Identifying the different viewpoints and key elements of digital transformation

Master thesis work
30 credits, Advanced level

Product and process development
Production and Logistics

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Abstract

The saturation of markets due to globalization has caused a need for digital evolution of organizations to generate innovative manufacturing practices to assure sustained competitive capabilities. Even though technological capabilities have the impact to generate competitive capabilities strategic implementation is a must for optimal performance. The phenomenon of digital transformation and relating strategic efforts are subject to greatly varying viewpoints which has made it challenging for manufactures to engage with digital transformation. The purpose of the thesis is to decipher the phenomenon digital transformation and to further identify the vital aspects of approaching digital transformation strategies through analysing literature and manufacturing companies. In order to fulfil the purpose of this research project two research questions was formulated:

- RQ 1: Which are the crucial aspects of digital transformation?
- RQ 2: How should digital transformation strategies be approached?

This thesis is a part of digital transformation coordination project which include four industrial partners. The case companies were therefore set before the initiation of this thesis with including work packages. A literature review was performed to generate an understanding of the different viewpoints and to provide the case companies with an academic insight. Empirical findings were established through the gathering of data through observations during project meetings and the through the use of questionnaires. An analysis was conducted by comparing the different datasets.

Establishing a frame of reference were vital in understanding the scattered phenomenon of digital transformation. Through identifying the contents of Industry 4.0 subsequent digital transformation and related strategical efforts provided the thesis with a profound theoretical support.

The empirical findings provided the thesis with an understanding of how four different manufacturing companies viewed digital transformation. The different state of digital transformations was identified with additions to stating the possibilities and challenges.

The crucial aspects of digital transformation were found through analysing the different views and meanings of digital transformation, presenting technology, and organizationally driven digital transformation and finally the fundamental aspects of digital transformation. A sound approach for manufacturers to strategize digital transformation was found through analysing the key factors of digital transformation strategies and the current constraints of digital transformation strategies. Furthermore, a discussion of additional themes which does not apply to the research questions were found to be the cause of digital transformation disparity throughout the case companies and the communication of digital transformation.

The crucial aspects of digital transformation are found to be the identification of internal and external company objects that require a holistic, organizational changing continuous process. Which further utilizes the potential of novel disruptive technologies to develop novel business practices to generate value and competitive competences. A sound approach towards digital transformation strategies is suggested to be through generating a current state understanding to recognize the appropriate activities that must be performed and understanding the financial aspects of said activities and formulating them in a practical holistic way to assure adequate organizational support. Furthermore, understanding and communicating each strategical phase is vital to assure that the organizational aspects can support the digital transformation.

Keywords: Industry 4.0, Digital Transformation, Digital Transformation Strategy
Acknowledgments

This thesis was enabled through the great opportunity provided by the digital transformation coordination project as a whole. Upmost gratitude towards the research project as a whole for providing me with the great opportunity to perform this thesis project with you all.

Furthermore, great thanks for the knowledgeable support throughout the course of this thesis to the tutors at Mälardalen University. The communication with the tutor was a vital part of this thesis in his ability to provide clarity and guidance in times of confusion.

Great appreciation goes out to all the respondents of the questionnaires and to the research project participants who engaged in interesting discussion during the project meetings. They provided a vital insight to the complexity of digital transformation.
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1 Introduction

This section of the thesis introduces the reader to the Background which provides a contextual overview of the subject in which this thesis research as well as a Problem definition which further defines the challenges that exist within the research subject. Furthermore, the specifics of the thesis are stated within the Purpose and Research Questions followed by the identification of the scope throughout the Delimitations.

1.1 Background

The saturation of markets that came with globalization has created a demand for innovative manufacturing practices to gain a competitive edge (Gubán & Kovács, 2017; Ungerman, Dedkova, & Gurinova, 2018; Zhou, 2013). The development of manufacturing companies through scientific and technological innovation is vital to become competitive (Zhou, 2013). The globalized markets and technological innovations have created the circumstances for an industrial initiative to become more competitive called Industry 4.0 (Bal & Erkan, 2019). Industry 4.0 creates value through the potential business practices that are made possible through the various technologies that it encompasses (Adamik, 2019). The main technologies of Industry 4.0 are: Artificial Intelligence, Autonomous Robots, Augmented- and Virtual Reality, Big Data, Cyber Physical Systems, Cloud Computing and Digital Twin (Adamik, 2019; Frank, Dalenogare, & Ayala, 2019). However, gaining these advantages are a great challenge for companies that seeks to utilize the potential of Industry 4.0. What companies has to mainly overcome is the challenge of generating of a profound understanding of the needs of such transition towards a digitalized company (Adamik & Nowicki, 2018). Adamik (2019) states that even though the innovative technologies possess great potential, prerequisites for these technologies needs to be fulfilled through strategically transforming companies to become more digital.

Digital transformation has been defined in many ways and a consensus has not been established. Generally Digital Transformation refers to the optimization and transformation of business practices enabled through strategically combining digital technologies for optimal utilization (Schallmo, Williams, & Boardman, 2017; Vial, 2019).

Matt, et al. (2015) explain that it is common for all digital transformation strategies no matter what type of company or market it operates in are the four aspects of the use of technologies, transformation of value creating activities, structural change, finance. The extent of technology usage represents a company’s capability to utilize technologies to their benefit. Additionally, their approach towards new technologies as adopting new technologies has potential for competitive advantages but can also become a risk. The adoption of new technologies has the potential to transform companies value creating activities as the new technologies are implemented within the organizational structure and are often distinct from the traditional activities. To further fulfil the needs of the changing value creating activities the structure of the company has to change to whether it is changing processes, products, or workforce competence (Tillväxtverket, 2017). However, major structural change is mainly required if the transformed activities differ greatly from prior and have distinguished requirements. For the prior efforts to function financing is required to assure successful transformation to a more digital company (Matt, Hess, & Benlian, 2015; Tillväxtverket, 2017).

Chianias, et al. (2019) identified that even though the benefits as well as the threat of not digitally transforming has been identified as vital by 84% of global companies only 3% has shown to have implemented and performed a digital transformation. Furthermore, they state that this is often the situation for companies even though they see digital transformation as a key enabler for their future survival.

Digital transformation strategies have to be developed individually and unique for each manufacturing company who seeks to transform. Furthermore, best practices are defined which are of the applicable for organization. Thereafter, securing the performance of the strategical activities to ensure that it fulfils
the requirements of the company’s stakeholders and customer requirements. The roadmap is then finalized with an implementation of the digital efforts which results in designing of value-creation activities and a new digital customer experience (Schallmo, Williams, & Boardman, 2017).

The lacking nature of clearly defined all-encompassing digital transformation strategies stems from the uniqueness of companies and their needs. The result of this is often digital transformation strategies methods and techniques which possibly confuse companies’ efforts rather than steering them in the right direction. Value creation is also unique for every company which differs the relevancy of digital transformation strategies (Tillväxtverket, 2017).

The process of becoming a digitally transformed company is a challenging process which requires great effort. However, the benefits that can be gained are vast and will provide companies with possibilities of creating new business opportunities through a digital transformation which comes with complex challenges (Berghaus & Back, 2016).

1.2 Problem Definition
Research has identified the potential of essential benefits that are derived from performing a digital transformation (Earley, 2014; Matt, Hess, & Benlian, 2015; Schallmo, Williams, & Boardman, 2017; Tillväxtverket, 2017). This has also been the case when evaluating the digital transformation maturity of manufacturing companies (Berghaus & Back, 2016; Ifenthaler & Egloffstein, 2020; Tillväxtverket, 2017). However, it is also stated by researchers to further evaluate their findings to fully determine the constitute parts of a digital transformation often by validating their findings through implementation in case companies and analyzation by experts (Berghaus & Back, 2016; Charias & Hess, 2016; Ifenthaler & Egloffstein, 2020; Matt, Hess, & Benlian, 2015; Schallmo, Williams, & Boardman, 2017).

The research background on the topic of digital transformation presents a state where the best practices has not been determined broadly enough. Which as results in a situation where companies who seeks to digitally transform their business practices and strategies have great challenges to specify which steps, they should take to reach a digital transformed state. Therefore, this research project focus on evaluating digital transformation efforts in an industrial context through evaluating case companies’ efforts. Which will be analysed in relation to the current academic understanding of digital transformation to generate an understanding and identification of the constituent parts in a digital transformation as well as how strategical efforts are approached.

1.3 Purpose and Research Questions
The purpose of the thesis is to decipher the phenomenon digital transformation and to further identify the vital aspects of approaching digital transformation strategies through analysing literature and manufacturing companies. A sought-after outcome of the thesis is to identify the crucial aspects of digital transformation is to make the transformation more tangible for manufacturing companies. An additional goal is identifying the key elements of strategizing digital transformations in order to clarify how companies should consider and understand to strategize accordingly. To fulfil the purpose of this research project two research questions was formulated:

*RQ 1: Which are the crucial aspects of digital transformation?*

*RQ 2: How should digital transformation strategies be approached?*

1.4 Delimitations
The subject of digital transformation strategies has great possibilities to prosper in the future however the focus of this research project is on the current state. Therefore, a profound description of the current state and the best practices of digital transformation strategies be performed. Digital transformation strategies can be implemented in a wide variety of industries, but this research project will focus mainly on literature and theories that are applicable for manufacturing industries. The theoretical framework
will give a basis and will provide a context to the current state of the four industrial case companies. The empirical data that will be gathered solely from four case companies which will influence the findings of this research project as it will be affected by their business practices. Furthermore, the empirical data was gathered through project meetings with key individuals as well as questionnaires.
2 Research methodology

This section of the thesis presents the methodologies chosen by the researcher in the Research Approach. Followed by an introduction to the cases and the research project in which this thesis is a part of in Case Description. Furthermore, the methods that were used are in detailed described in throughout the section of Data Collection. Lastly the methods used to analyse the data that was collected is presented in the Data Analysis followed by a detailed description of how the quality of this thesis were upheld in the Research Quality segment.

2.1 Research Approach

This thesis is a part of a research project with prior defined objectives and a set of case companies which was the project partners. The approach used for this thesis was of a comparative design as a part of the qualitative approach used for the thesis as suggested by Bryman (2016), to sufficiently approach the multiple-case companies that are a part of the research project. The multiple cases will support the development of theories based on the number of cases that can be examined and compared, to additionally explore the validity of theories through the perspective of multiple cases. Contrasts and resemblances within the specific cases and in comparison, to each other within the research project as a whole will offer further opportunities to generate an understanding of causations through the unique or similar contexts of the individual cases companies. Which is a suitable research approach to fully understand the subject through the different sources, mainly the case companies which supplied the thesis with first-hand observation. Finding contrasts within the different data sources as well as between each other was a vital part of the thesis to both test existing theoretical findings and the empirical aspects found throughout the case companies based on the questionnaires and observations. The digital transformation coordination project required theoretical framework to provide an academic insight of the phenomenon digital transformation, which the literature review subsequently supplied the thesis with. To ensure that the findings of this thesis were generated from the comparisons and similarities found based on the data gathered an inductive approach was used to ensure that theories emerge from the data. The inductive approach was used instead of a deductive to ensure that any hypothesis found was not applicable to the subject area and the multiple-case companies, resulting in an unsatisfactory result (Bryman, 2016). Therefore, an iterative process was used to both enable the influencing of the different datasets and analysis throughout the research to ensure continuity. The research questions were defined to adequately respond to the research projects focus as well to be relevant academic literature of the subject digital transformation (Simons, 2009).

