miste in de introductie ook hoe je precies op een maturity level uitkomt. Ik zou dat ook toevoegen.
Future work	**[E5]:** Ik zou ook kijken naar het baseren van scores op basis van aanwezige data binnen het bedrijf i.p.v. het scoren aan de hand van de mening van de experts. Ik snap dat dat niet misschien nu nog teveel tijd kost, maar zou het dan als future work wel toevoegen.
Effort expectancy	**[E5]:** Als ik verder naar de introductie kijk, leg je goed uit wat alles is. De kleuren in de plaat en de relaties tussen agile en digitale transformatie zijn me ook duidelijk.
Completeness	**[E5]:** Als ik kijk naar de layout van de plaat, denk ik dat het ”agility” blok op de juiste plaats staat. Alleen zou ik in de introductie nog even goed uitleggen waarom dit blok op een andere manier geplaatst is.

Performance expectancy	**[E5]:** De eerste drie assessment questions bij de indicatoren van het sub-aspect ”willingness to make decisions” die eindigen allemaal met ”employees make his/her own decisions.” Het lijkt nu heel erg, voor mijn gevoel, dat deze vragen erg op elkaar lijken. Ik kan me voorstellen dat een manager die deze vragenlijst invult hierdoor deze vragen misschien snel dezelfde score geeft. **[T]:** Dus je bent bang dat, omdat ze zoveel op elkaar lijken, de vragen op dezelfde manier worden ingevuld. Ik had hier in eerste instantie voor gekozen, omdat door het toevoegen van ”employees make his/her own decisions” de vraag duidelijk terugslaat op het sub-aspect ”willingness to make decisions”. Maar misschien hoeft dit niet perse.
Completeness	**[E5]:** Ik denk dat dat inderdaad niet perse nodig is, want iemand die het invult, hoeft niet exact te weten bij welk sub-aspect het hoort zolang het in de applicatie maar de goeie link heeft. Ik zal het stukje aan het einde van die vragen dus weghalen. **[E5]:** Ik zie dat ”no blame culture” 2x terugkomt. **[T]:** Klopt, deze werd door experts in de eerste ronde bij twee sub-aspecten genoemd en staat er daarom 2x in.
Performance expectancy	**[E5]:** Je moet nog wel even opnieuw kijken naar de assessment question bij knowledge sharing, want die klopt niet helemaal.
Completeness	**[E5]:** Ik snap dat de indicator er dan 2x instaat. Ik zal er alleen één algemene vraag van maken.
Effort expectancy	**[E5]:** De description van ”digital management” vind ik niet helemaal duidelijk. Nu is het gewoon het strategische viewpoint van het management.
Completeness	**[E5]:** Moet het viewpoint hier niet wat meer uitgelegd worden aan de hand van de indicatoren die bij dit blokje horen? Dit maakt het een stuk duidelijker.
Completeness/Effort expectancy	**[E5]:** Bij ”strategy based on digital transformation goals” moet hier in de assessment question dan ook niet duidelijk digital transformation goals staan i.p.v. alleen goals.
Performance expectancy	**[E5]:** Ik ben benieuwd of organisaties gaan aangeven dat ze zelf een one-trick pony zijn. Bij zo’n woord als one-trick pony krijg je denk ik snel dat mensen denken van, nah dat ben ik niet. **[T]:** Zou je adviseren dit woord aan te passen?
Completeness	**[E5]:** Ik zou eerder dit woord weghalen en er van maken of de organisatie zich focust op alle digitale transformatie doelen of op maar één doel. Zo maak je het minder confronterend om hier ja op te antwoorden.
Effort expectancy	**[E5]:** Ik weet niet of ik deze vraag helemaal snap bij ”digital process knowledge”.

	[T]: Dit heeft ermee te maken dat er niet één iemand is die de kennis heeft van één bepaald process en hier al een lange tijd opzit. Dit zou kunnen zorgen voor het feit dat deze persoon geen verandering nodig ziet en niks wil veranderen. Als er meerdere personen op één process staan, dan krijg je dit wel sneller.
Completeness	**[E5]:** O, op die manier, dan begrijp ik het wel. Ik had het woord ”process” anders opgevat als in het verwerken van informatie. Ik zou van het woord ”process” voor de zekerheid het woord ”processes” van maken, dan voorkom je dat.
Self-efficacy	**[E5]:** Degene die de vragen in de ”technology” tab invult, moet wel degelijk kennis hebben van IT, anders wordt het lastig. Ik denk dat je meerdere mensen nodig hebt om alle vragen van het gehele model te beantwoorden.
Effort expectancy	**[E5]:** Bij de beschrijving van het blok ”data monitoring” is het alleen tijdens de digitale transformatie dat je dat moet monitoren of altijd?
	[T]: Eigenlijk zal je dat het liefst natuurlijk altijd willen doen. Denk je dat ik ”during digital transformation” hier weg moet halen?
Completeness	**[E5]:** Misschien wel, want het is lastig in te vullen als een bedrijf dus nog moet beginnen aan digitale transformatie en dan dit model invult. De vraag is of je dan überhaupt al dit model wilt invullen.
Performance expectancy	**[E5]:** Bij de vraag over de indicator ”Ratio in cloud/on premise” moet je de assessment vraag even omdraaien, want nu gaat het niet goed als je een score geeft.
Effort expectancy	**[E5]:** Bij het sub-aspect ”Department/Teams” vind ik de beschrijving erg algemeen.
Completeness	**[E5]:** Ik zou hier ook meer de indicatoren betrekken in de omschrijving van de description.
Effort expectancy	**[E5]:** Ik zou in het dashboard scherm niet zo snel de middelste tabel laten zien, omdat het heel veel informatie is en dat maakt het onoverzichtelijk. Je zou de eerste kunnen laten zien en met een soort van uitklap functionaliteit verder kan kijken door op een aspect te klikken.
	[T]: En welke visualisaties zouden hier mooi zijn?
Effort expectancy	**[E5]:** Managers houden van plaatjes, dus die zou ik zeker toevoegen. Zo'n radar chart is heel duidelijk vind ik.
Effort expectancy/Future work	**[E5]:** Ik kan me voorstellen dat een vragenlijst indelen per aspect duidelijker is dan alleen een complete vragenlijst van 130 vragen.
Effort expectancy/Future work	**[E5]:** Het zou ook mooi zijn, maar weet niet of het in je MVP past, dat je kan laten zien hoever je in de vragenlijst bent.

Effort expectancy/Future work	Korte introductie toevoegen is ook zeker nuttig per aspect. Ik zou ook niet de description van indicators of sub-aspecten toevoegen in het prototype, dan wordt het teveel.
	Permission to record audio is requested before starting.
Self-efficacy	**[E6]:** Als ik naar de introductie tab kijk, zou ik weten wat ik met het model zou moeten doen, met de uitleg in tekst erbij.
Completeness	**[E6]:** Je zou nog wel kunnen uitleggen waar die punten vandaan komen, want dat staat op dit moment nergens uitgelegd.
Completeness	**[E6]:** Daarnaast, zou het ook handig zijn als je kort kan uitleggen wat het zegt als je een bepaald maturity level scoort.
Future work	**[E6]:** Uiteindelijk heb je natuurlijk de vraag van, stel je bent level 3, wat moet ik doen om naar level 4 of 5 te komen. Maar ik gok dat dat buiten je scope valt.
	[T]: Dat is inderdaad op dit moment niet de insteek, misschien algemene recommandaties aan de hand van het level.
Future work	**[E6]:** Ik denk dat je daar een losse studie op zou los kunnen laten en als je, zoals je aangaf, er iets globaals over gaat zeggen, voegt dat net niet genoeg toe. Dan zou je het beter kunnen weglaten. Echter, zou je het bij future work kunnen opschrijven.
Completeness	**[E6]:** Wat ook wel goed is om te doen, is naast het score vak ook de mogelijkheid geeft om het antwoord toe te lichten in een tekstvak naast de vraag.
Completeness/Effort expectancy	**[E6]:** Je zou de schaal van 1 tot 5 nog iets meer kunnen uitleggen door toe te voegen dat 1 strongly disagree is en 5 strongly agree. Want is de 1 nou goed of slecht? Mensen kunnen dit mis interpreteren.
Effort expectancy	**[E6]:** Ik zou de kleuren uit deze Excel sheet halen, ik denk dat dat bij de plaat genoeg is. Ik vond het soms hier een beetje verwarrend.
	[E6]: Je kan dan altijd in de resultaten weer matchen naar de introductie en naar de plaat.
	[T]: Dus de plaat bij de results nog een keer neerzetten?
Effort expectancy	**[E6]:** Ja, zodat je het verhaal weer bij elkaar brengt.
Performance expectancy	**[E6]:** Ik kijk net even naar "constant communication" en "open environment". Zeggen die niet hetzelfde?

	[T]: Dat is een lastige, er is sowieso verband tussen de twee. Waarom ik het los had gedaan, omdat een open environment echt aangeeft dat de omgeving een gevoel geeft dat mensen met elkaar willen praten en kunnen praten en er geen informatie achtergehouden wordt. En constant communication geeft meer aan dat er mensen ook echt constant met elkaar praten.
Completeness	**[E6]:** Hoe je het nu verder uitlegt, zie ik een duidelijk verschil. Daarom zou ik de descriptions van beide indicatoren wat beter uitleggen. Beschrijf wat meer wat een open environment precies betekent.
Performance expectancy	**[E6]:** Die "no blame culture" stond boven toch ook al?
	[T]: Ja, dat klopt, soms zijn er dubbele indicatoren die voor meer sub-aspecten kunnen gelden. Ik stel dan wel maar één keer de vraag.
Completeness	**[E6]:** Duidelijk, dat klinkt logisch.
Completeness/Effort expectancy	**[E6]:** Trouwens ook een goed idee om even de wegingen in de introductie uit te leggen. Want blijkbaar is het hoe hoger het getal hoe belangrijker. Mensen kunnen dit ook anders interpreteren.
Self-efficacy	**[E6]:** Ik vind "agile roles" wel heel concreet, maar ik kan me voorstellen dat sommige mensen deze niet kennen.
Completeness	**[E6]:** Je hoeft ze denk ik niet allemaal te benoemen, maar je zou er een aantal tussen haakjes kunnen zetten of de belangrijkste.
	[T]: Wat zou jij zeggen dat dan de belangrijkste zijn?
	[E6]: Een productowner, een scrummaster, dat zijn sowieso de belangrijkste.
	[T]: Dus toevoegen in de description om het duidelijker te maken en in de assessment questions?
Self-efficacy	**[E6]:** Ja, kijk wij weten het allemaal, omdat we zo werken.
Effort expectancy	**[E6]:** Wat bedoel je met het woord "silo's" in de beschrijving van "DevOps".
	[T]: Je zou het kunnen zien als de verschillende op zichzelf staande departments, die niet met elkaar communiceren en los van elkaar staan.
Completeness/Effort expectancy	**[E6]:** Ah oke, ik zou het woord silo's hier dan niet gebruiken, want dat vind ik onduidelijk. Zou het veranderen in departments.
	[E6]: Waar komt die team size van 5 tot 9 vandaan?
	[T]: Dat is een keer genoemd tijdens de interviews van de eerste ronde.

Effort expectancy	**[E6]:** Misschien is het dan duidelijker om aan te geven om wat voor soort teams dat dan gaan. Wij hebben hier namelijk teams die zijn allemaal groter dan 9 personen. De vraag is dan of wij daardoor agile slecht zijn?
Effort expectancy	**[E6]:** Of gaat dit om de softwareontwikkeling teams. Dan snap ik dat wel. Ik zou aangeven om welke teams het hier gaat.
Performance expectancy	**[E6]:** Ik vind de ”security” bij ”technical excellence” vrij zwaar wegen. Natuurlijk is het belangrijk, maar als je puur naar agile kijkt, is het niet iets wat een organisatie meer agile maakt dan een organisatie waar de security slechter is.
	[T]: Als je het zo redeneert, klinkt dat logisch. Misschien is het tijdens de brainstorm-sessie niet op die manier naar gekeken en is dat erbij ingeschoten. Welke weging zou jij geven?
Completeness	**[E6]:** Als ik puur naar agile kijk, zal het voor mij op een weging van 1 uitkomen.
Completeness/Effort expectancy	**[E6]:** Ik was aan het kijken naar ”monitoring met KPIs and learn”. Wat ga je daar dan uiteindelijk mee doen? Er staat nu learning van findings, maar misschien kan je hier een voorbeeld toe te voegen. Hoeveel meer tijdwinst is er sinds een nieuwe applicatie bijvoorbeeld. Ik zou ook de naam veranderen naar ”learning from monitoring” anders heeft het veel overlap met ”monitor using KPIs” die bij ”technical excellence” staat.
Effort expectancy	**[E6]:** Ik vind die ”personalized content” nog wel lastig. Ik zit meer te denken vanuit ons en klanten zijn dan vooral bedrijven. Personalized content kan je ook betrekken op bedrijven, maar misschien moet het dan anders verwoord worden.
Performance expectancy	**[E6]:** Je hebt dus wel een bedrijf waar je je op moet aanpassen, maar niet perse één persoon. Ik denk dat personalized dus niet helemaal de lading dekt.
	[T]: Heb je een idee hoe dit eventueel anders te verworden? Anders duik ik daar zelf even in.
Completeness	**[E6]:** Zou je even moeten kijken.
Future work	**[E6]:** Ik zou op de dashboard tab eerst de samenvatting laten zien en dan de mogelijkheid geven door te klikken naar meer gedetailleerdere informatie. Een meer details knop bijvoorbeeld.
	Permission to record audio is requested before starting.
Effort expectancy	**[E7]:** Waar komen die maturity level assen vandaan?
	[T]: Die komen uit een bestaand digitale transformatie maturity model.
Completeness	**[E7]:** Ik zou ervoor zorgen dat je dat ergens in je verslag meeneemt en wel duidelijk opschrijft.

Completeness/Effort expectancy	**[E7]:** Ik vind de 7 aspecten duidelijk en ik denk dat die kloppen. Het laat ook goed zien dat digitale transformatie niet alleen met technologie te maken heeft. Het zit namelijk over veel meer assen.
Effort expectancy	**[E7]:** Ik twijfel alleen of de 'agility' sub-aspecten begrijpelijk zijn voor iedereen en of dat mensen boeit. Oke, er is overlap tussen agile en digitale transformatie, maar moet je dat ook op deze manier laten zien in het uiteindelijke figuur?
Completeness	**[E7]:** Ik zou dat wel uitleggen in je verslag, maar het 'agility' aspect grotendeels uit het figuur halen.
Performance expectancy	**[E7]:** Een klant ziet de aspecten, waar moet ik aan denken? Waar sta ik nu? Dus een klant wil graag weten op welk maturity level hij/zij zit op de aspecten. Dat heeft echt toegevoegde waarde.
Future work	**[E7]:** Het lijkt me handig dat meerdere mensen de vragenlijst kunnen invullen. Want een IT manager kan het anders invullen dan andere werknemers binnen het bedrijf. Ik als consultant ga dan graag het gesprek aan over de resultaten en de eventuele verschillen.
Effort expectancy	**[E7]:** Hoe bepaal je precies wanneer je 1 of 5 scoort? **[T]:** Op dit moment gebaseerd op de ervaring en mening van de persoon die de vragenlijst invult.
Performance expectancy	**[E7]:** Oke, dat maakt het wel lastiger reproduceerbaar.
Future work	**[E7]:** Liever baseer je de meeste scores bij indicatoren op aanwezige informatie. Echter, snap ik dat dat voor zoveel verschillende indicatoren lastig is.
Performance expectancy	**[E7]:** Ik kan me voorstellen dat iemand dit model naar zijn eigen voordeel gaat invullen, maar daar heeft hij alleen zichzelf mee.
Performance expectancy	**[E7]:** Het voordeel van deze manier is dat je makkelijk het gesprek met de persoon die het ingevuld heeft kan aangaan, gebaseerd op de ingevulde scores. Daarvoor is dit middel perfect.
Performance expectancy	**[E7]:** Ik zie het als een tool om het gesprek aan te gaan met een klant en af te vragen of ze wel echt goed bezig zijn. Je kan het helemaal wetenschappelijk gaan dichttikken, maar klanten uit verschillende sectoren met verschillende context, kan maar zo bepaalde indicatoren niet hebben. Dan zit daar super veel moeite in, maar heb je er niet altijd iets aan. Voor een consultant is dit gewoon goed. **[T]:** Is het verder duidelijk hoe we in zo'n tab van aspect uiteindelijke helemaal bij een maturity level uitkomen?
Effort expectancy	**[E7]:** Ja, duidelijk

Effort expectancy	**[E7]:** Het sub-aspect 'willingness to make decisions', is door de hele organisatie neem ik aan?
	[T]: Ja, klopt.
Completeness	**[E7]:** Dat zou ik dan even specifiek toevoegen.
Performance expectancy	**[E7]:** Ik denk dat het ook belangrijk is dat de cultuur zowel bij ons als bij de klant waar we het model toetsen goed zit. Als wij al niet willen veranderen, denken we misschien ook heel anders over die indicatoren. Moeten kritisch naar ons zelf kijken.
Performance expectancy	**[E7]:** Ook weer hier, ligt het er soms maar net aan vanuit welke invalshoek je het model bekijkt. Je kan het niet helemaal perfect invullen het model. Wat mij betreft ziet het er goed uit en kan je je doel ermee bereiken.
Effort expectancy	**[E7]:** Bijvoorbeeld: een 'willingness to make decisions' triggered bij mij misschien net wat anders dan bij andere werknemers. Daarom is het goed dat er i.i.g. een algemene descriptie bijstaat.
	[T]: Als je de indicatoren in deze 'culture' tab zo ziet, zijn ze duidelijk genoeg voor je om allemaal te begrijpen.
Effort expectancy	**[E7]:** Ja, ze zijn prima te begrijpen en er is ook nog een uitleg bij.
	[T]: Ik twijfel of ik al deze descriptions straks ook in het prototype moet zetten.
Future work	**[E7]:** Ik zou minimaal de description van het aspect en misschien zelfs het sub-aspect erin zetten.
Completeness	**[E7]:** Bij het sub-aspect "data monitoring" heb je daar ook al iets toegevoegd over dat je over de hele keten heen monitort?
	[T]: Ik heb dat nu niet specifiek erin gezet, maar dat is natuurlijk wel het doel.
Completeness	**[E7]:** Wat je ziet, is dat vaak systemen hun eigen monitoring hebben. Maar hoe zit het nou als bijvoorbeeld een pakket van A naar X moet en waar, in de keten, loopt hij vast of waar duurt het lang? Dus ketenmonitoring zou ik ergens aan toevoegen. Misschien aan de indicator "data monitoring based on KPIs".
Completeness	**[E7]:** Scalability is ook heel belangrijk. Je doet bijvoorbeeld de Cloud gebruiken om uiteindelijk snel te kunnen schalen. Ah, het valt eigenlijk onder de indicator "flexible IT systems". Ik zou hier kort iets zeggen over scalability.

Completeness	**[E7]:** Daarnaast moet je heel goed kijken of je de juiste technologie hebt die past bij je cultuur, je strategie, eigenlijk bij de context dus. Dit zie ik niet helemaal terugkomen. Je zou het kunnen toevoegen aan de descriptie bij de indicator ”chose the right systems”. Dat je het hier breder trekt naar ”chose the right technology” en dan kan je in de descriptie het voorbeeld van de systemen geven.
	[E7]: Ik zat ook nog te denken over het punt afhankelijkheid. Hoe afhankelijk is het bedrijf van bepaalde partijen bijvoorbeeld?
	[T]: Dit zou je bij externe organisatie ergens kunnen toevoegen denk ik.
Completeness	**[E7]:** Ja, ik denk dat dat redelijk in het verhaal past bij de indicator ”influence in competitive chain”. Hoe hoger je staat, hoe minder afhankelijk je bent bijvoorbeeld.
Performance expectancy	**[E7]:** Wat ik zie bij ”digital customer engagement” is dat de customer journeys steeds belangrijker worden. Maar ik zie dat dat daar ook een indicator is. Het ziet er verder goed uit.
Completeness	**[E7]:** Bij het sub-aspect ”department/teams” is agile echt super belangrijk. Agile rollen moet ook zeker ergens terugkomen, want zijn er product owners aanwezig, scrum masters, etc. Als je die rollen niet hebt, dan zijn ze intern nog niet klaar om zelfstandig te gaan ontwikkelen.
Completeness	**[E7]:** Wat je ook vaak ziet, is dat een organisatie van traditioneel naar meer IT of agile gaat en dan maar gewoon de functietitel van werknemers verandert, maar niet de juiste verantwoordelijkheden en verwachtingen aan ze geeft. Dat is gewoon compleet kansloos, dan weet je dat het gaat falen. Je hele vibe van agile vervalt dan. Het moet dus naast agile rollen ook zo zijn dat de responsibilities goed uitgelegd zijn. Maar ik zie dat je dat in je model hebt.
Completeness	**[E7]:** Daarnaast zou je nog kunnen toevoegen of een bedrijf een agile framework zoals SAFe hanteert of niet. Je kan die bij way of working eventueel toevoegen en ik denk dat het dan de weging 4 heeft in die rij. Natuurlijk in het ”agility” blok.
Completeness	**[E7]:** Het is ook zeker handig als een bedrijf voor een groot deel zelf de IT beheert en niet alles outsourced. Ik denk dat dat zeker bijdraagt aan de digitale transformatie. Dus ergens moet er toegevoegd worden hoeveel er geoutsourcet wordt van de core IT systems. Ik zou het ergens toevoegen in het aspect ”interne organisatie”. Je zou het kunnen toevoegen aan de indicator ”IT in departments” en daarbij meer de vraag stellen in hoeverre ze de IT zelf beheren of outsourcen.
Performance expectancy	**[E7]:** Ik denk echt dat je een heel eind bent met dit model. Bij het aspect ”agility” merk ik wel een hele hoop overlap.
	[T]: Ja, klopt dat komt dus doordat er soms indicatoren voor zowel digitale transformatie als voor agile belangrijk zijn.

Effort expectancy	**[E7]:** Ah dat is logisch ja, ik zal wel ervoor zorgen dat je straks niet dubbele vragen stelt, want dat zorgt voor verwarring.
Effort expectancy/Future work	**[E7]:** Ik zou vooral de eerste tabel van de 3 laten zien en dan zorgen dat je in detail kan kijken. **[T]:** Dus je zou eigenlijk in de tabel willen doorklikken?
Future work	**[E7]:** Dat zou in principe ook gewoon naar een Excel kunnen verwijzen, bijvoorbeeld op de manier hoe je het nu doet.
Effort expectancy/Future work	**[E7]:** Mensen zijn vaak het meest benieuwd naar wat nog niet goed is en dat wil je snel in kunnen zien. Zou ook vooral kleuren toevoegen aan de cijfers die overeenkomen met je maturity levels.
Future work	**[E7]:** Je zou ook het figuur dat nu in je introductie staat bij resultaten laten zien met kleuren die overeenkomen met het level dat je gescoord hebt. Dan kan je dus per aspect en sub-aspect het meteen zien. Als je dan details wilt, klik je op het sub-aspect en dan krijg je de indicators.
Performance expectancy/Future work	**[E7]:** Zo'n radar chart is alleen leuk om toe te voegen als je score en desired score op elkaar mapt. Is ook niet MVP.
Effort expectancy/Future work	**[E7]:** Het zou misschien ook een idee zijn om naast de score en desired score, een gap tabel te laten zien. Dan kan je snel zijn waar de grootste gaten zitten.