The research questions were developed to guide the thesis, and both enable the testing of existing theories and generating of new ones based on collected data. To reach the aim of this thesis data collection methods as literature review, questionnaires and observations were used (Bryman, 2016; Simons, 2009) to generate different sources of data to enable the development of deeper understandings and the analysis of multiple data sources. To further evaluate the phenomenon of digital transformation and consequent strategizing efforts the data collection methods was deployed at the case companies which is partners in the digital transformation coordination project. Which makes the cases suitable for this thesis since their interest, efforts and experience regarding the subject can help to develop further insight into the phenomenon. The different methodologies used to gather data for this thesis was used to uphold the quality of the research through triangulation which was used to diminish both the different weaknesses of each data collection method and to eliminate the potential internal biases that possibly may exist (Basu, 2010). The combination of gathering data from the different sources and through the different methods simultaneously and iteratively made it possible to generate a profound framework which enabled a comparative analysis which and ultimately aided the achieving the purpose of this thesis.
2.2 Case Presentation
The thesis as a part of a research project evaluates four research project partners, which for this thesis are the case companies A, B, C and D. The case companies all are manufacturing companies which have initiatives towards realizing their efforts of transforming their businesses.

2.2.1 Description of Digital Transformation Coordination Project
Digital developments are one of the largest global trends which changes society in various ways which present manufacturers and industrial companies with new opportunities and challenges. The current state of research regarding the impact of digitalization, digitization and digital transformation has not found a consensus regarding the definitions and descriptions varies (Vial, 2019). The aim of the digital transformation coordination project is to create an understanding of the challenges that comes with digital transformation and how to manage them. The coordination project mainly focuses on three digital transformation challenges found in an industrial context which correlates with research gaps. Three main challenges were identified:

- Designing organizational structures and working methods that support digital transformation and coordination of it
- Establishing a digital transformation strategy and roadmap from a production perspective
- Knowledge on the ability to coordinate the digital transformation in factory networks

The goal of the research project is through evaluating these challenges that exist in research industrial context is improving coordination of digital transformation efforts to further improve efficiency and competitiveness through utilizing new technologies throughout industrial networks. New technologies as stated as a part of the project goal are technologies which are novel based on if they are new to the company, market, or the world. Estimated results for the industrial company project partners are individually aimed frameworks for coordinating organizational structure, digital transformation strategies, roadmaps and more. The project’s focus on coordination of digital transformation distinguishes the project for its contemporaries since the focus of other projects often are on specific technologies, supply chains, value adding information management amongst others. The digital transformation coordination project will both have industrial and scientifical applications results.

The digital transformation coordination project is separated into three different work packages and this thesis work is linked to the second work package (Development of digital transformation strategy) with the focus on strategy for digital transformation. The case companies and research literature are analysed based on the contents of the second work package. The contents of the second work package are measures to designing digital transformation strategies through formulating tools for maturity assessments, strategical framework, and roadmaps.

Strategies are essential for success for companies which who seek to digitally transform to ultimately achieve a change from current state to target state. Digital transformation strategies set the fundamentals on how to achieve a digital transformation through roadmaps to perform the transformation with logical actions. To further establish a digital transformation strategy a current maturity assessment has to be performed to create an understanding of the capacity of the current infrastructure and knowledge to further understand which measurements that are required. The current state maturity assessment is of great importance to understand the gap between the current and the goal state. The main focus of this thesis project is a segment of the second work package which is performed in collaboratively with the partner companies which is the main enablers of this work package.

2.2.2 Introduction to the Digital Transformation Coordination Project Partners
The case companies included in this thesis are a part of the digital transformation coordination project which was established prior to the thesis’s inception. The partners of the projects are thereby the case companies of the thesis.
The case companies are four globally active companies which operate in different markets, one in the transportation which are presented in Table 1. The case companies state in yearly reports that their operations has been affected by the pandemic to varying degrees. 

Table 1 Presenting the Case Companies

<table>
<thead>
<tr>
<th>Case Company</th>
<th>Industry</th>
<th>Sales 2020 (SEK)</th>
<th>Number of employees with direct involvement throughout the research project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company A</td>
<td>Automotive</td>
<td>80 Million SEK</td>
<td>7</td>
</tr>
<tr>
<td>Company B</td>
<td>Automotive</td>
<td>208 Million SEK</td>
<td>8</td>
</tr>
<tr>
<td>Company C</td>
<td>Transportation</td>
<td>1.5 Billion</td>
<td>3</td>
</tr>
<tr>
<td>Company D</td>
<td>Industrial supplier</td>
<td>75 Billion SEK</td>
<td>4</td>
</tr>
</tbody>
</table>

The companies are all global but this thesis through the digital transformation coordination project has focused on the facilities in Sweden, however, global aspects and viewpoints are included since representatives from the partner companies have global as well as global positions. The context is therefore mainly focused on globally operating Swedish facilities who engage in digital transformation efforts locally and throughout their global networks. The case companies have expressed great interest in digital transformation and has had a part in formulating the scope of the digital transformation coordination project. Representatives mainly have manager, directors or team leader positions related to research and development, coordination, logistics and manufacturing. The case companies currently have, to varying degrees digital transformation efforts in place currently though are mainly described through different terminology. These efforts are performed both local and globally, however, the case companies have primarily presented locally bottom-up based efforts which often are often are in their initial steps. The local efforts are as presented by the case companies often supported or overseen by top-down directives which are often wide in the terminology and unclear in its execution.

In order to support the digital transformation coordination project and its partners with developing digital transformation strategies this thesis examines the partners´ digital transformation efforts and knowledge along with relevant prospects. Information was presented through the partners own presentation of their efforts during project meetings. Further data was additionally gathered through questionnaires which presented individual research project participants viewpoints of digital transformation and digital transformation strategies as well as their view of their company´s efforts.

2.3 Data collection
This thesis used a qualitative, inductive approach to research gathering, which assesses phenomenon through the explaining human behaviour which were applicable due to the subject area (Kanavours, et al. 2018). Therefore, first-hand viewpoints from the case companies were collected through various methods which supported the qualitative approach in combination with data collection methods used to establish a theoretical framework. Both structured and un-structured methods were used to capture the full scope of the phenomenon as was seen by the case companies through questionnaires and observations that was seen during meetings. As data collection is often seen as a key part of research (Bryman, 2016), choosing and utilizing adequate methods and performance was of great importance. The main source of data that was collected through the case companies were primary, as the data was provided specifically for the digital transformation coordination project and by extension this thesis. However, secondary data was also included in the form of presentations performed by the case companies to present their current state and efforts towards the focused phenomenon. Which enabled the use of both primary and secondary data analysis based on the different data sources collected (Bryman, 2016). The different data collection methods used presented a wide array of findings displaying differing findings which are importance to evidently present to assure the quality of the
research. Describing the various viewpoints found throughout the data collection methods enables the discovering of relationships and full description of the phenomenon as a whole more consistent with fair representation (Bryman, 2016). Therefore, different sources which related to digital transformation and strategizing efforts were included within the area that was subject to research.

The data collection for this thesis was performed between 2021-01 and 2021-5 through the methods: literature review, questionnaires, and observations.

2.3.1 Literature review
To support the thesis in evaluating the phenomenon of digital transformation and correlating strategizing efforts a literature review was conducted to establish a theoretical framework in which the empirical findings could be compared to. The function of the literature review was also to give the author of the thesis a more profound understanding to evaluate the empirical findings and the contents of the academic literature. The literature review includes the origin of the focused phenomenon of this thesis as well as recent academic findings to present a holistic theoretical framework (Bryman, 2016; Machado & Davim, 2020). The literature review provided a vital additional insight into the possible challenges and identification of prominent issues suggested by current academic literature which gave a broad understanding of the current state through various perspectives (Simons, 2009). Bryman (2016) also state that literature reviews provide authors with important insight and understandings of phenomenon’s current state, which concepts and theories has been applied, which research methods has been tested, the existence of controversial aspects exists and the main contributors to the subject. These aspects were of great importance to understand for the author since the relatively novelty of the research regarding the phenomenon and the possible impact that the influx of differing viewpoints has had of an effect on the academic current state. The literature review was initiated at the beginning of the thesis to generate an initial understanding based on academic literature regarding the phenomenon. Since the digital coordination project had defined work packages the subject of the thesis was already set, and initial open research questions were formulated to help frame the study. The research questions also provided a foundation for the key words used to scan for relevant academic literature. Some of the main keywords used were “digital transformation”, “digital transformation strategies”, “Industry 4.0”, “digitalization”, “digitization” and “organizational transformation”. The keywords were used to find relevant academic literature for the thesis, however substitutes were used to fully scan the data bases used due to the differing terminology that the phenomenon is prone to be subject to. Different combination of the key words was also used to find a broad spectrum of academic literature and with different focuses based on the research questions. The main databases used for the literature review were Scopus, ScienceDirect, SpringerLink, Mälardalens University library and additional comparable contemporary databases. Other complementary databases were used as Google Scholar as a substitution when full articles were not available at the primarily used database. Google Scholar was also used as a tool to Cite Reference Search which is a technique suggested by Bryman (2016) which seeks to further identify how contemporary academic literature view well cited articles to further support the findings.

After the academic literature was gathered through the databases by using the keywords in different arrangements the articles were screened. The screening process started with eliminating duplicates. Then further steps were made based upon their characteristics to ensure relevance to the thesis. First a limitation was set to 10 years to assure that only articles of recent findings were used due to the novelty of the research area. Academic literature with focus on disciplines as process development, production and organisational and business change were of priority, however exceptions were made based upon the article’s relevancy. Highly cited articles were of priority to assure that the contents of the articles were of importance. However as suggested by Vissak (2020), articles were not only chosen based upon the number of citations rather the relevancy of the content was of the highest priority. The established reference articles were then subject to backward reference and forward reference search to further establish relevancy. Furthermore, the abstracts with focus on the findings were screened at first to see the contents of the academic literature at first glance to further place the academic literature in themes.
Then analytic readings of the articles were made to further evaluate the relevancy and to identify subsections into specific themes and subthemes that were suitable and where other academic literature found similarities or differences. The most significant sections of the articles were extracted and gathered in an external excel document where the themes and subthemes were placed to uphold an initial structure. Which resulted in approximately 65 academic literature containing research articles, books, and conference papers. Commonalities in academic findings and terminology were further identified to navigate the phenomenon of digital transformation more effectively. The theoretical framework was then written iteratively, with the emerging and diminishing of priorly suggested themes to present the literature review more naturally with insights from the empirical findings. The theoretical framework was then subject to analysis in addition to analysis with the empirical findings.

2.3.2 Observation
The observations made to gather empirical evidence throughout the thesis was performed during the digital transformation coordination project meetings with all participating case companies. These first-hand information gathering instances for the researcher gave the opportunity to evaluate the understandings of individuals and groups through observations. The focus of an ai is the generating of an understanding through focusing on key components of activities that groups and individuals perform (Leydens, Moskal, & Pavelich, 2004). The project meetings were of semi-structured nature to enable the opportunity for discussion and interesting discourse regarding digital transformation. Two meetings were set during the duration of the thesis with different purposes with all industrial project partners present. The agenda for the different meetings were set by the research partners of the project which was also the tutor for the researcher of this thesis. For the first meeting the research partners presented the aim and subject areas of the research project with the different work packages, scope and the next steps that were to be performed. From there on the different industrial project partners presented their current state including current projects, perspectives, goals, and challenges. The meetings were in a semi-structured form to let the different partners freely discuss the topic. The first meeting was performed at the initial stages of this thesis and were also of the initial steps of the digital transformation coordination project which generated a situation where a demand for additional knowledge were clear. The second project meeting where the different partners were gathered was also set by the research partners of the project. An agenda based upon a questionnaire and the theoretical framework was presented. This meeting was also set to stimulate discussion based upon the questionnaire answers which was also presented in comparison to a theoretical framework to generate insight and opinions from the industry project partners. Observations were made throughout the meetings that were two hours each which existed of presentations made by the industrial partners, but the most important observations were found throughout the partners discussions where the thesis researcher was passive. The discussion enabled a greater understanding of the case companies’ perspective based upon their different companies that they work for and how their perception of digital transformation compares to each other. The meetings made it possible for the researcher of this thesis to find contrasting opinions and more elaborate answers to complement those of the questionnaires. The meetings were also recorded which let the thesis researcher to review the different meetings repeatedly to further evaluate and facilitate the findings based on the observations. The two project meetings where two hours each with a 10 min break halfway. This was suitable for the thesis as observations are mainly used to favour qualitative research approaches in generating an intensive understanding of the different cases of a case study (Bryman, 2016).

2.3.3 Questionnaires
To gather an understanding regarding the subject phenomenon of this thesis a questionnaire were sent out to all industry project partners. The method of questionnaire that was utilized for this thesis were self-completion questionnaire through e-mail (Bryman, 2016). The method of questionnaire was used to enable data collection by all the different industry project partners effectively through sending it with the possibility to forward the questionnaire throughout their companies. The questionnaire (see appendix) was used to gather the different perspectives of the research subject that case company employees have. Enabling the retrieval of perspectives from various positions were important to
generate varying understandings. The questionnaire was designed with the tutor of this thesis, which is also one of the main research partners of the project. The questionnaire was designed with open questions to enable a wide array of answers and to avoid insinuating that there were any right answers (Cohen, Manion., & Morrison, 2000). However, the open questions of the questionnaire may have negatively impacted the response rate due to the complexity of the subject which it requires to be fully evaluated (Bryman, 2016; Cohen, Manion, & Morrison, 2017). The importance of the questionnaire was to establish a current state regarding digital transformation and strategizing efforts for the industry side of the research project to understand how to continue the project. It was of importance to gather many opinions for each company to not seek a holy grail of questionnaire respondent which could have all the right answers. This further generated a more realistic and complete picture of the industry’s view on the subject phenomenon. Communication to clarify some contents of the questionnaire were conducted based upon some questionnaire respondents’ requests. The positions in which the questionnaire was initially sent out to were:

- Technical Lead Manufacturing IT
- Director Regional IT & Central Services
- Team Lead, Manufacturing IT
- Manager Reliability & Future Factory
- Process & Manufacturing Development Manager
- Production & Logistics Developer
- Head of Industrialization and Manufacturing Engineering
- Manager Manufacturing Technology Development
- Director Process & IT Operations
- P&IT Local & Regional Manager
- Global Research & Development Technical Director
- Manufacturing Engineer
- Technology Transformation Manager

The data collected from the questionnaires were handled anonymously with some references to the specific positions of the questionnaire responder. The total amount of questionnaire responses for each research project partner were A: 4, B:5, C:4 and D:5 totalling in 18 responses. The evaluation processes of the data collected was performed through identifying themes on different levels. Initially a project wide level was set with its subthemes to identify the different understandings of the subject phenomenon. Furthermore, internal company comparisons and commonalities were identified to further understand how the phenomenon is understood in different contexts.

2.4 Data analysis

To analyse the data which was retrieved through the data collection methods required structure to adequately be analysed. The literature review based on 70 academic articles, the observations from the meetings and the questionnaire responses generated a body of data in which themes were identified within. Establishing relevant data analysis methods are vital in achieving relevant results for research and therefore adequate analysis methods are required (Cohen, Manion., & Morrison, 2000). Coding as a method of scanning and understanding data is commonly used for research with qualitative approach methods (Bryman, 2016). A coding method were used to determine themes on different levels, the representation of data, which challenges the data may suggest, critical events found throughout the data and more. The coding process was initiated by reviewing the theoretical framework, observations, and questionnaire responses to identify fundamental themes. The initial themes were established based upon the priorly developed research questions to assure that continuity and that relevant findings were established. The individual dataset based upon their retrieval methods were scanned and coded. Which was a process that was continuously repeated. The establishment of the different datasets were performed throughout the process of this thesis. Data was retrieved continuously for the theoretical
framework whereas the data collected through observations were focused during the two project meetings. The questionnaire was responded during a space of time in which the contents were analysed continuously through coding methods. This method of continuously collecting data made it possible for the different data sets to affect and form each other to further ensure continuity and relevance to each other.

The academic literature which was the foundation of the theoretical framework were analysed to identify commonalities based on their findings and structures. Essential aspects of each academic article were identified and subject for coding. The observation as well the coding methods used for the academic literature were found based upon the setting of each meeting and its specific contents. The initial steps of analysing the data collected through the questionnaire were coding through identifying themes which initially originated based upon the questionnaire questions. Subsequent steps for all data sets were the identification of underlying themes and connection to the other datasets. The initially identified themes where then further analysed to determine the relevancy of its contents and its possible connections to other themes and subthemes. Themes where then sorted based on their correlating or contradicting contents in relation to other themes. An analysis was then conducted where all the contents from the different datasets were presented to generate a full inclusive analysis of digital transformation and digital transformation strategies to reach answers to the research questions. Key findings made through the theoretical framework was utilized as an foundation for analysis to assure that the different datasets where fully cross analysed.

2.5 Quality of research
To assure that research uphold standards establishing quality through increasing the validity and reliability are of great importance. Therefore, this thesis focused on establishing internal and external reliability to assure that the thesis was trustworthy. Increasing the validity of a research focuses on the integrity, through establishing internal and external validity. Internal validity refers to the quality in which the relations between the researchers understanding of a research phenomenon and the findings in which the researcher proposes. Qualitative research methods are often seen to have good internal validity based upon the duration of the research being conducted assuring that researcher develop a consistent understanding of the subject area (Bryman, 2016). The internal validity was assured through this thesis based upon the different data collection methods used under a prolonged time, giving the researcher a profound understanding of the phenomenon resulting in consistency throughout the research. External validity refers to the applicability of the findings of a research to a general level, which in the case of qualitative research can be a challenge based upon the number of cases that are observed. The concerns regarding the ability to increase the thesis external validity due to the qualitative methods used the research questions were designed at a general level to assure that the findings are of value on a general level. The internal processes at the case companies were generalized to assure that the specifics of each case did not affect the general nature of this thesis findings. Furthermore, a wide array of theoretical findings was used and cited to assure that a small array of viewpoints was not used. Connections found throughout the data gathered from the case companies and the theoretical frame work were established to further facilitate the external validity through assuring that the findings were concluded based on various sources of data.

A high level of reliability assures that research that has been conducted can be repeated based upon the methods presented by the researcher. The level of reliability of research can be evaluated and established internally and externally. External reliability for qualitative studies is often challenging to establish based upon the unique situation the cases are existing in. The establishment of repeatability and in extension reliability a clear context description and the methodology used throughout the thesis were presented. Internal reliability refers to the ability of researchers to evaluate a topic at hand through finding similar understandings of the same phenomenon and that observations made are agreed upon. This thesis had a single researcher however a close collaboration with the thesis tutor throughout the activities conducted was enabled through the context that the tutor was also a part of the research project.
Furthermore, due to the context of the researched phenomenon that was a main part of the research project the tutor performed similar data collection methods and evaluated the questionnaires. The researcher of this thesis and its tutor then evaluated their findings and found similar conclusions regarding the data sources (Bryman, 2016)

Establishing a fully developed scope of a subject are often done by researchers through triangulation. Triangulation refers to the usage to multiple data collection methods to fully support the research by diminishing the possible weaknesses that some data collection methods have. The possible negative aspect of the response rate of the questionnaires were diminished by the observations made during the meetings (Cohen, Manion., & Morrison, 2000). The different data collection methods created different viewpoints to base evaluation and analysis of the subject phenomenon on. The use of triangulation further diminished the preconceived opinions of the researcher by presenting multiple datasets which gave different viewpoints on digital transformation and coexisting strategizing efforts.
3 Frame of reference

This section of the thesis presents a theoretical framework by providing a thorough presentation of the subjects Industry 4.0 and Digital Transformation. The current state of the latest industrial revolution and its contents are presented under the heading Industry 4.0. Furthermore, the state of academic literature regarding efforts towards defining transformations that companies undergo are presented under the heading of Digital Transformation. Finally, the different strategical efforts to digitally transform that has been conducted and academic viewpoints are presented under the heading of Digital Transformation Strategies.

3.1 Industry 4.0

Industrial companies have digitalized their operations since the 1970s to gain a greater understanding of processes and to gain competitive capacity. However, main digital efforts have resulted in one-directional communication with a low level of integration between operational technologies and information technologies (Isaksson, et al. 2018). Maghazei, et al. (2017) found through their literature review that potential factors may be unseen for manufacturing companies which seeks to transform during the current industrial revolution. They historically evaluated the implementation efforts of novel technological practices by manufacturing companies. The findings furthermore facilitated that the overall trend for transformation is performance improvements but the during the latest century the implementations were impacted by unanticipated. Isaksson, et al. (2018) identified that the latest improvement regarding data generating, data handling, computing power and communication infrastructure has opened up the possibility to revolutionize industries through digital means (Isaksson, et al. 2018). The improvements and affordability of digital capabilities and internet technologies has led to the era of Industry 4.0 (Gürdür, et al. 2019; Short, et al. 2019). Industry 4.0 also has the possibility to support the efforts working against global challenges such as, resource scarcity, energy usage and societal changes (Horváth & Szabó, 2019; Pfeiffer, 2017). The conceptualisation of a new industrial revolution has its origin in Hannover Messe 2011 at an Industrial trade fair where the term Industry 4.0 was coined (Luthra & Mangla, 2018; Pfeiffer, 2017). Industry 4.0 is considered revolutionizing based upon its capabilities of forming smart factories and changing the way work is conducted. Additionally, it allows for application of information technologies in supply chains and products product-lifecycles (Frank, Dalenogare, & Ayala, 2019). This statement is further affirmed by Luthra, et al. (2018) as they claim that the latest industrial revolution has the capability to impactfully change the business practices of manufacturers throughout their business practices. Thun, et al. (2019) identified that the potential of Industry 4.0 is vital for the survival of northern European manufacturing companies as it will uphold the competitive capabilities through the novel business opportunities it enables. However, they emphasise that the benefits will only be reached through adopting the newly developed industrial technologies while also modifying their organizational structure.

Neumann, et al. (2021) stated that manufacturing companies has to undergo fundamental organizational changes to fully establish the applications of Industry 4.0. Which they further insinuated that the changes and its implications has unforeseen outcomes where they call the consequences of Industry 4.0 as a possible “black box”. The varying impacts of digitalization is also challenging to accurately forecast as Horváth, et al. (2019) articulate the impact that automation can put on existing jobs where more than a quarter of jobs are of high risk. Both Pfeiffer (2017) and Thun, et al. (2019) sees that the focus of the digital transformation towards smart manufacturing and Industry 4.0 needs to be on the empowerment and development of shop floor operators as they will be the crucial enabler for a successful transformation. Neumann, et al. (2021) further facilitates this point when stating that “There are no engineered systems without humans. Humans cannot be re-engineered, so designs must be made to suit them.”, a synergy between the technological systems and their operators therefore are a prerequisite for
Industry 4.0. To further highlight the many possibilities and hurdles of digitally transforming a manufacturing company into an Industry 4.0 state Ghadge, et al. (2020) verbalize the digital transformation struggle: “executives need to revamp their understanding and attitude to Industry 4.0 by considering both their driving forces and barriers for Industry 4.0 implementation.”. Organizing oneself’ s business practices for Industry 4.0 through digital transformation is a challenging task according to Neumann, et al. (2021) and they also state indicate that there is no single best way for manufacturing companies, and they need to find their own way.