Table 46. Expert evaluation interview transcripts.

Coding category	**Coding category definition**
Maturity level	A comment about the maturity level structure.
Indicators	A comment about the indicators structure.
Indicator weight	A comment about the indicator weight structure.
Performance expectancy	A comment about the believe that using the system is beneficial for the interviewee.
Effort expectancy	A comment about the degree of ease of use of the system.
Self-efficacy	A comment about of the interviewee about operating the system without help.
Completeness	A comment about the completeness of the digital transformation aspects.
Future work	A comment about the remaining phase of the project or about future work opportunities.

Table 47: Coding categories and their definitions during evaluation.

G ADT SUB-ASPECTS & INDICATORS V2

Sub-aspect	Description	Indicator	Weight	Description	Assessment question (ranked 1-5 Likert scale)
Willingness To Make Decisions	The culture of seeing opportunities, taking risks and being able to make decisions to explore these opportunities **throughout the whole organization.**	Everyone is allowed to make decisions	5	Decision making is possible throughout all levels of the organization.	To what extent does there exist a culture which allows employees **throughout all levels of the organization** to make his/her own decisions?
		No blame culture	4	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports **the knowledge sharing between employees and the decision-making**?
		Open environment	3	Environment where it's supported and encouraged to make decisions and pitch them.	To what extent does there exist an open environment **which enables and encourages knowledge sharing between employees and decision-making**?
		Multicultural disciplinary team	1	**A team with different cultures and skills helps to provide a range of unique knowledge which helps to make decisions.**	**To what extent do there exists multicultural disciplinary teams where people from different cultures with different skills come together in one team to support the willingness to make decisions based on a broad range of knowledge?**
		Transparant environment	2	Environment where it's supported to make decisions, since all knowledge is availalble **and understandable** to everyone.	To what extent does there exist a transparant environment by making knowledge available **and understandable** throughout the organization?
Willingness To Change	The culture of change which should be in the veins of the employee - think change, do change.	Accept and expect change throughout the whole organization	3	Not only accept change, but expect it and even think about things you can change.	To what extent does there exist a culture where employees are accepting change and think in change?
		Teams encouraged to embrace technological excellence	2	Be open to new developments in the technology area and make sure your team is up to date.	To what extent does there exist a culture in which employees are open to technologies and embrace them?
		Teams encouraged to embrace innovation	1	Be open to innovation and change your team based on innovative ideas.	To what extent does there exist a culture in which employees are open to new innovation and embrace new digital advancements?
Knowledge Sharing	Between the employees there exist an environment of teamwork to increase knowledge sharing to keep learning from each other.	Business - ICT trust	2	The business and IT department should trust each other and wanting to collaborate.	To what extent does there exist a culture where the business & IT trust each other and share knowlegde?
		Constant communication	1	The employees of an organization have a mindset of constant communication.	To what extent does there exist a culture where knowledge sharing is encouraged by constant communication **mindset of** employees?
		Identify, share, apply learnings to projects	3	The employees are focused on learning from expercies during projects and identify, share and apply these learning to new projects.	To what extent does there exist a culture where learnings from experience are identified, shared and applied to other projects?
		Open environment	6	Environment where it's supported and encouraged to share knowledge.	To what extent does there exist an open environment which **enables and encourages** knowledge sharing between employees **and decision-making**?
		No blame culture	5	Culture where you learn from errors and don't only put blame on errors.	To what extent does there exist a no blame environment which supports **the knowledge sharing between employees and the decision-making**?
		Transparant environment	4	Environment where it's supported to share knowledge, since all knowledge is availalble **and understandable** to everyone.	To what extent does there exist a transparant environment by making knowledge available **and understandable** throughout the organization?

Figure 54: Culture aspect V2

Sub-aspect	Description	Indicator	Weight	Description	Assessment question (ranked 1-5 Likert scale)
Digital Management	The management's strategic viewpoint on how to manage digital transformation, **including commitment from management on all levels, a focus on change management and establishment of digital importance.**	Commitment from top, middle and lower management	1	All management levels need to be on the same page and support the digital transformation.	To what extent do top management, middle management and lower management all commit to digital transformation?
		Management focus on change management	2	The management needs to work on how to change the current organization to be a digital organization. Examples: transform the traditional organization into a more flexible organization. Make employees part of the change.	To what extent does the management focus on change management to make sure the organization changes towards the envisioned endpoint and make employees part of this change?
		Top management establishes digital importance	3	Top management should create awareness around digital transformation.	To what extent does top management support digital transformation to make sure awareness around digital transformation is established throughout the entire company?
Digital Transformative Vision	The digital transformative vision displays the digital transformation strategy and is often established based on a digital transformation roadmap.	Clear digital transformation start point	2	What is the current situation of your organization?	To what extent does the organization focus on creating clear start points, displaying the current state of the organization, of the digital transformation?
		Clear digital transformation end point	3	What is the future state of your organization?	To what extent does the organization focus on creating clear end points, displaying the future state of the organization, of the digital transformation?
		Digital transformation roadmap to determine the path from start to end	1	A roadmap describing the vision on how to come from your start point to your end point.	To what extent does the organization focus on creating digital roadmap envisioning the paths from how to come from your start to end points?
		Execute your digital roadmap based on your culture and internal organization	1	Choose an execution strategy based on the context of your organization. Example: plan-driven vs agile.	To what extent does the organization choose a strategy which fits the context, for example culture and internal organization, of the organization?
Digital Strategy	The digital strategy describes how the digital transformation goals are achieved.	Strategy based on digital transformation goals	3	The strategy has to be aligned with digital transformation goals/strategic themes.	To what extent is the strategy aligned with the **digital transformation goals/strategic themes** of the organization?
		Chosen technology based on digital transformation goals	3	The choice of technology has to be aligned with the digital transformation goals.	To what extent is the choice of technology aligned with aligned with the goals/strategic themes of the organization?
		Two way operations	5	A part of the strategy is that the new digital transformed way is built next to the **traditional** way **(two ways)** and slowly plotted on each other **only if the organization is ready for this.**	To what extent does there exist a two way operations, which means that the new digital transformed way is built next to the **traditional** way **(two ways)** and slowly plotted on each other **only if the organization is ready for this**, in the strategy of the organization?
		Outside-in strategy	7	Base your strategy on developments in the outside world.	To what extent is the strategy a outside-in strategy, i.e. based on developments in the outside world?
		Prioritization of your digital transformation goals	6	Have a good understanding of the digital transformation goals and their importance. Base a priority list on this.	To what extent does there exist a prioritization of the digital transformation goals/strategic themes based on importance?
		Oversee all goals **instead of focusing on one goal**	1	Focusing on just one digital transformation goals **instead of all** is not recommended for a digital transformation **strategy**.	To what extent does the organization **focus on executing** one digital transformation goal/strategic theme well instead of focusing on all?
		Start with small success and eventually scale	4	Focus on small success first to increase the awareness and importance of digital transformation.	To what extent does the organization focus on small successes first to establish/increase awareness and importance of digital transformation initiatives?
		Continuously evolve digital strategy	2	Continously evolve digital strategy based on prior outcomes and program feedback.	To what extent is the organization able to continuously adapt the digital strategy based on prior outcomes and feedback without it being a hurdle?
		Data-driven decision-making	2	Base strategic decisions on obtained data.	To what extent is the organization able to base strategic decisions on obtained internal or external data?
Digital Resources	The digital resources describe the resources which are important during digital transformation for the strategy.	Budgetting for digital transformation	2	The company has a budget for digital transformation to make sure money is set aside for it.	To what extent does there exist a budget for digital transformation?
		Time management	1	The company acknowledges that digital transformation consumes much time and plans accordingly.	To what extent does the organization realise digital transformation is a significantly large topic which needs much time?
Monitoring	Monitoring describes the ability of an organization to monitor the progress of the digital transformative vision and the digital strategy.	Monitor execution progress of your strategy	1	Monitor the execution of your digital strategy through KPIs and metrics to gain awareness of the progress.	To what extent does the organization monitor the execution of the digital strategy based on well defined KPIs and metrics to know exactly the progress of the digital strategy?
		Monitor the execution of your roadmap	2	Monitor the execution of your transformative vision to know exactly where you are in your digital transformation.	To what extent does the organization monitor the execution of the transformative vision based on well defined KPIs and metrics to know exactly the organization's current state?
		Establish KPIs and metrics to montitor execution	3	Relevant KPIs and metrics are determined to monitor execution of strategy and roadmap.	To what extent does the organization determine relevant KPIs and metrics which suit the transformative vision and the digital strategy?

Figure 55: Strategy aspect V2

Sub-aspect	Description	Indicator		Description	Assessment question (ranked 1-5 Likert scale)
Expertise Management	The management of digital transformation expertise within an organization.	Digital transformation expertise flows throughout the entire organization	1	Digital transformation expertise is distributed throughout the whole organization and everybody knows the definition.	To what extent does the entire organization agree on a common digital transformation definition and is digital transformation expertise distributed over the entire organization?
		Inhousing or outsourcing knowledge	2	The organization thinks about having the digital expertise inside the organization or to hire it from outside.	To what extent does the organization think about the right mix between inhousing and outsourcing digital transformation knowledge?
		Digital transformation execution knowledge	3	The management has expertise on how to execute a digital transfromation inside the organization.	To what extent does the management know how to execute a digital transformation inside the organization?
		Learning budget	4	The organization has a budget for learning to make sure money is set aside.	To what extent does there exist a learning budget within the organization to offer the employees the opportunity to keep learning?
Digital Expertise	The expertise which is important for performing digital transformation within an organization.	IT knowledge	5	Expertise on the technical side of things.	To what extent does the organization have IT expertise to perform a digital transformation?
		Business knowledge	4	Expertise on the business side of things.	To what extent does the organization have business expertise to perform a digital transformation?
		Digital transformation execution knowledge	1	Expertise on how to execute digital transformation.	To what extent does the organization have digital transformation execution knowledge to perform a digital transformation?
		Personal knowledge	6	Expertise about yourself.	To what extent do the employees have personal knowledge which helps them perform a digital transformation?
		Team roles knowledge	2	Expertise on team roles within an organization and what each role entails.	To what extent does the organization have team roles knowledge to establish the right team for performing digital transformation?
		Digital processes knowledge	3	Digital expertise of **several** employees on processes inside the organization.	To what extent does there exist knowledge about a certain process among more than only one employee?
Continuous Learning	The ability of an organization to offer continuously learning opportunities and the ability of employees to continuously learn.	Having a digital academy	1	A central place of knowledge or a programm which offers learning opportunities.	To what extent does there exist a digital academy/programm which offers digital transformation learning opportunities?
		Having a learning mindset	4	A mindset of employees to keep learning and improving themselves.	To what extent does there exist a learning mindset among employees to keep learning and improving themselves?
		Employees keep learning	3	The employees of the organization keep learning and are pushed to learn.	To what extent do the employees actually keep learning within the organization?
		Providing trainings	2	The organization offers trainings to keep learning.	To what extent does the organization offer training, such as traineeships or even trainings after the traineeship, to keep learning?