3.1.1 Industry 4.0 Technologies
The latest wave of increased digitalization efforts that has made the latest industrial revolution possible are mainly supported by the technologies and methods that has been developed for industrial application (Frank, et al. 2019; Yli-Ojanperä, et al. 2019). The goal of the enabling technologies of Industry 4.0 is to digitally transform the facilities of manufacturers and global systems through creating networks where the most elements can possibly be connected. This is to further enable the communication and data gathering processes to enable the creation of novel business practices (Ghadge, Kara, Moradlou, & Goswami, 2020; Kiel & Voigt, 2017; Pfeiffer, 2017). The business practices that are most often attractive for manufacturers are the enhancement regarding highly customized products, real-time communication, enhanced visibility, autonomy in design and processes monitoring and overall efficiency in production and development (Ghadge, Kara, Moradlou, & Goswami, 2020). However, to fully engage with the enabling technologies of Industry 4.0, manufacturing companies are required to find their own applications because of the uniqueness of their current state and future plans. Another challenge is the lack of a clear consensus on how to approach the technologies are not fully established (Neumann, et al. 2021). Veile, et al. (2020) sees the trend of developing and implementing digital technologies in combination with organizational rearrangements as a way of achieving a state of smart factories which will further enhance the value creation capacity of manufacturers. Rüssmann, et al. (2015) identified that there are nine technological pillars that enables digitalization and smart factories which are autonomous robots, simulation, horizontal and vertical system integration, the industrial internet of things, cyber security, the cloud, additive manufacturing, augmented reality, and big data analytics. They further state that some of the founding technologies of Industry 4.0 is already in industrial use but the in combination with the other Industry 4.0 technologies they will revolutionize the industrial sector.

3.1.2 Industry 4.0 in practice
The different technologies in which Industry 4.0 includes can all be implemented individually but also in various combination to strive towards synergy-oriented benefits, however, the precise effect of such combination is still unclear (Büchi, et al. 2020). Frank, et al. (2019) presents a somewhat conflicting statement through declaring that combinations of digitalisation technologies should be focused on to achieve possible positive synergy effects. In addition to the statement, they purpose that systematic thinking is of great importance when strategizing towards which technologies should be implemented since literature indicates that the implementations impact can fluctuate.

Achieving a digitalised manufacturing is a great challenge and fully realizing the manufacturing concept Industry 4.0. The challenging nature of Industry 4.0 is often related to the changes and prerequisites that are often required for a successful implementation. Manufacturing companies as a whole have to undergo, modified processes and management, increased authority for operators and organizational structural changes (Thun, et al. 2019). Successfully achieving a state where Industry 4.0 practices can be implemented requires strategical efforts and understanding the possible barriers related to digitalization is of great importance for success (Da Silva, et al. 2020). Expanding on the point of barriers related to Industry 4.0 implementation both Da Silva, et al. (2020) and Raj, et al. (2020) identified that
the most crucial barriers relate to financing, managers and operators lacking in relevant competence, shifting organizational structures and insufficient infrastructure.

The investments required for achieving Industry 4.0 put manufacturing companies in a situation where existing strategies has to shift in order to support the transformation. Investing only in technologies are highly insufficient because other internal aspect of manufacturing companies also requires investments such as infrastructure, innovations, training, and processes. However, it is also of great importance of investing and developing a supply chain which supports Industry 4.0 initiatives, otherwise opportunities will be lost, and other barriers will present themselves (Da Silva, et al. 2020; Raj, et al. 2020). Raj, et al. (2020) further state that the rigorous financial aspect of Industry 4.0 often deters investments towards developing Industry 4.0 practices. Additional hindrances related to the financing aspect of Industry 4.0 stems from the uncertainty in how return of investment performance of novel technologies which is coherent with previous investment dilemmas. Pfeiffer (2017) expands on the latter point that when examining the methods often used for predicting the value of Industry 4.0 investments can often be described as “black-box prognoses”.

Even if manufacturers successfully implement the fundamental practices of Industry 4.0 into their processes, they still require operators and managers who have the competence to utilize the technologies. This is a widespread barrier amongst manufacturers and can therefore act as one of the first barriers for implementation since it can deter collaborative opportunities with service supplying partnerships. Establishing an educated and capable workforce should therefore be a top priority for manufacturers if they want to initiate a shift towards Industry 4.0 (Raj, et al. 2020). Without implementing supportive effective support systems for operators, they cannot fulfil their potential. Even highly motivated employees cannot perform effectively without the right information. This is of great importance since operators hold great responsibility for the reason that the future of manufacturing requires operators with more authority which can take on the tasks that managers currently perform (Lall, et al. 2017; Thun, et al. 2019). However, Thun, et al. (2019) found that the technologies of Industry 4.0 primarily are designed for managers instead of operators who potentially will hold the responsibility of ensuring performance. Additionally, this has created a situation where managers report a higher level of satisfaction and receptiveness towards digitalization. To overcome this challenge Raj, et al. (2020) and Agostini and Filippini (2019) suggest that cultural changes is necessary to ensure that internal employee related implementation barriers are mitigated, and training of existing employees is possible and collaboration with external experts are not hindered.

One of the main measurements to manage organizational linked barriers is rearranging the hierarchical structure. This is important due to the level of understanding that operators will require in an Industry 4.0 context. Hierarchical levels need to flatten in order to achieve a more opportunities for authority and decision making (Agostini & Filippini, 2019). Manufacturing companies who seek to digitalize in the Industry 4.0 era should therefore have an organizational structure which support decentralized decision making and should also be innovation stimulating. If manufacturing companies make these changes, they will be able to transition from the traditional automation pyramid into a decentralized cyber-physical system-based automation (Misita & Milanovic, 2019).

Manufacturing companies will often find themselves in a situation where their digital and physical infrastructure is insufficient if they want to implement Industry 4.0 practices. Investments in technologies and systems will be required to support the concepts of Industry 4.0. Enhancing of the internal infrastructure may not be enough as supply chains’ infrastructure need to develop to avoid barriers which may affect the performance of Industry 4.0 based business practices (Da Silva, 2020). Along those same statements Raj, et al. (2020) state that digital infrastructure and high-speed broadband
are the main factors regarding infrastructure and the scarcity has forced collaboration to secure developed infrastructure to support Industry 4.0.

Supply chains will be impacted and redefined by the practices of Industry 4.0. The systems used to uphold supply chains will become more efficient in forecasting, traceability, real-time communication, and intelligent logistics. Industry 4.0 enhanced supply chains become smart and will generate a digital platform which connects, suppliers, retailers, consumers, and partners to develop a synchronistic collaboration which becomes more cost effective and efficient (Ghadge, et al. 2020).

Hamdy, et al. (2018) and van Geest, et al. (2021) suggest that smart warehouses will be made possible in the future through the utilization of Industry 4.0 practices. A smart warehouse concept supported by IoT is presented by Hamdy, et al. (2018) where real-time monitoring, data analytics and enhanced decision-making support is achieved. The main differentiating elements of smart warehouses are the usage of Automated Guided Vehicles (AGV), IoT tracking and traceability, Robotics along with AR and AGV facilities picking processes, AGV used for transporting goods inhouse and finally communication networks which enables transferring of information. Smart warehouses present advantages which are enabled through digitalisation technologies are real-time communication, traceability, scalability, automated decision-making, responsiveness towards change and monitoring of key process to assure minimum waste (Van Geest & Tekinerdogan, 2021).

Industry 4.0 will also have the capability to improve the sustainability aspect of manufacturing through implementing its technologies. Sustainable processes such as remanufacturing will be enhanced by the capabilities of IoT, virtual reality and AR but a greater understanding is required for these to optimally perform (Kerin & Pham, 2019). Circular economy and business sustainability is also supported by Industry 4.0 technologies according to Nascimento, et al. (2019) as reincorporation of used products is made possible through internet technologies, reverse logistics and Additive Manufacturing which minimizes the total consumption of manufacturing processes.

The concept of Industry 4.0 is still relatively new the practices that the concept includes still have the opportunity to change existing business practices and create innovate new ones for manufacturing companies (Wolfschlaeger, et al. 2017).

3.2 Digital transformation.

Information technologies and information systems has been the cause of transformation for companies through the novel methods information can be processed and utilized (Heilig & Voß, 2017). Regardless of the sector that companies operate in, all companies strive towards providing their customers with better performing and more satisfying products and services. The power of digital applications to support products and services has great potential to transform business models of a wide range of sectors. The transforming efforts of companies’ business models into a more digital capable one is often referred to as digital transformation (Schallmo, et al. 2017; Warner & Wäger, 2019). Digital transformation is of vital importance for companies, without adequate preparation and adapting efforts for novel technologies companies may find them going out of business due to the competitive state of markets. Even if understanding the implication of the technological aspects of digital transformation is of importance readying companies for strategical and organizational shifts are also crucial (Ismail, et al. 2017). Nambisan, et al. (2019) further explain that the development of digital applications, platforms and infrastructure has a greater impact than just generating novel business opportunities for manufacturers and service providers but because of its potential fundamental impact on businesses.
Ibarra, et al. (2017) identified that research expanding the knowledge regarding digital transformation has increased, however researchers has proposed several varying coining of transformation efforts of companies: Industry 4.0, Smart Manufacturing, Industrial Internet, intelligent manufacturing, advanced manufacturing, Integrated Industry, Smart Industry and Smart Factory. The state of differing descriptions on the subject of digital business strategies is further explored by Schallmo, et al. (2017) and Tillväxtverket (2017), where they found that there is a lack of clear consensus and clarity, however one of the causes was found to be a consequence of the relatively young state of the research subject.

Research expanding on the subject of digital transformation has generated several varying definitions, but similarities can still be found in the overall focus on organizational aspects, the use of technologies however the specifics may differ, and the phenomenon of transformation of entities often differs in scale (Vial, 2019). To define digital transformation more specifically, Mergel, et al. (2019), Morakanyane, et al. (2017), Schallmo, et al. (2018) and Vial (2019) saw that certain properties and dimensions was found to be fundamental in the overall digital transformation definitions of the research subject. Through interviewing 40 digital transformation experts Mergel, et al. (2019) identified four fundamental dimensions of defining digital transformation, firstly the reason for deploying digital transformation, secondly the object of the digital transformation, thirdly the process and approach towards digital transformation and lastly the perceived effect of a digital transformation. They further state based on their definition of digital transformation that it is a transformation processes that is more holistic than digitizing processes and services. Through analysing the current definitions of digital transformation Morakanyane, et al. (2017) identified that they are often conceptualized based on what the digital transformation is, the characteristics, how digital transformation are driven, the impacts and finally which entities the digital transformation affects. Similar findings of digital transformation definitions were found by Schallmo, et al. (2018) who present the components of digital transformation as what is the initial objective of the digital transformation, how will the digital transformation be performed, what is the scope of the digital transformation, how is the digital transformation novel and finally which entities are the subject of the digital transformation based on the current state of digital transformation definitions. Additionally, Vial (2019) identified the essential properties of digital transformation definitions as target entity, scope, means and expected outcome based on systemic analysing the current state digital transformation definitions even though definitions are often unclear and scattered.

To further analyse the digital transformation definitions and descriptions of the current state of research the properties identified by Vial (2019): target entity, scope, means and expected outcome will be utilized to determine the components of the identified definitions and descriptions in Table 2. The definition properties found by Vial (2019) will be used since the properties are encompassing due to the differing definitions which was used as a foundation for the analysis and therefore can be applied widely. It is highly appropriate to utilize definition properties which are broadly applicable properties due to the nature of highly differing subject of digital transformation definitions. The definitions and descriptions of digital transformation were chosen based on their relevancy to the subject of digital transformation efforts and that they should preferably be clearly stated by the authors themselves. Exceptions were made due to the relevancy of the definition or description to the subject of digital transformation.

*Table 2 The definitions of digital transformation*

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition as stated by the source</th>
<th>The properties of digital transformation definitions (Vial, 2019):</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>- Target Entity (TE)</td>
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<tr>
<td></td>
<td></td>
<td>- Scope (S)</td>
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<td>- Means (M)</td>
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<td></td>
<td></td>
<td>- Expected Outcome (EO)</td>
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<tr>
<td>Source</td>
<td>Definition</td>
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<tr>
<td>Vial, (2019)</td>
<td>“a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies”.</td>
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<tr>
<td>Schallmo &amp; Williams (2018)</td>
<td>“For the purposes of this book, we define digital transformation as a sustainable, company-level transformation via revised or newly created business operations and business models achieved through value-added digitization initiatives, ultimately resulting in improved profitability.”</td>
<td></td>
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<tr>
<td>Morakanyane, et al. (2017)</td>
<td>“an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value”</td>
<td></td>
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<tr>
<td>Reis, et al. 2018</td>
<td>“Therefore, we define Digital Transformation as the use of new digital technologies that enables major business improvements and influences all aspects of customers’ life.”</td>
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<td>Ismail, et al. 2017</td>
<td>“We define it as the process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system). “</td>
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<tr>
<td>Heilig, et al. (2017)</td>
<td>“For ease of exposition we use the term digital transformation to exclusively refer to these transformations. Currently, enablers of digital transformations include novel delivery models (e.g., cloud computing), pervasive computing</td>
<td></td>
</tr>
</tbody>
</table>

- (TE) Any given entity
- (S) Significant changes
- (M) Digital capabilities enhancement technologies
- (EO) Achieving a change to the target entities of the transformation and improvement

- (TE) Company controlled entities
- (S) Incremental and radical depending on the current state and the novelty of what digital transformation encompasses
- (M) Digitization
- (EO) Profitability

- (TE) Business models and operational processes
- (S) Evolutionary steps to eventually achieve radical change
- (M) Digital capabilities and technology
- (EO) Value

- (TE) Business models
- (S) Training and digitally shifting organizations
- (M) New digital technologies
- (EO) Efficiency and customer satisfaction

- (TE) Operational and business model aspects of companies and customer aspects.
- (S) Overhaul of business dimensions affecting products and services, processes and decision-making, skills, talent and culture as well as the complete value system
- (M) Digital technologies
- (EO) Superior performance and competitive advantage

- (TE) Business entities
- (S) Changing of current practices with addition of implementation of novel practices.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Description</th>
<th>TE</th>
<th>EO</th>
<th>SM</th>
<th>M</th>
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<tbody>
<tr>
<td>Shahi &amp; Sinha, (2020)</td>
<td>“Based on the above result and interpretation of the responses, Digital Transformation can be defined as transforming various business aspects such as operations, functions, processes to generate value for all the stakeholders of the business, bringing in measurable KPIs, SMART goals and vision for operations, monitoring and outcome by using current digital technologies.”</td>
<td>(TE)</td>
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<tr>
<td>Van Veldhoven &amp; Vanthienen, (2019)</td>
<td>“Digital transformation is the continuously increasing interaction between digital technologies, business, and society, which has transformational effects and increases the change process’s velocity, scope, and impact.”</td>
<td>(TE)</td>
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<tr>
<td>Mergel, et al. (2019)</td>
<td>“Digital transformation is a holistic effort to revise core processes and services of government beyond the traditional digitization efforts. It evolves along a continuum of transition from analog to digital to a full stack review of policies, current processes, and user needs and results in a complete revision of the existing and the creation of new digital services. The outcome of digital transformation efforts focuses among others on the satisfaction of user needs, new forms of service delivery, and the expansion of the user base.”</td>
<td>(TE)</td>
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<tr>
<td>Zaoui &amp; Souissi (2020)</td>
<td>“This paper defines it as a new development model that calls for redefining relationships between companies, their stakeholders, and clients and reviewing previous approaches to offering services and products [2] as companies undergo multidimensional transformation”</td>
<td>(TE)</td>
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</table>

(M) Information technologies and solutions and trends
EO) Competitive advantage, data handling capabilities and transformation enhancement.
- (S) Evolving existing entities
- (M) Current digital technologies
- (EO) Value for all stakeholders.
3.2.1 Formulation of digital transformation definitions

The process of defining and conceptualizing digital transformation may be a challenge due to the nature of the scientific field of digital transformation, however, patterns, contradictions and commonly used terms can be found (Morakanyane, Grace, & O’Reilly, 2017; Van Veldhoven & Vanthienen, 2019; Vial, 2019). Through analysing the current state of digital transformation research and finding the challenges to then formulate systematically based on conceptualisation guidelines and finding the main properties of digital transformation definitions Vial (2019) designed a definition for digital transformation. Similarly, Morakanyane, et al. (2017) formulated a definition though analysing the contents of digital transformation definitions which presented patterns who could be utilized as a foundation for their definition that underwent an iterative process to ensure validity which further exposed the scattered state of digital transformation definitions. Additionally, Van Veldhoven, et al. (2019) sought to comprehensively define digital transformation through analysing the terminology commonly used in the subject area of digital transformation. Furthermore, they found key components which was prevalent throughout the definitions which resulted in a framework with three axes, digital technologies, society, and business from which they extracted their definition as stated in Table 2. Novel technologies as a core element of digital transformation base itself on digital innovation which seek to reach advanced AI but has been undergoing the last 50 years. Business transformation is the digital transformation of companies to reach enhanced performance through transforming internal structures, employee competence and novel products and services. The society based digital transformation focuses on the transformation of people, mostly external and their awareness and utilization of digital solutions through the increased use of novel technologies. The identification of the different axes as stated by Van Veldhoven, et al. (2019) is further supported by Reis, et al. (2018) through their suggestion of dividing digital transformation definitions into three separate distinct elements: digital technologies, organizational, and social, which became the foundation for their digital transformation definition as stated in Table 2. The methodology to realize a digital transformation definition however varies, Shahi and Sinha (2020) presented a digital transformation definition through conducting interviews in combination with utilizing natural language processing to identify key components based on processing raw data. To further evaluate the definitions stated in Table 2 the properties identified by Vial (2019) is further discussed to identify similarities and differences of the analysed digital transformation definitions.

3.2.2 Target entity

When utilizing linguistic systemic decomposing of digital transformation definitions Vial (2019) identified that a common theme of the definitions was the specification of a target entity which is as described the phenomena that are being altered which commonly were organizational aspects, platforms, ecosystems, and society. Schallmo, et al. (2018) define the main target of digital transformation as internal processes that companies control but also sees that the objects of digital transformation of business models also differ in scale based on the inclusion of individual elements as well as an entire business model, value chains and value creation networks.

The target of Reis, et al. (2018) digital transformation description are the business models of companies or organizational processes since that is the critical entities within companies that must change for survival in competitive marketplaces. Similarly, Ismail, et al. (2017) identified that the entities that is subject for change of digital transformation are the key to sustain companies’ competitive capabilities, which were business dimensions such as business models, customer experience, operations, and networks. Shahi, et al. (2020) described the target entity for transformation for digital transformation are company entities such as business processes, manufacturing processes and functions because of the specified entities enabling factor for reaching the sought outcome of digital transformation. Heilig, et al. (2017) present their targets of a digital transformation as the entities that as a consequence of digital transformation is the subjects of change, which are information flows, knowledge, culture, and people.
to enable business transformation. Along those same lines, Morakanyane, et al. (2017) identified that due to digital transformation company entities such as business models, operational processes and customer services will be affected and transformed by the process but are not necessarily the essential specific targets of digital transformation. Somewhat in contrast with the previously stated target entities of digital transformation definitions Zoui, et al. (2020) sees the main target entity of digital transformation as the relationships that companies have with its partners, stakeholders, and costumers through also focusing the transformation on the services and products that companies operate. When designing a digital transformation framework to formulate their digital transformation definition Van Veldhoven, et al. (2019) identified three axes and the target entities can be identified on two of the axes, business and society which included targets such as business models, business structure, people, and work structure amongst others. The identified targets of the axes indicate that digital transformation target companies and their surrounding stakeholders as a whole prompting the importance of a holistic digital transformation view. The target entities of Mergel’s, et al. (2019) holistic digital transformation definition are the policies, currently operated processes, and user requirements in order to undergo a complete and all-encompassing holistic approach towards transformation which is a point of great importance according to the authors.

The defined target entities of digital transformation differ as seen in the aforementioned literature, but common concepts can be found such as the focus of company-controlled entities and internal aspects as found by Heilig, et al. (2017), Ismail, et al. (2017), Morakanyane, et al. (2017), Schallmo, et al. (2018), Shahi, et al. (2020) and Reis, et al. (2018). However, Mergel, et al. (2019) and Van Veldhoven, et al. (2019) both identified that the target entities of digital transformation definitions should come more from a holistic viewpoint to ensure that the overall digital transformation does not discourage the holistic aspects of digital transformation. Somewhat bridging the two approaches towards defining the target entities Zoui, et al. (2020) claims that the targets should be internal and external, but the internal aspects should accelerate the external efforts.

3.2.3 Scope
The extent of which target entities are subject to change in the context of digital transformation is one of the factors that differentiate digital transformation from traditional IT transformations according to Vial (2019), who sees this as a main property of defining digital transformation and sees it as the scope of digital transformation and is as a main defining property of digital transformation. When describing to which extent a digital transformation of business models could be Schallmo, et al. (2018) both identify that changes can both be incremental and radical depending on the current situation of both companies and their industry as well as how impactful the implementation of novel practices is. Morakanyane, et al. (2017) defines the scope of digital transformation more of an evolutionary process through continuously having a gradual ongoing series of digital transformation-initiated activities to further reach a radical change over time. Stating the importance of understanding digital transformation as a continuous process are Van Veldhoven, et al. (2019) when they emphasise that it is a holistic change process that cannot be performed as individual single event activities but rather it bases itself on the gradually implementing the means of achieving transformation. Mergel, et al. (2019) further support the continuous viewpoint of digital transformation as they state that continuous revisions and improvement are the main needs of digital transformation, and the focus should be achieving a continuous feedback loop and not a final state. With the focus on implementing new and current technologies Heilig, et al. (2017) present the scope of entities change by digital transformation with levels from 1-5 which evaluates the utilization and maturity of implemented technologies. The levels structure in itself presents sought-after states that can contradict with the aforementioned viewpoint, however, the final one containing continuous characteristics by stating that traditional scopes should be extended. The scope of Ismail’s, et al. (2017) digital transformation definition focuses on a holistic change of business entities based on the intertwined relations within companies which require broad improvement to support individual changes which results in evolutionary transformation business entities. Correlating Zaoui, et al. (2020) found that the scope of digital transformation may differ greatly
depending on the size and current state of companies but should be holistic and include both internal and external aspects which require preparation to be successful. The entities that are subject to transformation according to Reis, et al. (2018) should be changed to such an extent that training is required to enable the change of process and business model to become digital. They further state based upon that, the scope of the digital transformation does involve changes to the workforce’s competence and the business models of the company. Shahi, et al. (2020) propose that the entity that are target for change should be transformed through digital transformation to an extent where they are efficient enough to satisfy measurable digital metrics.