Figure 56: Expertise aspect V2

Sub-aspect	Description	Indicator	Weight	Description	Assessment questions (ranked 1-5 Likert scale)
IT Architecture	The building blocks of the IT architecture, the coupling between the building blocks and a tool to visualize the IT architecture for the digital transformation of an organization.	Usage of the cloud	4	The organization uses cloud services as part of their IT architecture.	To what extent does the organization use cloud services in their IT architecture?
		Process automation	4	The core processes inside of an organization are automated during digital transformation.	To what extent does the organization focus on automating core processes within the organization?
		Choose the right technology	3	The choice of **technology** is based on need and not just based on randomnous. **For example: systems are chosen based on the culture and strategy of the organization.**	To what extent are the IT systems bought based on organizational need instead of buying quantity?
		Flexible IT systems	4	The IT systems are flexible and changes can be made easily.	To what extent are the internal IT systems flexible and can changes be made easily to systems when necessary?
		Integration systems layer	4	There exists a layer in the architecture which shows the integration between systems.	To what extent does there exist an integrational systems layer connecting systems in the IT architecture of the organization?
		Datalake/datawarehouse	2	The datalake/datawarehouse saves all the data from systems in one place.	To what extent does there exist a datalake/datawarehouse, which saves data from systems in one place, in the IT architecture of the organization?
		Open APIs	4	The open APIs ensures that other systems can connect to your system and communicate.	To what extent do there exist open APIs, that ensure systems to connect to your system and communicate, in the IT architecture of the organization?
		Loose coupling between layers	4	The layers are loose coupled if there are few connections between them and if not everything is depedent on one layer.	To what extent does there exist loose coupling, which means there are only few connections between each layer to decrease dependency of a layer, between the different architectural IT layers of the organization?
		Microservices	4	The microservice consists of small components of other services.	To what extent are systems build like microservices, the main service consisting of smaller other services, in the IT architecture of the organization?
		Design principles	**4**	**The design principles of the IT architecture which determine how to set up and populate your IT architecture landscape.**	**To what extent do there exist design principles which are used as a guideline when adding new technology into your IT architecture?**
		Enterprise architecture tool	1	The enterprise architecture tool helps you envision the IT architecture by making models.	To what extent does the organization use an enterprise architecture tool to visualize the IT architecture of the organization?
Data **Exploitation**	The ability of an organization to obtain data from systems, **connect systems with each other, do simulations using AI and make decisions based on data.**	Connecting systems to systems	**2**	The ability to connect different systems with each other.	To what extent are systems in the IT landscape connected with each other in the organization?
		Get data from systems	4	The ability to retrieve structured data from systems.	To what extent is the organization able to retrieve structured data from their systems?
		Simulations with AI	1	The ability to make simulations and do predictions, **using AI technology**, based on analyzed retrieved data.	To what extent is the organization able to perform simulations/predictions using AI and based on the retrieved data from the systems?
		Make decisions based on data	**3**	The ability to make decisions based on the retrieved and analyzed data.	To what extent is the organization able to make decisions based on the retrieved and analyzed data?
Data Monitoring	The ability of an organization to monitor the obtained data from systems **throughout the whole supply chain.**	Data monitoring based on KPIs	3	The ability to monitor data based on KPIs **throughout the whole supply chain**. Important KPIs are: quality, findability, etc.	To what extent do there exist well defined KPIs to monitor data from systems inside the organization?
		Functionality based data monitoring	1	Data monitoring based on how the system is used by customers. Examples: number of clicks, repeated actions, etc.	To what extent does the organization perform functionality based data monitoring, which includes the monitoring of how the application is used?
		Technological based data monitoring	2	Data monitoring based on the functionalities of the system. Examples: uptime, performance, etc.	To what extent does the organization perform technological based data monitoring, which includes the monitoring of the technical system?
IT Security	The measures taken to increase security of the systems in an organization.	Ratio on cloud/on premise	5	The ratio between **systems in the cloud and on premise systems**. On premise systems are less secure compared to cloud systems.	To what extent does the organization **have systems in the cloud instead of on premise systems**?
		Technological standards	5	The technological standards describe what is accepted in the market and what not.	To what extent does the organization comply to technological standards in the market?
		Manage risks	4	The smart tools are created to easily identify possible risks and mitigate them.	To what extent does the organization use smart tools to identify and manage risks which could occur to systems?
		Secure interfaces	3	The interfaces should be secured to prevent intruders. Example: access control.	To what extent does the organization focus on secure interfaces to prevent intruders by, for example, defining access control?
		Intrusion detection	1	Intruders entering the systems should be detected by a system.	To what extent is the organization able to detect intruders in their IT systems and act based op on intrusions?
		Security testing	2	The security of your systems has to be regularly tested.	To what extent does the organization regularly test the security of their IT systems?

Figure 57: Technology aspect V2

Sub-aspect	Description	Indicator	Weight	Description	Assessment question (ranked 1-5 Likert scale)
Leadership	The leadership components for top management in the interal organization of an organization when performing digital transformation.	Leadership vision	3	A clear leadership vision which supports, transfers and maintains digital transformation importance and fits the organizational culture.	To what extent does there exist a clear leadership vision at the top management level which supports, transfers and maintains digital transformation initiatives that fit the organization's context?
		Democratic leadership	1	The leadership style which supports teams and employees to have leadership as well.	To what extent does there exist a democratic leadership style at the top management level which enforces leadership in teams?
		Comfortable work environment	2	The leader makes sure the work evironment of employees is comfortable and supports productivity.	To what extent does the top management ensure a comfortable work environment for their employees?
Departments/Teams	The department/teams components for the internal organization, **such as available IT, business & IT people, self-organization and collaboration with other teams**, when performing digital transformation.	IT in departments	5	The importance of **having your own** IT capabilities **in** departments and teams **and not all IT systems are outsourced**.	To what extent do there exist **inhouse** IT capabilities in departments and teams **and are not all IT systems outsourced**?
		Connect business & IT	4	The business and IT are both connected in departments and teams.	To what extent are business and IT connected within departments and teams?
		Communication with top management	3	The departments and teams communicate with top management to stay on the same page.	To what extent does there exist communication between top management and department and teams to keep each other updated?
		Self-organized	2	The departments and teams **need to be organized in a way it supports** self-organization to **operate** indepedently.	To what extent are departments and teams self-organized and able to **operate** independently?
		Collaboration between teams **and departments**	1	The department and teams are able to collaborate with eacht other to reach common goals.	To what extent does there exist collaboration between department and teams to reach common goals?
Organizational roles	The components for organizational roles within the organization when performing digital	Defined roles	1	The roles within the organization are defined and clear.	To what extent are roles defined and clear within all levels of the organization?
		Defined responsibilities	2	The responsibilities within the organization are defined and clear.	To what extent are responsibilities defined and clear within all levels of the organization?
Way of working	The components for the way of working when performing digital transformation.	MVPs	3	A part of the way of working is creating minimal viable products to create small successes quickly.	To what extent is the way of working inside the organization based on creating minimal viable products and thus small, quick successes?
		Planning rhythm	1	A part of the way of working is to establish a planning rythm which details the period of time after which planned goals have to be reached.	To what extent is the way of working inside the organization based on a planned rythm which details the period of time after which certain goals have to be reached?
		Flexible prioritization	2	A part of the way of working is to have a flexible prioritization of goals which can be altered when needed.	To what extent does there exist a flexible prioritization of goals which can be altered when needed in the way of working of the organization?
		Agile framework	4	**A part of the way of working is to adopt an agile framework to some extend, since agile can benefit the digital transformation of an organization.**	**To what extent does the organization adopt an agile framework and bases the way of working on it?**
		Context aligned	5	A part of the way of working is that it needs to be aligned with the context of the organization (culture).	To what extent is the way of working of the organization aligned with the context of the organization (culture)?

Figure 58: IO aspect V2

Sub-aspect	Description	Indicator	Weight	Description	Assessment question (ranked between 1-5 Likert scale)
Digital Partner Network	The digital partner network of the organization, how they are able to support the digital transformation and how this can be envisioned.	Partners kickstarting the DT	3	A partner with knowledge about digital transformation is useful to kickstart your own digital transformation.	To what extent do there exist partners in the digital partner network who can kickstart the digital transformation of the organization?
		Digitally transformed partners	2	The partner network which is digitally transformed as well, so working together is easier.	To what extent are the partners in the digital partner network digitally transformed?
		Event driven chain architecture	1	The event driven chain architecture in the partner network which allows to start processes at partners and the other way around.	To what extent does there exist an event driven chain architecture, which allows the organization to start processes at partners and the other way around, in the digital partner network of the organization?
		Continuous stakeholder management	5	The continuous management of stakeholders who are included in running projects to ensure quality.	To what extent does there exist continuous stakeholder management in running project to ensure quality within the digital partner network of the organization?
		Collaborative feedback	4	The collaborative feedback with your partner network to share experiences and improve processes.	To what extent does there exist collaborative feedback exchange to share experience and improve processes within the digital partner network of the organization?
Competition	The competition of the external organization which describes the awareness of the competition and the	Competition growth	2	The growth of the competition which is kept an eye on.	To what extent does there exist awareness of the competition to make decisions based on developments in the competition environment of the organization?
		Influence in **competitive** chain	1	The order of power in the competitive chain of the organization which can influence the **other** organization's decisions, **as one organization can be more depedent on another organization and has to adapt**.	To what extent is the organization able to influence decisions made in the external environment of the organization, due to a **high amount of** power **and enforcing dependency** in the **competitive** chain?
Digital Customer Engagement	The digital customer engagement of the external organization which describes how the customer is involved with the organization.	Pull clients in your context	1	The ability to pull clients in your context to, for example, do a pilot. This helps to improve the quality of the product.	To what extent is the organization able to pull clients in the organization's context by, for example doing pilot projects, to ensure quality is delivered to the customer?
		Customer centricity	5	The importance of putting the customer central and base decisions on what the customer thinks and wants.	To what extent does the organization put the customer central and base decisions on what the customer wants and thinks?
		Adaptable content	2	The content which is made/shown to the customer is **adaptable to it's context/preferences**.	To what extent is the organization able to offer **adaptable** contents to match the likings**/context** of the customer?
		Digital customer journey	4	The digital journey of the customer and the ability to stand in his/her shoes.	To what extent does the organization create digital customer journeys to envision what the customer wants?
		Expose growth opportunities	3	The digital marketing focused on exposing new growth opportunities to customers and see how the products and services adapt to the customer.	To what extent is the digital marketing of the organization focused on exposing customers to new digital growth opportunities to check how the products and services adapt to the customer?
		End-user communication	6	The communication with the end-user of the product to make sure the customer is involved.	To what extent does there exist communication with the end-user to ensure product quality?

Figure 59: EO aspect V2

Sub-aspect	Description	Indicator	eig	Description	Assessment question (ranked 1-5 Likert scale)
Embrace change to deliver customer value	The success of a software development effort is based on the extent to which it helps deliver customer value. In many cases, the development team, as well as the customer, are in a continuous learning process as to the requirements necessary to realize additional customer value. Hence, an attitude of welcoming and embracing change should be maintained throughout the software development effort.	Change based on outside developments	2	The change is based on developments in the outside world.	To what extent is the change inside the organization based on developments in the outside world?
		Apply agile to complex, uncertain problems	1	**The possible change of complex and uncertain problems is embraced by applying agile practices to solve them.**	To what extent is the **possible change of working on complex and uncertain problems embraced by applying agile practices to solve them**, inside the organization?
		Accept and expect change throughout the whole organization	3	Not only accept change, but expect it and even think about things you can change.	To what extent do employees accept change and think in change in the organization?
Plan and deliver software quality iteratively	Early and frequent delivery of working software is crucial, because it provides the customer with a functional piece of the product to review and provide feedback on. This feedback is essential for the process of planning for upcoming iterations, as it shapes the scope and direction of the software development effort.	Quarter planning (PI)	1	A part of the planning of software quality is to establish a PI planning which details the period of time after which planned goals have to be reached.	To what extent does there exist PI planning, which details a period of time after which planned goals have to be reached, in the organization?
		Adaptive planning	2	The planning can be changed based on developments during the implementation period.	To what extent does there exist a adaptive planning, which can be changed based on development during the implementation period, in the organization?
		Priority planning	4	The planning is based on the prioritization of goals/strategic themes defined in the PI planning.	To what extent is the planning based on prioritization of goals/strategic themes in the organization?
		Defined strategic themes	6	A part of the planning of software quality is defining the right goals you want to achieve.	To what extent are goals/strategic themes defined in the organization?
		MVPs	5	A part of the delivery of software quality is creating minimal viable products to create small successes quickly.	To what extent is the way of working inside the organization based on creating minimal vialbe products and thus small, quick successes?
		Feedback loops with stakeholders	3	A part of delivering software quality is to have frequent feedback loops on delivered products with stakeholders, so the quality can be improved.	To what extent do there exist feedback loops with stakeholders after each iteration to obtain feedback on delivered products and improve the product based on this in the organization?
Human-centric	The reliance on people and the interactions among them is a cornerstone in the definition of agile software processes.	Define agile roles	7	The agile roles (product owner, scrum master) within the organization are defined and clear.	To what extent are roles defined and clear within all levels of the organization?
		Defined responsibilities	8	The responsibilities within the organization are defined and clear.	To what extent are responsibilities defined and clear within all levels of the organization?
		Collaboration between teams/departments and management	5	The department, teams and management are able to collaborate with eacht other to reach common goals.	To what extent does there exist collaboration between departmenst and teams to reach common goals in the organization?
		BizDevOps	2	The business, IT and operations are all connected in departments and teams **to increase their collaboration.**	To what extent are the business, IT and operations connected in department and teams **to increase their collaboration**?
		DevOps	4	The IT and operations are **all** connected **in departments and teams to increase their collaboration.**	To what extent are IT and operations connected **in department and teams to increase their collaboration**?
		Self-organized teams	3	The teams need some level of self-organization to work indepedently.	To what extent are departments and teams self-organized and able to work independently in the organization?
		Development team size of 5-9	6	The size of the **development** team which is between 5 and 9 employees.	To what extent are the sizes of the **development** teams in the organization between 5 to 9 employees?
		Employee dedicated to one team **of 5-9**	6	A employee is assigned to one team and fully dedicated to this team **of 5-9** and does no work for other teams.	To what extent are the employees in the organization assigned and dedicated to one team **(of 5-9)** only and do not work for other teams at the same time?
		Distributed agile network	1	The possibility to work remotely and still effective through a distributed agile network.	To what extent are employees able to work remotely from home and still be effective through a distributed agile network of the organization?
Technical excellence	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments, such as the ones characterized as agile.	Security	1	The security of the IT systems in an organization.	To what extent do there exist security measures to make sure the IT systems are secure in the organization?
		Design principles	5	The ability to build what you really need according to architecture and to avoid incidental architecture.	To what extent is code build under architecture to make sure you build what you need and avoid incidental architecture in the organization?
		Quality of code	3	Agile developers are comitted to producing only the highest quality code possible, because high quality code is essential in high-speed development environments.	To what extent does there exist a focus on producing the highest quality of code possible in the organization?
		Validation of code	4	The constant validation of the code you are building for a project.	To what extent is the build code constantly validated based on test and requirements in the organization?
		Monitor using KPIs	2	The monitoring of the performance of the systems based on well defined KPIs.	To what extent does there exist monitoring of the performance of code based on well defined KPIs in the organization?
		CI/CD	1	Continuous intergration/continuous delivery of code and part of applications by automating building, testing and deployment.	To what extent does there exist CI/CD pipelines to support continuous integration and continuous delivery of parts of code and application in the organization?
Learning	Encourage people in the organization to participate in learning, teaching and improvement, collect measures to support learning and improvement.	Retrospective	4	The learning moment after each PI where you look back at what you did and what could have been done better.	To what extent does there exist a learning moment after each PI where you look back at what you did and learn from the experience?
		Continuous learning	3	The mindset of wanting to keep learning and have the opportunity to keep learning.	To what extent does there exist a continuous learning mindset among employees and does the organization offer opportunities to continuously learn in the organization?
		Monitor agile program	2	The monitoring of the agile way of working program in the organization.	To what extent is the agile way of working program monitored in the organization?
		Learn from monitoring	1	The monitoring of the performance of the systems **and data is used to learn from. Example: time savings after implementing a new application.**	To what extent is monitoring of data **and performance of** systems **used to learn from its findings, i.e. time savings after implementation of a new application,** inside the organization?
Customer collaboration	Inspired by the original statement of the agile manifesto, there must be significant and frequent interaction between customers, developers, and all the stakeholders of the project to ensure that the product being developed satisfies the business needs of the customer.	Digital customer engagement	1	The digital customer engagement of the organization which describes how the customer is involved with the organization.	To what extent does the organization focus on involving the customer in the creation of their products and new value?
		Communication with end-users	3	The communication with the end-user of the product to make sure the customer is involved.	To what extent does there exist communication with the end-user to ensure product quality in the organization?
		Customer journey	2	The journey of the customer and the ability to stand in his/her shoes.	To what extent does the organization create customer journeys to envision what the customer wants?

Figure 60: Agility aspect V2

H LIST WITH CHANGES BASED ON FEEDBACK FROM THE EXPERT EVALUATION INTERVIEWS

- Introduction tab: change something about the colours in the figure, as there are too many colours. (E4)
- Introduction tab: how are the maturity levels established? Add explanation. (E4, E5, E6, E7)
- Introduction tab: look into adding a description to the maturity levels. (E6)
- Introduction tab: establishing concrete maturity levels with definition is hard, due to gaps when looking at the indicators. (E1, E3)
- Introduction tab: add a description about the weights of indicators. (E6)
- Introduction tab: when do you score 1 and when do you score 5? Add explanation. (E5, E6)
- Introduction tab: explain why the agility aspect is placed differently. (E5, E7)
- Introduction tab: add the radar chart from the dashboard tab to the introduction tab to show what you are working towards if you use the assessment instrument. (E4)
- Prototype: keep it MVP and first think of minimal user stories based on requirements. (E3, E4)
- Prototype: arrange your questionnaire by asking questions per aspect and making this clear. (E5)
- Prototype: show the progress of the questionnaire. (E5)
- Prototype: be able to let people score indicators between 1 and 5. (E3)
- Prototype: provide small description of the aspects before asking questions about them. (E1, E5, E7)
- Prototype: add validation to alert if someone wants to score an indicator higher then possible based on earlier score answers. (E2, E3)
- Prototype: add a text box for additional explanation when scoring an indicator. (E6)
- Prototype: Make sure several employees of the same organization are able to fill in the assessment questions. (E7)
- Prototype: start with showing overall scores and make it possible to click through details. (E4, E5, E6)
- Indicator weights: the weights of the indicators should be adaptable to different contexts. (E4)
- Score: I would advise to look into scoring indicators based on available data within the organization and thus quantitatively. (E5, E7)
- Assessment questions: don't ask the same question twice. (E4, E5, E7)
- Culture tab: add an indicator "multicultural disciplinary team" to the "willingness to make decisions" sub-aspect. (E2, E3)
- Culture tab: add "understandable" to the description and assessment questions of the indicator "transparent environment". (E3)

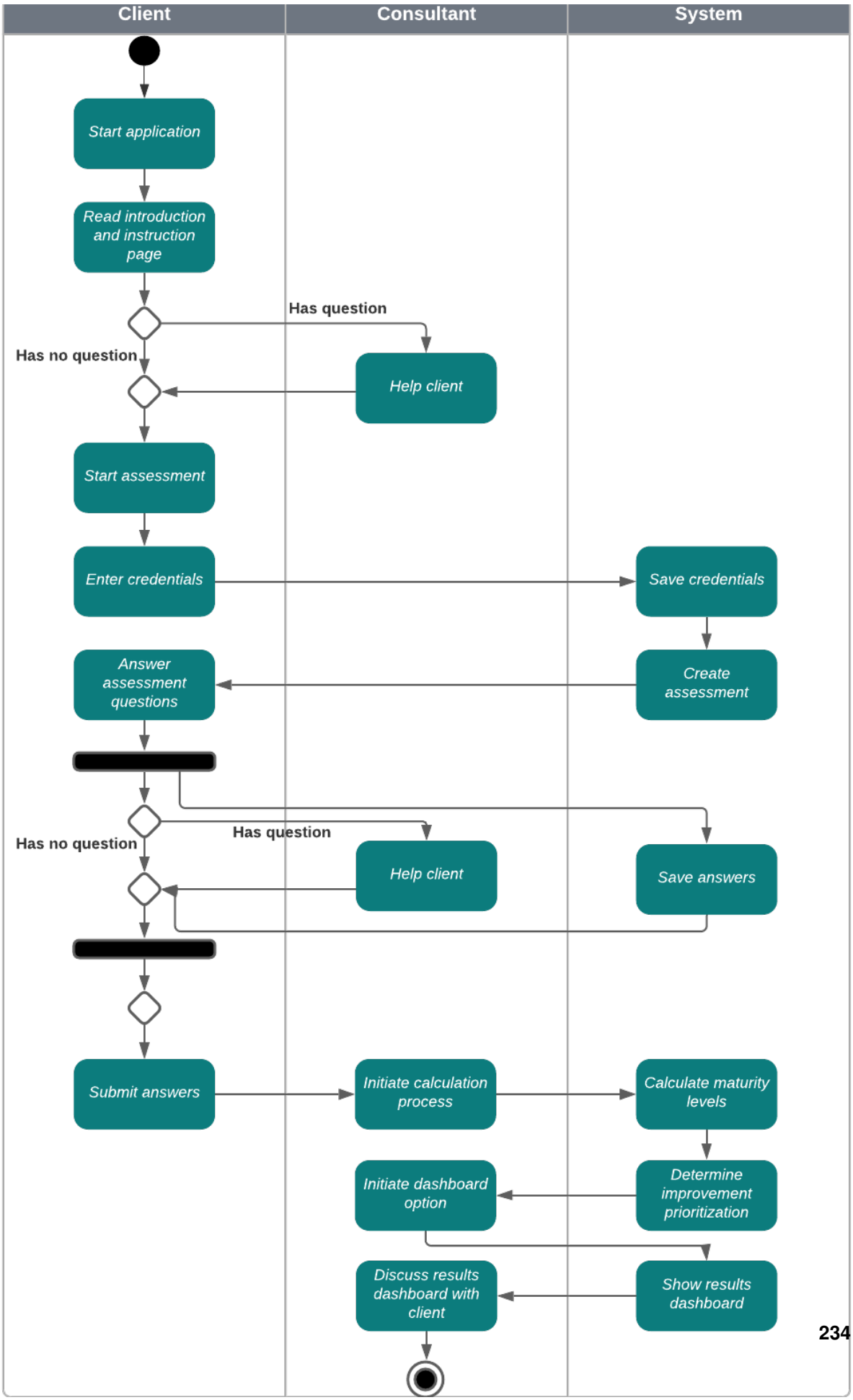
- Culture tab: change the first three assessment questions of the sub-aspect “willingness to change” by removing “employees make his/her own decisions”. (E5)
- Culture tab: look into the assessment questions at the sub-aspect “knowledge sharing”. (E5)
- Culture tab: describe the indicator “open environment” better, so it differentiates from the indicator “constant communication”. (E6)
- Culture tab: add “throughout the whole organization” to the description of the sub-aspect “willingness to make decisions”.
- Strategy tab: change the description of the sub-aspect “digital management” by incorporating information about the indicators of this sub-aspect. (E5)
- Strategy tab: change the assessment question of the indicator to “strategy based on digital transformation goals” by adding “digital transformation” to the question. (E5)
- Strategy tab: change the words “one-trick pony” into “focusing on one goal”. (E5)
- Expertise tab: change the sub-aspect “digital process knowledge” into “digital processes knowledge”. (E5)
- Technology tab: remove the sub-aspect “IT systems”. (E1, E3)
- Technology tab: move the indicators “flexible IT systems” and “choose the right systems” to the sub-aspect “IT architecture”. (E2)
- Technology tab: change the sub-aspect “data integration” to “data exploitation”. (E3)
- Technology tab: remove the sub-aspect “process automation” and add an indicator “process automation” to the sub-aspect “IT architecture”. (E1)
- Technology tab: change the indicator “manage risk using smart tools” to “manage risks”. (E3)
- Technology tab: remove overlap between “do analysis with big data” and the “data monitoring sub-aspect. (E4)
- Technology tab: remove “during digital transformation” from the description of the sub-aspect “data monitoring”. (E5)
- Technology tab: add “supply chain monitoring” to the description of the indicator “data monitoring based on KPIs”. (E7)
- Technology tab: add “scalability” to the indicator “flexible IT systems”. (E7)
- Technology tab: change the indicator “chose the right systems” to “chose the right technology” and add “chose the right systems” to the description of the indicator.
- Technology tab: change the wording of the assessment question of the indicator “ratio in cloud/on premise”, as it will hinder the calculation of the maturity level this way. (E5)
- IO tab: move the indicator “two way operations” from the aspect “internal organization” to the “strategy” aspect. (E1)
- IO tab: clarify the description of the “two way operations” indicator. (E1, E3)