Correlating identification are made by Mergel, et al. (2019), Morakanyane, et al. (2017), Schallmo, et al. (2018) and Van Veldhoven, et al. (2019) regarding to which extent target entities should be transformed by stating the importance of a holistic continuous viewpoint and stating that both incremental evolutionary changes occur as well as radical revolutionary changes but emphasise the importance of continuity. Both contrasting and somewhat relating statements are found by Heilig, et al. (2017) who both stated that there are levels (1-5) to which the scope of transformation can achieve but also include a sense of continuity but only in the final level. Adding to the holistic viewpoint of the scope property of digital transformation is Ismail, et al. (2017), Reis, et al. (2020) and Zaoui, et al. (2020) who all understand the holistic aspect as a must since the intertwined nature of business aspects required it and that preparation has to be made to ensure success. Finally, Shahi, et al. (2020) saw that the scope of digital transformation is to the extent of achieving increased efficiency.

3.2.4 Means
By examining definitions of digital transformation, and specifically the means of achieving one, digital technologies are widely cited as one of the most prevalent. One of the main the commonalities is the mentioning of digital technologies as the one of the main means of performing a digital transformation. Digital technologies in the context of defining digital transformation often represent the combination of internet-, software-, cloud- and analytical technologies which therefore the technological means aspect of the digital transformation definition is “through combinations of information, computing, communication, and connectivity technologies” (Vial, 2019). The findings of Vial (2019) regarding the usage of digital technologies in digital transformation definitions correlates with the definition stated by Shahi, et al. (2020) who identified digital technologies also as analytics, cloud, internet based with additions of social technologies who all are critical for decision-making. Furthermore. Reis, et al. (2018) also included social networks, mobile and big data as the main technologies of their digital technologies description who would let companies exploit their possibilities to the fullest. A similar perspective regarding digital technologies as the main means of digital transformation were stated by Van Veldhoven, et al. (2019) who included technologies such as automation enabled through IT, internet, advanced AI and furthermore, social media, mobile, analytics, cloud computing and IoT which is included SMACIT the key technologies of digital business. SMACIT is also referred to as the main enabling means of digital transformation transformations by Ismail, et al. (2017) and through integrating them externally, internally, and holistically. Identifying digital technologies as the means of a digital transformation are also found by Morakanyane, et al. (2017) yet, their definition of digital technologies is nonspecific through describing it as information and communication technologies in combination with novel technologies. Furthermore, their exemplification of digital technologies correlates with the contents of the aforementioned findings regarding digital technologies. Without using the term digital technologies Heilig, et al. (2017) identified the means property of their digital transformation definition as cloud computing, IoT, cyber-physical systems, mobile computing, social media, analytics, and machine learning which will enable information handling practices which allows for a transformation. Even though they did not use the term digital technologies their findings strongly correlate with those who used the term and saw it as the main means of digital transformation. Vial (2019) however, avoid the usage of specific term digital technologies as the means of their digital transformation definition to
avoid uncleanness and enable future applicability of their definition. Digitization was both mentioned in the definitions of Schallmo, et al. (2018) and Mergel, et al. (2019), however, their inclusion indicates conflicting viewpoints. Digitization initiatives who are value-adding will be the means of achieving novel operating capabilities and business models to finally achieving a digital transformation and making it a profitable endeavour. Furthermore, digitization can be defined in a transformation point of view as the processes of transforming entities that exist in an analog state into a digital. However, digitization can also be seen as the process of digitally enabling the retrieval of information and implementing entities into business processes, which prior to the digitization were analog to stimulate the retrieval of information and value generating of companies and their stakeholders (Schallmo & Williams, 2018). On the contrary Mergel, et al. (2019) sees that traditional digitization efforts are not sufficient in achieving a digital transformation as stated in Table 2 since their viewpoint amongst others comprehend digital transformation’s as holistic phenomenon. Nonetheless both Schallmo, et al. (2018) and Mergel, et al. (2019) both defined digitization comparably but also identified that the literature often uses terms as digitization, digitalization, and digital transformation interchangeably where they emphasise that distinctively using the terms are of great importance to understanding the field of digital transformation. Additionally, Mergel, et al. (2019) does not clarify the means of their digital transformation definition throughout their scientific article more than they would be digital and novel, this is a consequence according to the authors of the uniqueness of companies and a digital transformation definition must be widely applicable. Zaoui, et al. (2020) does not elaborate further regarding the means of their digital transformation definition than that the adaptation and integration of information technologies are a stage of the overall digital transformation process as seen by the scientific papers that they studied.

The definitions see similarities in their view of the means digital transformation as Digital technologies (Ismail, Khater, & Zaki, 2017; Morakanyane, Grace, & O’Reilly, 2017; Shahi & Sinha, 2020; Reis, Amorim, Melão, & Matos, 2018; Van Veldhoven & Vanthienen, 2019). Similarities with the term digital technologies can be found with Heilig’s, et al. (2017) findings where as Mergel, et al. (2019) and Schallmo, et al. (2018) found digitization as the main means of digital transformation. Wide presentations of the means of digital transformation are found in the statements made by Mergel, et al. (2019) and Zaoui, et al. (2020) due to their view that digital aspects are a main component of all digital transformation and therefore are not specified.

3.2.5 Expected Outcome

A commonly found property of digital transformation definitions are expected outcomes or perceived final states which are results of the transformation. Furthermore, common themes of digital transformation outcomes are that an impactful change occurs which optimally improves performance of business processes. A point of interest regarding the potential impact of digital transformation outcomes are the disruptive capability outcomes have on existing company culture and frameworks. However, a more profound understanding of the impacts and outcomes of digital transformation on differing levels and over different time periods are necessary to fully understand the implications of digital transformation. An additional aspect of digital transformation outcomes are undesirable outcomes. The undesirable outcomes related to digital transformation are often linked to data privacy and cyber security which is a product of the increased utilization of algorithms and data depended on process. The importance of data will become a critical point of interest in securing positive outcomes from digital transformation for companies, society, and individuals (Vial, 2019). Through transformation efforts and creating novel business practices based on digitization initiatives the outcome of digital transformation are increased profitability capabilities. The changes that business entities are subject to throughout digital transformation processes through utilizing of data and problem solving will often produce profitability and value. However, achieving profitability for long sustainable durations are often
challenging. Other goals that are sought after outcomes of digital transformation are enhanced value-creation chain capabilities such as resource management, skill generating and business processes to further generate value (Schallmo, & Williams, 2018). Value created by digital transformation are not only related to the costumer’s point of view but also companies. The value created which impacts companies’ internals most specifically are strategical, productivity, resource efficiency, enhanced stakeholder relations and market shares. The transforming of internal processes has the possibility to positively impact other aspects of companies to further enhance the value created both for companies and customer. However, a greater understanding of the outcomes for companies who undergo digital transformation are needed to further understand specific impacts of technologies implemented and on the varying aspects of companies (Morakanyane, Grace, & O'Reilly, 2017). Investment in information communication technologies has traditionally made a positive economic outcome, similar correlation can be found in the positive relation of digital transformation and the creation of value as the main outcome. The value created through digital transformation are generated for all stakeholders of companies with customers gaining significant value. Value is created when company entities are transformed through the implementation of digital technologies (Shahi & Sinha, 2020). Similar outcomes of digital transformation were found by Mergel, et al. (2019) who identified more and better value creation as an outcome through novel service deliveries and user satisfaction, however, better workplace conditions, organizational change and contributions to a digital society was also found to be outcomes of digital transformation.

The outcome of digital transformation as defined by Reis, et al. (2018) are significant improvements for both the customer and companies through business improvements which correlates with the aforementioned digital transformation expected outcomes without the emphasis on value creation. Ismail, et al. (2017) sees the outcome of digital transformation also as value generated throughout multiple existing business dimensions and value chain on an evolutionary level which will bring companies possibilities of achieving superior performance and prolonged competitive advantages. Similarly, Heilig, et al. (2017) identified the potential competitive advantage as an outcome of digital transformation but they also see the outcome of digital transformation as and enhanced data handling capabilities the capability to transform business entities. In contrast, Van Veldgoven, et al. (2019) do not see the focused sought-after outcome of digital transformation as creating value but instead increasing the transformation’s velocity, scope and impact compared to traditional business transformations. Zaoui, et al. (2020) saw that the outcome of digital transformation often are changes to multiple business dimensions which affects all company stakeholders, but the change is strongly dependent on the effort of the stakeholders and the unique circumstances of companies.

Value creation for all stakeholders, enhancement of value-chains, competitive advantages and other financial related aspects are commonly found expected outcomes throughout digital transformation definitions (Heilig, et al. 2017; Ismail, Khater, & Zaki, 2017; Mergel, Edelmann, & Haug, 2019; Morakanyane, Grace, & O'Reilly, 2017; Schallmo. & Williams, 2018; Shahi & Sinha, 2020). Similarly, but not emphasising the importance of value as the aforementioned digital transformation definitions are Reis, et al. (2017) who sees the satisfaction and overall improvements as the sought-after outcome of digital transformation. However, Van Veldhoven, et al. (2019) and Zaoui, et al. (2020) identified the expected outcome of digital transformation as the capability to transform in itself whether it is increased pace of change, scope, impact, or the achieving of a multidimensional business transformation. The viewpoint of achieving a transformation as the essential expected outcome of digital transformation relates strongly to the findings of Vial (2019) who see that triggering significant changes and the possibility of improvement however not guaranteed as the outcome of digital transformation.
3.3 Digital transformation strategies

The combination of strategies and information technologies with the focus on digitally altering business practices for a more digital company can be defined as digital transformation strategies. Such strategies use the capabilities of information- and digital technologies as drivers for altering products, processes, and coordination as mutual part for the overall strategy and not for specific cases. However, the field of digital transformation strategies lack a clear consensus. The research is riddled with a wide variety of definitions stemming from case studies, interviews, and literature analyses to generate an understanding (Schallmo, et al. 2017; Tillväxtverket, 2017; Vial, 2019). Digital transformation strategies differ from IT strategies where digital transformation strategies focus on the holistic transforming that comes with digital and technological development and implementation, to not just focus on the technological aspects in isolation (Chania, et al. 2019; Matt, et al. 2015). Furthermore, Chania, et al. (2019) expands on the point of strategies when stating that digital transformation strategies support in guiding implementation and development efforts for companies who seeks to utilize digital strategies which focuses on the goal of creating novel value capturing opportunities. Chania, et al. (2016) interpreted that the goal of undergoing a digital transformation strategy is to systematically generate a holistic company wide effort towards becoming digitally transformed through strategical. Vial, (2019) further supports the point and states that digital transformation strategies is a form of journey for companies and works as a designed plan to support companywide beneficial digital transformation and to avoid digital transformation to become a financial constraint. Along those same lines, Matt, et al. (2015) sees digital transformation strategies as a strategical effort of holistically collecting and systemizing the varying implementation efforts, consequences, and decision-making that are originates from digital transformation through systematically strategizing with consideration of the possible financial impacts.

Efforts towards strategically transforming companies into more digital differ based on their sector, market shares and business goals. Three of the mayor ways that digital transformation efforts are realized in focus on creating new value for customers, transforming operating models through establishing and integrating digital methods, lastly a combination of them both through incrementally forming business models based on the new value creating practices. Based on the context of the individual companies’ either focusing on the first or the second method should be impacted by the potential new ways you can generate value. However, if the situation for the company that seeks to digital transformation have specific goods that may not be optimal for additional value generating avenues a focus on the operational aspects should be of priority. The first two methods therefore focus mainly on what our value offer should be reimagined into the second one focuses on how we can reimagine our operative aspects. However, there are still situations where the third alternative should be considered where a combination in close synergy is important to achieve (Tillväxtverket, 2017).