- IO tab: change the description of the sub-aspect “department/teams” by incorporating information about the indicators of this sub-aspect. (E5)
- IO tab: look into overlap between the indicator “self-organized teams” and the “willingness to make decisions” sub-aspect. (E4)
- IO tab: look into overlap between the indicator “defined responsibilities” and the sub-aspect “willingness to make decisions”. (E4)
- IO tab: look into adding a new indicator to the sub-aspect “way of working” which describes the extent to which an organization adopts an agile framework. (E7)
- IO tab: add to the description of the indicator “IT in departments” to which extent the department/teams manage their own IT or outsource their IT.
- EO tab: change the indicator “power distribution in chain” to something less neutral. (E3)
- EO tab: change the word “personalized” in the indicator “personalized content”, so it fits a B2B context better. (E6)
- EO tab: Expand the description of the indicator “influence in competitive chain” by adding “dependent on others” to the description. (E7)
- Agility tab: add something about agile to the description of the “complex, uncertain problem” indicator. (E1)
- Agility tab: add “5-9” to the indicator “employee dedicated to one team”, its description and the assessment question. (E1)
- Agility tab: remove the indicator “management agility”. (E4)
- Agility tab: change the indicator “build under architecture” into “design principles”. (E4)
- Agility tab: add, between brackets, agile roles, such as, product owner and scrum master. (E6)
- Agility tab: change the word “silo’s” in the description of the indicator “DevOps” to departments. (E6)
- Agility tab: describe which teams are meant with the indicator “team size of 5-9”. (E6)
- Agility tab: change the weight from the indicator “security” from 4 to 1. (E6)
- Agility tab: add an example to the description of the indicator “monitoring using KPIs” about what can be done with findings from monitoring and change the indicator to “learn from monitoring”. (E6)
- Agility tab: add an indicator to the aspect “agility” which describes if an organization adopts an agile framework to some extent. (E7)
- Improvement roadmap: add improvement steps to reach higher maturity levels. (E6)
- Dashboard tab: use the colour of the maturity levels while displaying scores in the dashboard tab. (E4, E7)
- Dashboard tab: don’t show the middle results table, as it’s unclear. (E4, E5)

- Dashboard tab: start with showing overall scores and make it possible to click through details. (E4, E5, E6, E7)
- Dashboard tab: a radar chart is useful to show as a result. (E4, E5)
- Dashboard tab: let the figure from the introduction tab come back in the dashboard tab. (E6)
- Dashboard tab: let the figure from the introduction tab come back in the dashboard tab and fill the blocks with the colours corresponding to the maturity levels per sub-aspect. (E7)
- Dashboard tab: show the gap between desired and actual score in a table in the dashboard tab. (E7)
- General: remove colours from the Excel sheet and only keep it in the figure. (E6)

I ADT ASSESSMENT INSTRUMENT PROTOTYPE

I.1 Activity Diagram


Client
Consultant
System
Start application
Read introduction and instruction page
Has question
Has no question
Help client
Start assessment
Enter credentials
Save credentials
Answer assessment questions
Create assessment
Has no question
Has question
Help client
Save answers
Submit answers
Initiate calculation process
Calculate maturity levels
Initiate dashboard option
Determine improvement prioritization
Discuss results dashboard with client
Show results dashboard

I.2 Storyboard

- MVP stories:
  - Create domain model
  - Assessment questions pages
  - Create results dashboard
  - Credentials page
  - Introduction page
  - Save client credentials
  - Save assessment question answers
  - Calculate maturity levels
  - Save assessment results data
  - Total assessment result overview page
  - Results dashboard page
  - Improvement prioritization of indicators
  - Submit answers
- Not MVP stories:
  - Show progress of an assessment
  - Validation alert incorrect value
  - Additional explanation text box
  - Flexible indicator weights
  - Multiple people edit assessment at the same time
  - Dashboard - Click indicator, show assessment question
  - Improvement roadmap
  - Compare different assessment results
  - Indicator gap score priority list
  - Clickable result tables

J CASE STUDY DETAILS

J.1 Case study protocol

1. **Preparation:** before the case study is conducted, the organization is invited for an initial interview to introduce each participant, discuss its capability to perform the ADT assessment and to introduce the participants to the ADT maturity model and its contents. If the current group of participants lack knowledge to answer the assessment questions on all the seven aspects, additional participants were invited to participate in the case study.

2. **Kick-off meeting:** just before performing the case study, the participants are invited to a kick-off meeting to discuss the background information and instructions pages of the assessment instrument prototype. In addition, the researcher informs each participant about which assessment and assessment questions they have to fill in. The participants can ask final questions about the assessment procedure before the assessment starts.

3. **Assessment:** the participants start the assessment instrument prototype and perform their part of the assessment individually. Each participant answers a different set of assessment questions based on their expertise. It is possible that several participants are asked to answer questions about the same aspect. If this is the case, these participants come together, after answering the questions individually, to discuss about one common answer. All the assessment questions are divided among the total group of participants of the organization and will be, in the end, answered once. As a result, one complete assessment is performed.

4. **Results discussion:** after the assessment has been performed, the results are calculated automatically and await in the dashboard page. The group of participants together with the researcher will evaluate and discuss the results of the assessment in a general meeting.

5. **Evaluation:** the evaluation of the model during the case study happens during the results discussion. Next to discussing the results, the participants are free to leave any evaluation comment on the assessment instrument prototype. These comments are written down by the researcher and added to the 'case study coded transcriptions' in Appendix J2.

J.2 Case study log

Coding category	Transcription
	This is the coded transcription of the first case study. Permission to record audio is requested before starting.
Effort expectancy	**[C1.2]:** Soms zijn de vragen wel redelijk lang. Ze zijn wel duidelijk, maar ik moet heel aandachtig lezen.
Effort expectancy	**[C1.1]:** Thomas, ik denk een technisch mankement. Ik heb nu de vragen van de eerste twee sub-blokjes ingevuld en bij de derde zijn er nu al vragen vooraf ingevuld. Er is dus overlap. **[T]:** Dat kan kloppen en is niet perse erg. Dit komt doordat sommige vragen aan elkaar gelinked zijn, omdat ze nagenoeg hetzelfde zijn. Deze komt wel 2x terug, omdat hij voor beide sub-blokjes meetelt. **[C1.1]:** O, oke, mooi **[T]:** Als 'X' straks bij 'agility' gaat kijken, zal er al een hele hoop ingevuld zijn, omdat er veel overlap is tussen digitale transformatie en agile. **[T]:** Ik moet nu even alle antwoorden verzamelen.
Future work/Effort expectancy	**[C1.3]:** Geen conversie flow gemaakt om alle antwoorden samen te voegen? **[T]:** Nee, die heb ik niet, misschien dat ik die later nog kan toevoegen.
Future work/Effort expectancy	**[C1.3]:** Wat je ook kan doen is dat je de naam niet op dit niveau zet, maar op vraagniveau. Dus dat je samen in één assessment werkt. Je hebt dan één assessment, maar dat je de naam op vraagniveau vastlegt.

	[T]: Dat is uiteindelijk beter inderdaad en precies wat je wilt. Zodat er meerdere personen in één assessment tegelijk kunnen werken. Ik was bang dat in de huidige versie niet zou lukken.
Performance expectancy	**[C1.3]:** Je kan inderdaad wel het probleem krijgen dat je elkaar in de weg zit. Slim dat je het voor een MVP zo hebt gedaan, dat zeker.
	[T]: Ja, het is nu alleen lastig als je met een groep mensen het tegelijkertijd gaat invullen. Nu moet ik best veel werk doen om alle antwoorden te verzamelen en in één assessment te stoppen.
	[T]: Ik vind dat jullie de vragen vrij snel ingevuld hebben. Zelf had ik verwacht dat het langer zou duren.
General	**[C1.3]:** Ik denk dat de eerste ingeving redelijk snel is, maar ik denk dat er tijd gaat zitten in het discussiëren tussen een groep mensen die het tegelijkertijd invullen. Bijvoorbeeld: ik heb een 3 ingevuld en jij een 4. Hoezo? Daar komen de interessante bevindingen uit.
	[T]: Bij de tweede case gaan meerdere mensen hetzelfde blokje eerst individueel en daarna gezamenlijk invullen. Ik denk dat je dan meer discussies krijgt, een breder beeld en betere resultaten.
General	**[C1.3]:** Wat ik nog wel lastig vind bij 'X' is dat we niet een mega groot bedrijf zijn. Dus dat kan je nog wel als één organisatie doen, maar bij 'X' heb je wel meerdere afdelingen, dus wat is dan je scope? Heel 'X' of een deel van 'X'?
	[T]: Het is nu de groep die zich bezig houdt met het agile en digital programma, zodat het een relevante groep is.
General	**[C1.3]:** Ik denk ook dat je bij verschillende afdelingen een verschillende volwassenheid gaat tegenkomen.
Performance expectancy	**[C1.3]:** Het is wel leuk om dit soort vragen voor onszelf in te vullen, want eigenlijk focussen we altijd op onze klanten. Als je dan naar je eigen IT landschap gaat kijken, dan denk je echt van o, daar zit nog verbetering in.
Maturity level	**[C1.1]:** Zijn de maturity levels afgrond of is dat toeval?
	[T]: Dat komt door de 5 maturity levels die ik overgenomen heb uit een ander model. Je berekent een aantal punten onafgerond. Je kijkt tussen welk punt interval dit hoort en dan wordt er een level 1, 2, 3, 4 of 5 bepaald.
Assessment question	**[C1.3]:** De vragen kan je in het dashboard dus niet meer terugzien?
	[T]: Nee, maar de indicator ervan in principe wel. De indicatoren komen zo goed als overeen met de vragen. Zou je aanraden om de vragen hier te kunnen zien?