Digital transformation will have great effect on manufacturing companies and through analysing the possible impact that Industry 4.0 will have on business models, that is, how value creation, delivering and capturing will be impacted. Focusing on the aspects of business models four methods of performing digital transformation which differ in the way value is created, delivered, and captured based on two dimensions: the extent of the innovation and the novelty of the business model. The most incremental digital transformation strategy focuses on utilizing the technologies of Industry 4.0 to achieve optimization of internal and external processes, this method is seen as the most applicable for traditional manufacturing companies. The next method on the innovation and business model axes focuses on the value delivery aspect of business models as the method seeks to create and or optimize interactions with costumer to further enhance products and service to ensure customer satisfaction through Industry 4.0 technologies. The third digital transformation strategy which base itself on radical innovation and business model seeks to create ecosystems where stakeholders and partners are involved to move away
from value chains through Industry 4.0 technologies which will enable the defining of novel value capturing opportunities. The last digital transformation strategy is the most radical in both innovation and business model aspects based on its goal in using disruptive innovations and the way a business model will be formed. Technologies of Industry 4.0 should therefore be utilized to such an extent that they are disruptive and therefore the business model can provide with opportunities for the manufacturing company to expand and diversify into other markets, which is suggested to be developed alongside with an existing business model to ensure a constant revenue stream (Ibarra, Ganzarain, & Igartua, 2018).

3.3.1 Approaching Digital Transformation strategically
To successfully digitally transform companies an understanding of the key elements has to be established to adequately strategize (Matt, et al. 2015; Mhlungu, et al. 2019; Tillväxtverket, 2017; Ziyadin, et al. 2019). As seen by Mhlungu, et al. (2019) who had, and organizational viewpoint of digital transformation strategies saw that the key elements were customer centricity, governance, innovation, and resource attainment. They further explain that customer centricity is achieved through understanding how to design offers for the customer demands and how to adapt accordingly to those demands and how to innovate to meet the changing customer demands. They also state that understanding governance as a key element of strategies because of the importance of making the right decisions, establishing the right policies, and clearly defining the goals of projects and initiatives of the digital transformation strategy. Furthermore, innovation is seen as a vital element both in the innovative aspects of culture and practice. Mechanism to efficiently develop innovations, investigate novel innovative business models and implementing a culture that supports innovations and in extent digital transformation is essential to successfully strategize digital transformation. Allocating the right resources is an essential success factor for digital transformation strategies. Resource attainment does not only include financial aspects, but also the acquiring of the right knowledge, competence, and the right partnerships, both internally and externally. Creative models that enable a digital transformation are required to be established to fully support a companywide organizational strategy. These findings are not only accepted by the IT leaders of companies, the understanding that these are the essential success factors of digital transformation strategies with organizational focus is also the view of non-IT leaders. However, it is vital that leaders who seek to strategize digital transformations must clarify the areas of why? what? and how? to ensure that the management understand the reasoning, contents, and measurements behind the strategy (Mhlungu, Chen, & Alkema, 2019).

To digitally transform business models of companies a roadmap can be a possible adequate method to successfully strategize. Ziyadin, et al. (2019), identified common essential phases of digital transformation strategies as different phases. Which were identified as:

- **The beginning of a digital transformation:** Understanding the possibilities, threats, and outcomes.
- **The evaluation of a digital transformation:** Evaluating the possible alternatives for a transformation.
- **The assessment of a digital transformation:** Assessing the current state of the company to understand preparedness and possible challenges.
- **The commitment required for a digital transformation:** Adequately communicating the implications of a digital transformation to formulate companywide support on an individual level.
- **The implementation of a digital transformation:** Deploying formulated action plans into the various business areas.
- **The sustaining of a digital transformation:** Proceeding with continuous work for the action plans and developing them.
Based on these predominantly found essential phases of digital transformation strategies road mapping five digital stages is seen to be an adequate way to strategize: Digital Reality, Digital Aspiration, Digital Potential, Digital Fit and Digital Integration. The roadmap is initiated with generating a current state of a company’s business models, partners and potential customer demands to set a Digital Reality. The initial stage is then followed by identifying goals with incorporated time, financial and scope, to organize and measure the potential of the goals to identify the Digital aspirations. The followed step identifies the Digital Potential through empowering the processes and individuals which work with digital transformation to ensure that future potential to digitally enhance business models are assured. The second to last stage assures that the initiatives that are included in digital transformation strategies coincide with the dimensions of companies through guarantees that the innovations to business models satisfy customer requirements and that goals are reached which results in a Digital Fit. The final stage combines the initiatives of digital transformation strategies and organizes them to achieve a digitally enhanced customer experience and realization of the benefits from the initiatives are achieved in the stage of Digital Integration (Ziyadin, et al. 2019).

Common elements of digital transformation strategies found for all companies independent of the industry or market are the use of technologies, changes to value generating practices, organizational changes, and the financing of strategies. These essential elements can also be seen as dimensions, dictating the balance and influence of each element on digital transformation strategies. Which can dictate if companies choose to focus on organizational changes or their value generating practices (Matt, et al. 2015). However, the use technologies are still an essential part of both those strategies in the aspects of adaptability, utilization, and implementation. The technological element of digital transformation strategies has to be evaluated to identify to which capacity novel technologies should be used. Should the strategy provide with possibilities to become industry leaders in a technological aspect or should established, proven technologies be used. Becoming a market leader in a technological aspect can become a competitive ability through establishing new market standards, however it requires a vast amount of technological competence to fully capture such an opportunity (Matt, et al. 2015; Schallmo, et al. 2019). Furthermore, if a digital transformation strategy includes activities to achieve the utilization of new technologies a consequence is often a change to the value generating activities based on the impact of novel technologies. These changes often materialize based on the change from often analog processes or the expanding of current products through implementing new technologies. However, as connected to the use of new technologies, competences that can adequately support these new changes to value generating activities are required which comes with its own risks. The inclusion of new technologies into existing products that change value generating activities has the possibility to expand the market scope, through the interest of new customers which bring additional monetization opportunities (Matt, et al. 2015).

Technologies and the use of them throughout digital transformation strategies are not only focusing on forming new value generating activities but can also be used to perform organizational changes. The organizational changes represent the implementation of new technologies throughout the operational activities. A vital aspect of digital transformation strategies that seek to change organizational aspects are the understanding of how processes, products and the competences are subject to change. Understanding the extent of these changes will lead the strategy to either implement these changes into already existing organizational structures, since the scope of the changes are not too extensive (Correani, et al. 2020; Matt, Hess, & Benlian, 2015). On the other hand, if the changes are extensive, the changes may require separate systems to be fully developed before being implemented into the essential operations. However, the use of new technologies to change aspects of companies are highly dependent on financial aspects. Companies has to adequately finance transformation efforts therefore, companies must contemplate all their options to assure that a strategy will be possible to perform. Financial aspects are both a driving force and a barrier for digital transformation strategies, as they can bring new value generating activities, but require financing to fully support the transformation. Finally, digital
transformation strategies and the implementation of them are challenging and the different elements and their dimensions need to be accounted for to fully succeed (Matt, Hess, & Benlian, 2015).

To establish a framework for strategies that digitally change business aspects of companies Bharadwaj, et al. (2013) identified four themes to guide these strategies: scope, scale, speed, and value creation and capturing. Tillväxtverket (2017) incorporated these themes to make digital transformation strategies approachable. However, they both understand the scope as the capability of strategies to further the reach of companies based upon the impact of digital transformation. The scope of strategies transcends the traditional borders of companies through incorporating the different operational sections into one through holistic digital transformation. Scale refers to the dynamic capabilities of technologies which can scale up or down depending on demand. However, scale also refers to the possibilities of creating networks and partnerships to establish new services and enable cross-company data sharing. An essential aspect of digital transformation strategies is the possible speed that it enables across company activities. The speed of product development, decision making coordination with supply chains and partners based upon the possibilities generated from digital transformation strategies. Finally, the sources of value creation and the capturing of those valuable outcomes are also an essential aspect of digital transformation strategies. The capturing of value is designed through new business models, the increased capability to utilize and handle data, and organizational restructuring (Bharadwaj, et al. 2013; Tillväxtverket, 2017).

The scope, scale, speed and value creation and capturing are essential aspects of digital transformation strategies which focuses on changing business aspects however, there are additional vital aspects that require consideration according to Tillväxtverket (2017). First identifying that the strategical efforts of digital transformation can occur on different levels of companies to harmonize. Strategies can both be horizontal and vertical but often holistic in its perspective. Technological strategies, as digital transformation strategies must be an essential part of company’s overall strategy and not only the technological aspects of companies. Secondly engaging digital transformation strategies with a multi-dimensional perspective is key to understand which strategical choices that has to be done and the level of the strategy. The multidimensional perspective considers the focus of the transformation in combination with extent of which they choose to strategize. The focus as suggested are the transforming of either the value propositions of companies or the operative models of companies. A high-level strategy incorporates the possibilities of digital transformation to a great extent and harmonizes these possibilities to further enhance business practices. A high-level strategy according to Tillväxtverket (2017), takes into consideration the aforementioned elements identified by Bharadway, et al. (2013) scope, scale, speed, and value creation and capturing. Furthermore, due to the everchanging technologies that are suggested to be incorporated in digital transformation strategies, many companies perceive it to be challenging to strategize. Therefore, focusing on the competence of companies are more inclusive and makes digital transformation approachable for companies that find themselves in unique situation where technologies are perceived differently. Another vital aspect of digital transformation strategy is the consideration on two organizational aspects, the structure and culture. Transforming structure will enable new methods of communication and connects internally which will support strategical efforts. Culture is an important aspect to transform to assure that a transformation is supported by employees which will dictate the performance of a strategy and the potential outcomes. Lastly, understanding the context of which a digital transformation strategy should be deployed within is of great importance. Understanding which possible outcomes that can be achieved through digital transformation are vital to understand how to strategize. Context may possibly indicate which technologies that are required to make a significant impact and gain competitive advantages (Tillväxtverket, 2017).
4 Empirical Findings

This section will describe how digital transformation and digital transformation strategies are perceived and performed by four different manufacturing companies through first presenting individual perspective found throughout the research project which is presented under the heading Manager’s, director’s and team leader’s viewpoints of Digital Transformation. Followed by the case companies’ situation regarding conducting and communicating digital transformation on a company level which is stated under the heading 4.2 The Current State of Industrial Digital Transformation. Finally, the case companies’ strategical efforts in combination with their employees’ perceptions are presented under the heading Strategical Efforts Towards Digitally Transforming.

The empirical findings are based upon the data that were collected through observations that were made during the course of the research project meetings and data collected through the questionnaires. The data sources are presented together to more adequately present a full picture of the empirical findings.

4.1 The Case Companies View of Digital Transformation

Presenting the viewpoints of digital transformation are of importance to further understand the current state of knowledge and how interpretations of the subject digital transformation differ throughout the partner companies.

The viewpoints of digital transformation by the case companies’ key individuals differs throughout the coordination project but then again also on an internal basis within the companies. Commonalities however are also found throughout the individual viewpoints of digital transformation are mainly found regarding the involvement of technologies, mainly new to achieve changes. Digital transformations are seen as a holistic process which involves both external and internal aspects of companies but the focus of many were the manufacturing aspects of companies and their own position within their company. Furthermore, digital transformation explained through holistic viewpoints are also commonly described through stating how their work areas and adjacent are directly affected. Individual roles and responsibilities will naturally affect individual’s viewpoint of digital transformation, but deeper wider descriptions and definitions are presented. Areas that are subject of transformation are stated as: all levels of companies, work tasks, organizational structure, creation of infrastructure, horizontal and vertical, entire value-chain, supply-chain. The individual workers position throughout digital transformation are also stressed through stressing that competence development is of great importance. A companywide cultural journey which stimulates the digital competence of its employees throughout the different vertical and horizontal levels of companies is also seen as an important part of digital transformations. This further signifies that a higher-level understanding of digital transformation is understood as a holistic phenomenon.