Future work	**[C1.3]:** Je zou kunnen toevoegen dat je op de indicator klikt en dan een pop-up krijgt met de vraag die erbij hoort.
Future work	**[C1.3]:** Ik zou bij de resultaten ook toevoegen dat je kan zien welke je geselecteerd hebt. Nu is dat erg onduidelijk.
Improvement prioritization	**[C1.1]:** Kan je in de wetenschappelijke literatuur kijken welke elementen belangrijk zijn voor een geslaagd bedrijf op gebied van digitale transformatie en een bepaalde volgorde van verbeteren als we kijken naar de 7 aspecten?
Future work	**[C1.1]:** Daarnaast, kan je ook kwantitatief aangeven waar je aan moet werken om een hogere volwassenheid te krijgen?
	[T]: Dus eigenlijk een roadmap die aangeeft waar ik nu moet beginnen om mezelf te verbeteren?
Future work/performance expectancy	**[C1.1]:** Ik verwacht namelijk dat veel organisaties met een actueel level van 3 en een desired level van 4 komt. Het zou erg interessant zijn om daar dus iets objectiefs aan toe te voegen.
	[T]: Voor future work vind ik het inderdaad een goede stap om het model i.p.v. kwalitatief meer kwantitatief te maken door aan te geven wat er binnen een organisatie aanwezig moet zijn om een bepaald level te halen.
Future work/performance expectancy	**[C1.1]:** Lijkt me inderdaad een goed punt om in de discussie aan te geven.
Performance expectancy	**[C1.2]:** Uiteindelijk dient dit model ook als beginpunt voor een gesprek met de klant.
Future work	**[C1.1]:** Ja, maar je spreekt wel echt over een level dat je bent en je wilt misschien ook meerdere bedrijven met elkaar kunnen vergelijken.
	[T]: Ik ga dit meenemen in de discussie.
Self-efficacy	**[C1.4]:** Ik vond het soms best lastig om zelf een score te geven, omdat het best subjectief is.
Performance expectancy	**[C1.4]:** Er kwamen ook af en toe agile termen terug. Stel nou een bedrijf is nog helemaal niet agile, wil je deze dan wel al toevoegen?
	[T]: In principe is één van de doelen van het model om ook een agile level te bereken. Stel nou ze kunnen de term nog niet of werken niet op die manier, dan is hun score daar dus gewoon laag.
Effort expectancy	**[C1.4]:** Kan je deze assessment ook bij een ander bedrijf toepassen?
	[T]: Ja, dat kan, maar per context kan er een compleet verschillend antwoord uitkomen.

Performance expectancy	**[C1.4]:** Ik zie hier zelf erg het nut van in als we een project bij een bedrijf beginnen en in het voortraject dit model gebruiken als een meeting.
Performance expectancy	**[C1.1]:** Ja en het is dan helemaal interessant als wij zo'n assessment voor het bedrijf doen en zij zelf ook. Daarna kunnen we ze dan naast elkaar leggen.
General	**[C1.3]:** Een goeie vraag is nog hoe je kan voorkomen dat iemand bij een desired level altijd 5 invult?
General	**[C1.2]:** Je wilt vaak natuurlijk zoveel mogelijk verbeteren, maar als je dat voor alles invult, is dat gewoon niet haalbaar. Bedrijf moet van tevoren goed kijken waar ze beter in willen worden en waar de focus op moet liggen.
	This is the coded transcription of the second case study.
	Permission to record audio is requested before starting.
Effort expectancy	**[C2.1]:** Ik had wel een beetje de moeite met de desired score. Deze zal je toch altijd op 5 willen hebben?
Effort expectancy	**[C2.2]:** Ja, ik had dit ook een beetje.
	[T]: We kwamen hier inderdaad gaandeweg achter. Deelnemers hebben de desired score verschillend geïnterpreteerd.
Feedback	**[C2.2]:** Om even op één lijn te zitten. De desired score is eigenlijk bedoeld om je prioriteit op korte termijn aan te geven toch? Echter, heb ik hem zo ingevuld op de manier dat ik aangeef waar je als afdeling op een gegeven moment wilt zijn. Daarom heb ik grotendeels 5 ingevuld.
	[T]: Klopt en dit neem ik uiteindelijke mee in mijn onderzoek en het verslag.
Effort expectancy	**[C2.1]:** Hoe moet ik de vraag "To what extent does the organization have business expertise to perform a digital transformation?" interpreteren? Dat vind ik lastig.
	[T]: Zowel business als IT kennis is belangrijk voor digitale transformatie zie je in de literatuur. Met deze vraag probeer ik te meten in hoeverre de business kennis aanwezig is binnen het bedrijf.
General	**[C2.1]:** Ik had de vraag over de indicator 'work environment' opgevat op de manier hoe het binnen het agile werken ingericht is. Soms is dat nog steeds niet helemaal fijn voor mij als PO bijvoorbeeld.
General	**[C2.3]:** Ik had het anders geïnterpreteerd, want ik dacht namelijk dat het ging om de 'work environment' als in werkplekken en hoe dat zit.
Effort expectancy	**[C2.2]:** Ik vind de vraag "To what extent is the way of working of the organization aligned with the context of the organization (culture)?" een beetje raar.

General	**[C2.1]:** Ik denk dat je deze vraag moet lezen als hoe de cultuur binnen het bedrijf geregeld is en hoe mensen denken. **[T]:** Dat klopt ja, je moet de vraag op die manier interpreteren.

Table 48. Case study transcriptions.

Coding category	**Coding category definition**
Maturity level	A comment about the maturity level structure.
Assessment question	A comment about the assessment question structure.
Performance expectancy	A comment about the believe that using the system is beneficial for the interviewee.
Effort expectancy	A comment about the degree of ease of use of the system.
Self-efficacy	A comment about of the interviewee about operating the system without help.
General	A general comment about the ADT maturity model.
Improvement prioritization	A comment about the sequence of improvement steps based on the results.
Future work	A comment about future work opportunities.

Table 49: Coding categories and their definitions during evaluation.

J.3 Case study results

J.3.1 Overview of complete case study results

	Case 1: Consultancy			Case 2: Logistics		
	Actual level	Desired level	Gap	Actual level	Desired level	Gap
Total ADT level	3	4	-1	3	4	-1
Culture	3	4	-1	3	4	-1
Willingness to make decisions	3	4	-1	2	4	-2
Knowledge sharing	3	4	-1	3	4	-1
Willingness to change	4	4	0	3	4	-1
Strategy	2	4	-2	3	4	-1
Digital transformative vision	2	5	-3	3	4	-1
Monitoring	1	4	-3	3	4	-1
Digital strategy	3	5	-2	3	4	-1
Digital resources	2	4	-2	4	5	-1
Digital management	3	4	-1	4	5	-1
Expertise	4	5	-1	3	4	-1
Continuous learning	3	5	-2	3	4	-1
Expertise management	4	5	-1	3	4	-1
Digital expertise	4	5	-1	2	4	-2
Technology	3	4	-1	4	5	-1
IT Architecture	3	5	-2	4	5	-1
Data monitoring	2	4	-2	3	4	-1
Data exploitation	3	4	-1	4	5	-1
IT Security	3	4	-1	5	5	0
Internal Organization	3	4	-1	2	4	-2
Leadership	3	4	-1	2	5	-3
Department/Teams	3	4	-1	3	4	-1
Organizational roles	3	4	-1	2	4	-2
Way of working	3	4	-1	3	4	-1
External Organization	3	4	-1	3	4	-1
Digital partner network	3	4	-1	3	3	0
Digital customer engagement	3	4	-1	3	4	-1
Competition	4	4	0	3	4	-1
Agility	3	4	-1	3	4	-1
Technical excellence	2	5	-3	4	5	-1
Plan and deliver software quality iteratively	3	5	-2	3	4	-1
Embrace change to deliver customer value	3	4	-1	3	4	-1
Human-centric	3	4	-1	2	4	-2
Learning	3	4	-1	3	4	-1
Customer collaboration	4	4	0	3	4	-1

Figure 62: The case study results.

J.3.2 Critical values case study 1 and 2

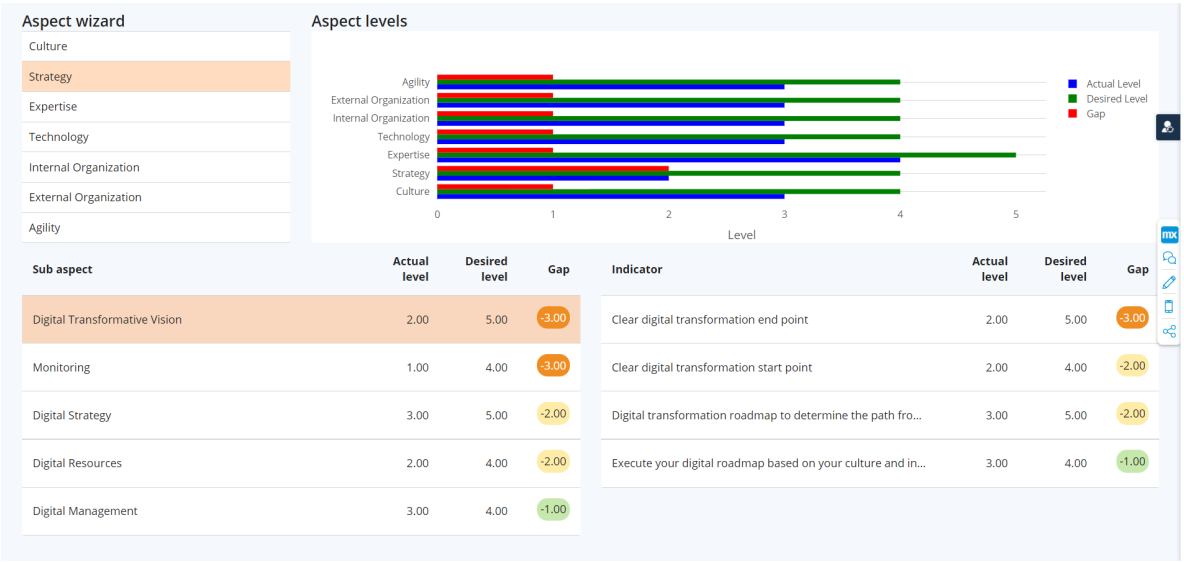


Figure 63: Case 1: Overview of the levels for the digital transformative vision sub-aspect.

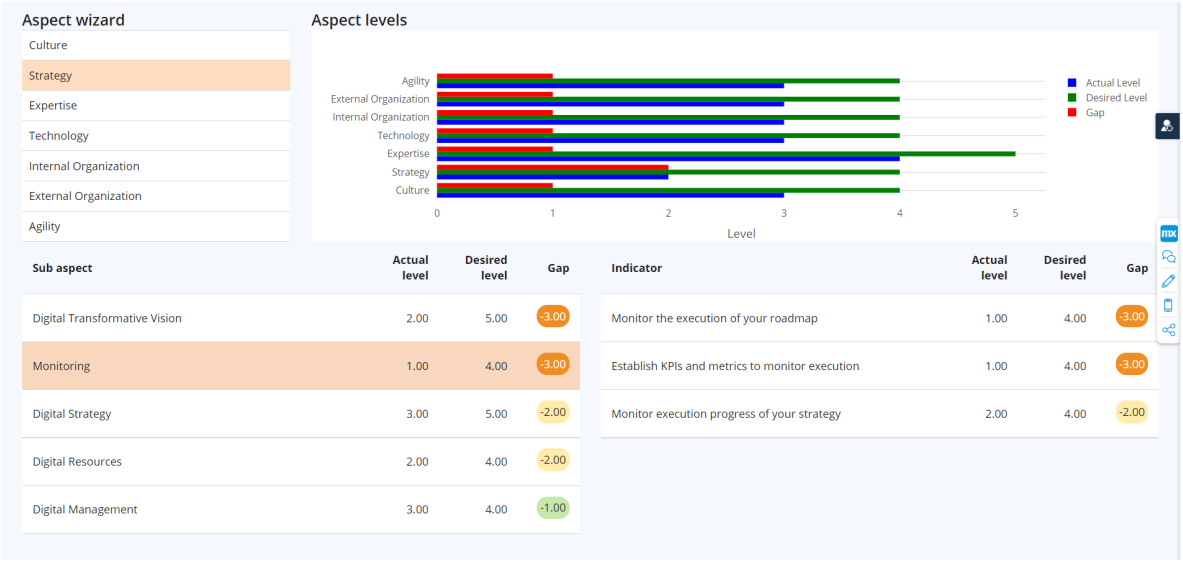


Figure 64: Case 1: Overview of the levels for the monitoring sub-aspect.

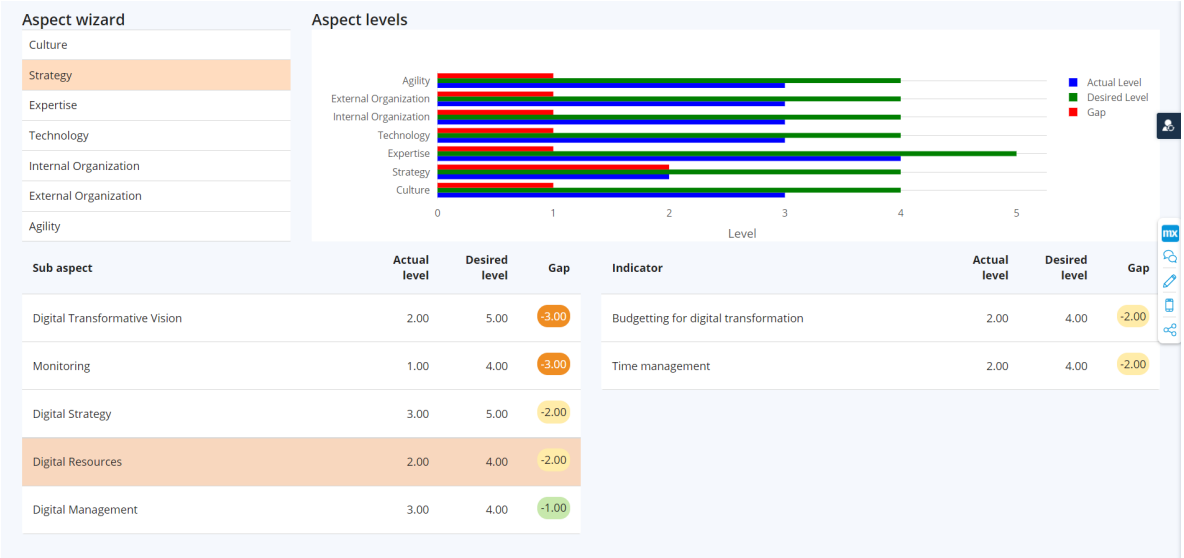


Figure 65: Case 1: Overview of the levels for the digital resources sub-aspect.

Figure 66: Case 1: Overview of the levels for the data monitoring sub-aspect.

Figure 67: Case 1: Overview of the levels for the technical excellence sub-aspect.

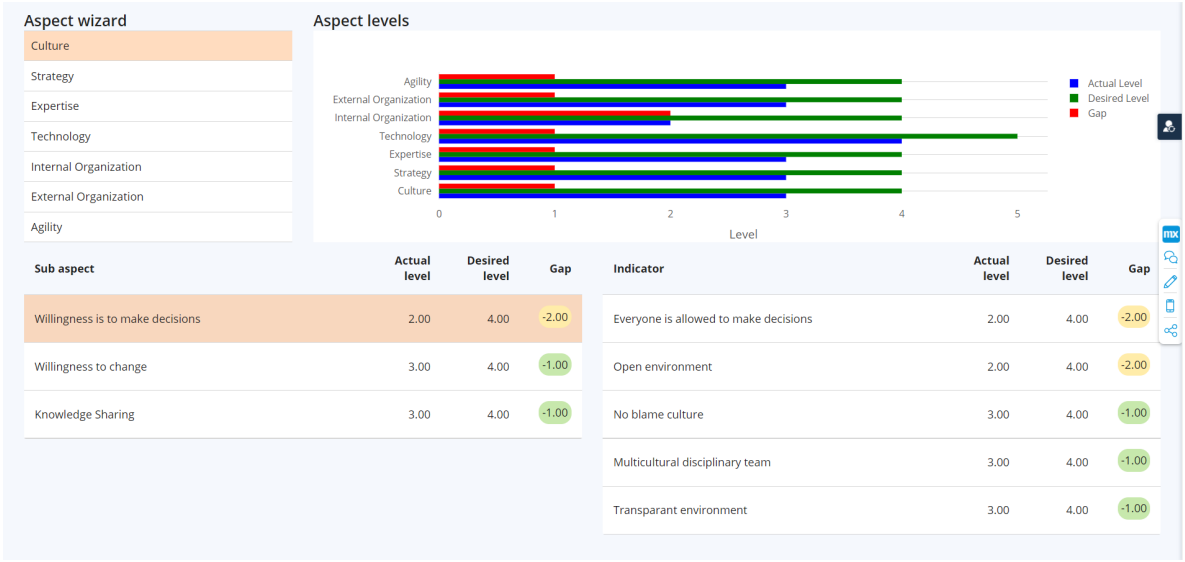


Figure 68: Case 2: Overview of the levels for the willingness to make decisions sub-aspect.

Figure 69: Case 2: Overview of the levels for the digital expertise sub-aspect.

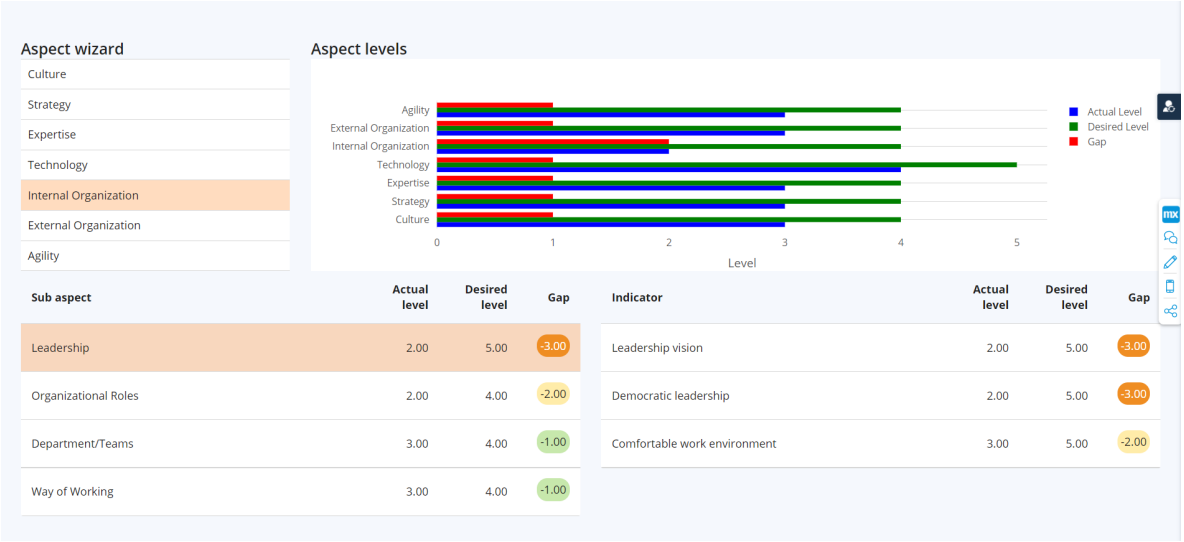


Figure 70: Case 2: Overview of the levels for the leadership sub-aspect.

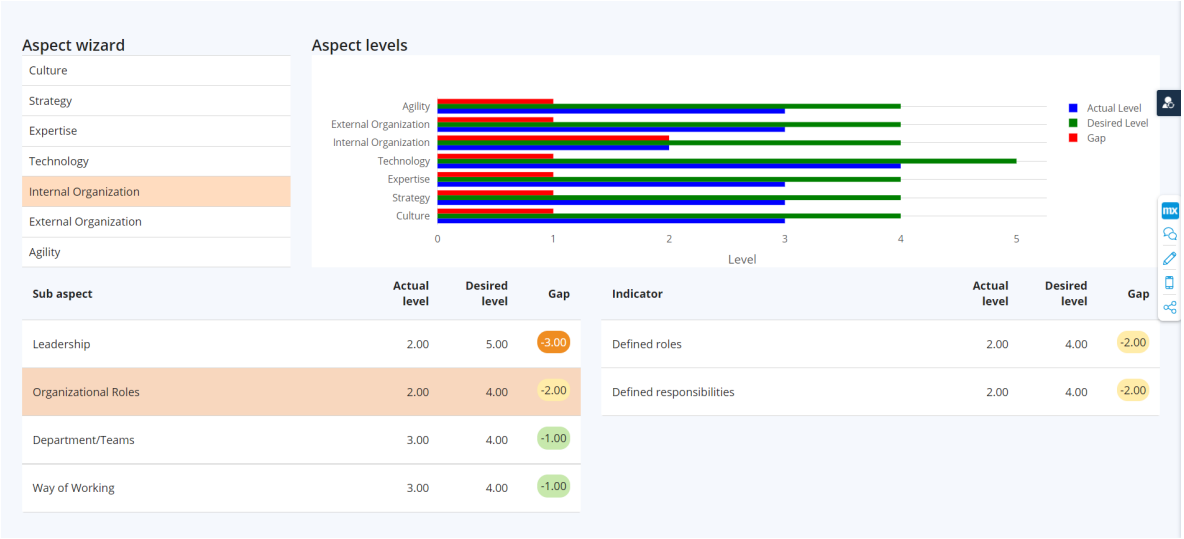


Figure 71: Case 2: Overview of the levels for the organizational roles sub-aspect.

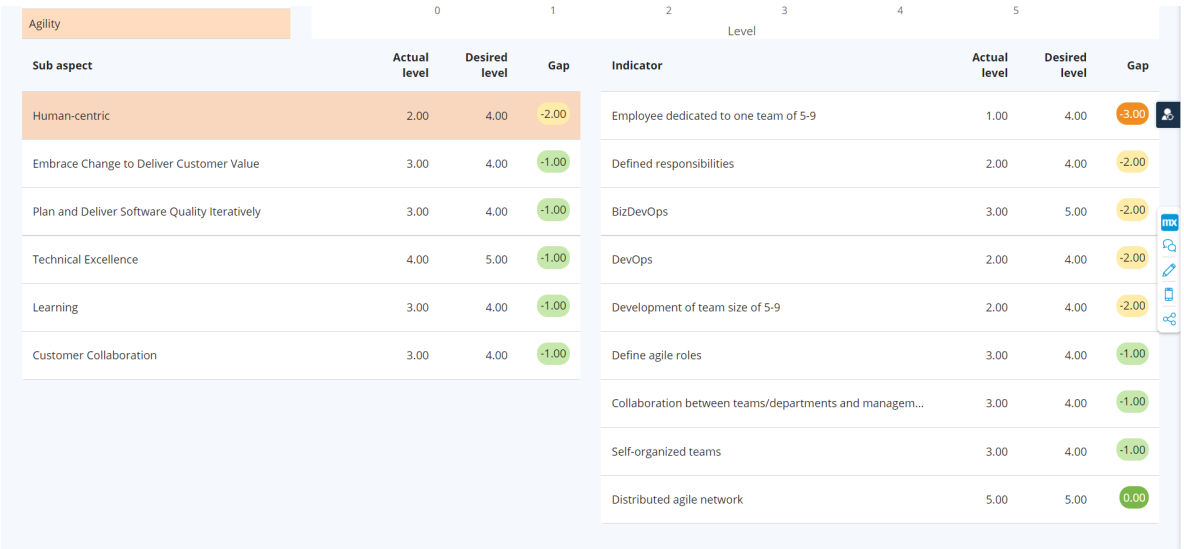


Figure 72: Case 2: Overview of the levels for the human-centric sub-aspect.