The most common viewpoint of performing digital transformation is seen as the involvement of new technologies often described as digital technologies to enable novel business practices which will enable further data utilization. The use of data is seen as a main point of digital transformation and making data accessible throughout the company as a whole is seen as important, but manufacturing aspects are still in focus. Terms as digitalization and digitization are used to describe what should happen to processes and practices but further specific descriptions are not used. However, there are differences in the aspect of the outcome and motivation for digital transformation. Some comprehend the motivation for digital transformation is a process to enable the utilization of future digital applications and towards a novel digital landscape while other see it as the further utilization of data and customer value generating. The digital applications are more specified and exemplified in advanced analytics, elimination of waste and overall support for companywide strategical objectives. Other see new digital technologies as one of the means to achieve digital transformation and do not perceive it as an outcome. One of the companies specifies the reasoning for digital transformation for their manufacturing aspect as an accelerating factor for their Lean journey, this viewpoint is highly individual for that specific project partner company.
Specific possibilities that can be derived from digital transformation are many and are suggested to be value generation and providing capabilities to withstand the evermore competitive manufacturing environment. Additionally, real-time data handling will bring various positive aspects and the flexibility acquired from the novel technologies which digital transformation can bring will increase flexibility in all the steps of product development and production bringing value to the customer and enhanced customer responsiveness.

The human aspect is also seen as subject of transformation and exemplified through the possibility for more attractive working conditions. Additionally, beneficial aspects of digital transformation are seen to some extent as reachable and may not require an overwhelming effort to achieve. These are seen as initial steps of digital transformation and open up for further novel practices which rely heavily on data utilization. Overall, the possibilities focus on the novel ways data can be utilized to enhance production and product development to further bring value to the company and the customer. However, positive outcomes of digital transformation are also seen to potentially negatively impacted by differing situations throughout companies. Mainly the differences that may occur when digital transformation efforts are at local facility to facility basis does not fully correspond to global efforts. The hindrances are seen to be in the different standards and manufacturing systems that may not coincide and fully cooperate with each other. Prerequisites for global systems may not be achievable by individual facilities and therefore corporation and potential benefits may be lost. Nevertheless, local facilities and bottom-up digital transformations efforts are still seen by key individuals across all companies to have potential in driving changes and realize the initial possibilities of digital transformation. Additionally, possible positive environmental effects are seen as a possibility of digital transformation through its potential in reducing waste and will be a step towards achieving a greener factory.

4.2 The Current State of Industrial Digital Transformation

The case companies all strive towards incorporating digital aspects in their companies and often articulate these efforts different with different terminology. This has created scatteredness throughout the digital transformation coordination project on company to company basis. This is seen when evaluating how managers, directors and team leaders understand their company’s viewpoint on digital transformation and if a company wide definition has been reached. This state of digital transformation for manufacturing companies is evidently seen based on the viewpoints of the partner companies’ key individuals. Unanimous viewpoints are not found throughout all the case companies when determining if a digital transformation definition has been stated.

4.2.1 Company A

According to the project participants of Company A unanimity is found in that a definition for digital transformation is stated. Furthermore, their descriptions of the said definition are similarly further solidifying that their company has found a definition. Digital transformation is stated to be achieved through their company’s digital strategical effort: Factory 4 Tomorrow. Digital transformation defined as Factory 4 Tomorrow is seen as a wide all-inclusive definition by the key individuals. They see this as a beneficial aspect to the definition as it does not exclude possible methods that can be useful during their company’s digital transformation. The main components of Factory 4 Tomorrow are the inclusion of a wide set of data connected entities ensuring a focus on data and the utilization of it. Technologies stated to be essential parts of Factory 4 Tomorrow includes additive manufacturing, virtual solutions, digital twins and data utilization throughout operations aspect. On the contrary openness to data related technologies is also suggested advocating for an open view for possible technologies that can be included throughout a digital transformation. Factory 4 Tomorrow consists of goals and visions, short-, mid- and long-term. Furthermore, Factory 4 Tomorrow was formulated in 2019 as Industry 4.0 as a concept was brought to the company. The concept is fully owned by the company as it was formulated internally which made it possible for the company to dictate its contest and communicate it to the company’s stakeholders. The positive aspect of Factory 4 Tomorrow is the concretizing of initial steps that should be taken when coordinating efforts regarding the development and work involving digital
transformation and Industry 4.0. The concept of Factory 4 Tomorrow is currently most solidified throughout the operations of the company and must grow further to be established and communicated to areas such as logistics and manufacturing, but the goal is to spread the concept throughout the entire company. The main method currently used to spread knowledge regarding digital transformation and Industry 4.0 through the concept Factory 4 Tomorrow is by the use of company produced media. This will spread the knowledge and ultimately increase the competence of the company’s employees. Although the definition is perceived as wide all-including, the definition it is still understood clearly. They still see the company’s digital transformation definition as a process of becoming smart and connected by digitally advancing various internal company entities. However, the key individuals of the case company do not specifically separate the terms digital transformation and digital transformation strategy as strategical efforts are included in their description of the definition. Which they further solidified with the mentioning of bottom-up and top-down strategies with defined milestones as a part of the digital transformation definition.

4.2.2 Company B
The perceptions of definitions are scattered, however, majorities of the respondents within Company B does not see that their company has defined digital transformation. With stated interpretations also varying internally. Furthermore, the second project partner company that operates within the automotive industry did not as seen by their key individuals define digital transformation. The project participants however describe their interpretations of their company’s view on digital transformation similarly. Common viewpoints are presented throughout the focus on achieving a transformation to a sought-after state where novel digital solutions are made possible. Digital transformation is further seen as an effort to enable handling of complex aspects of their operations to further increase efficiency and further utilize data. However, based on the lack of a stated definition for digital transformation by the company, the project participants insinuate that one is needed. This is further exemplified in their need to have a definition which present clearly what the contents of digital transformation is to further work as a guide for their transformation efforts. As mentioned earlier the perception regarding the company’s definition or lack thereof was not unified. As there were still a key individual who saw that the company had a clearly stated definition for digital transformation. However, the project participant did not further explain the definition more than it was a widely stated and clear in that aspect however specifics are not set and how a digital transformation will harmonize with the current state of the company is also absent. The sole viewpoint of the state of digital transformation at this company may not support or give evidence to the existence of a clearly stated companywide definition. Furthermore, a lacking definition for digital transformation was found by one of the project participants which can be seen as a reason for Company B to develop a clearer definition which specifies the contents for the company as a whole. The perception of digital transformation’s potential is however seen as plentiful. Digital transformation has for the company potential positive impacts on its financial aspects through enhanced utilization of resources, productivity, knowledge sharing through collaborative systems sharing data efficiently allowing it to be utilized by more people seamlessly. Another potential outcome of digital transformation is seen to be the enhanced capabilities when creating value for customers and their experience with the company through availability, problem solving services and quality.

4.2.3 Company C
Company C’s situation is unique because they have been acquired by another company and this has affected the key individuals’ viewpoints of the company’s digital transformation definition or lack thereof. The majority of the project participant which took part in the questionnaire saw that the company had not clearly defined digital transformation and that one of the project participants specified this to be the outcome of the recent acquisition of the company. The acquiring of Company C has impacted the clarity for the project participant regarding digital transformation, by disrupting existing initiatives and not efficiently communicating ongoing initiatives that the acquirer may have. This may be the result for the differing viewpoints stated by other research members of Company C. This is further solidified as one project participant stated that their company, prior to the acquiring did not have a clearly stated
definition for digital transformation and the term was not really used and the employee did not know if the acquirer had the term defined. Uncertainty regarding the terminology after an acquiring may be common, but clarity must be achieved especially for managers and leaders to ensure optimal communication. A viewpoint which saw that the company did not have a stated or clearly defined digital transformation however interpreted the company’s viewpoint as the effort of eliminating analog processes and non-value adding processes. This is exemplified by the project participant of Company C as the reducing of manual work and paper-based communication and creating data communication infrastructure throughout the company. A contrasting viewpoint stated by a project participant of Company C was that the company had defined digital transformation as the effort of implementing digital applications and solutions. This is further seen to be a part of the company’s major overall development plan on local and global levels. The potentials of digital transformation for the company as seen by the project participant strongly correlate with their perception of the company’s definition or view on digital transformation. Therefore, they see the potential of digital transformation differently with proclaiming that safety, quality, and productivity will be enhanced through the elimination of wasteful activities. On a different level digital transformation is seen to have great potential on a local level which can have the potential of being hindered by global standards.

4.2.4 Company D

Company D’s situation was similar to Company B’s situation in that they had differing opinions regarding the state of defining digital transformation at their company. However, a majority of the respondents of the questionary saw that the company did not have the term digital transformation defined. A common theme throughout the opinions regarding the state of digital transformation and how it is expressed by the company is that there are no one specific definition. This has created a situation where many different definitions and opinions has been brought forward and coexist with each other, mostly on a plant-to-plant basis. This is further explained to be a result of the company’s size and the various areas it operates in. The coexistence of many different definitions for digital transformation causes a confusion regarding the clarity of digital transformation definitions. Further explaining that point is one questionnaire respondent who states that the definitions stated may be similar and can potentially have the same meaning, but they are specified separately, which can cause possibly confusion. Further confirming that the situation at this specific partner case company’s dispersed state of digital transformation is the lack of clearly stating a definition by those who saw that the company had one. This further solidifies the opinions of the majority which saw that there was no clear definition. The most substantial definitions suggested are presented by those who interpret the company’s view on digital transformation. They mostly see the company’s definition as the optimization of manufacturing process through digitalization, digital standardization, digital transparency, and education to increase competence. The goal of digital transformation is viewed as the achieving of a company which has “World Class Manufacturing”, “Supply Chain 4.0”, manufacturing flexibility, cost efficiency, and value creation for costumers. Terms as “Supply Chain 4.0” and “World Class Manufacturing” are further explained as to be achieving data transparency between partners and the digitalizing of the company’s factory shop floor. However, these terms were not widely used by the employees setting a situation where the terms are not well communicated throughout the company as a whole. The term company initiative World Class Manufacturing was suggested to be a part of the company’s digital transformation efforts by a manufacturing manager.

The use of terms and abbreviations in the day-to-day communication may cause additional confusion and disruption as the terms may be interpreted differently. Therefore, determining the meanings of terms and abbreviations may be a challenge throughout the company’s digital language spanning wider than digital transformation. Determining terminology is also shown in the form of inaccurate labelling of investments and projects which further dilute the meaning of commonly used terms. However, due to the lacking clarity and the many coexisting of digital transformation definitions some of the questionnaire respondents further explain that these views of the company’s definition often come from their own. This can be seen as the outcome of absence of a clearly applied companywide definition.
However, the company states that it has guidelines for digital transformation in place to further clarify the company’s intention and initiatives:

- **Value Creation**: The guidelines presented by the company is set as a chain of activities with the goal stated as the creation of value for customer as, stating it as the main priority.
- **Small initiatives with big effects**: The next guidelines focus on the achieving of the first guideline through initiating digital transformation tasks on a small scale with large prospects focusing on a holistic viewpoint.
- **Value before innovation**: Capturing value through maximizing benefits instead of focusing on attractive novel technologies that might not bring the full benefits promised.
- **Start now**: The initiatives should start as soon as possible to set the processes in action to work towards creating a robust digital platform.
- **Bottom-up innovations**: The bottom-up perspective is further solidified in guideline focusing on local level as innovation can take place on such a scale faster with additional benefits as local competence and employee empowerment.
- **Security**: Establishing security is an important aspect of digital applications, therefore establishing data security, data ownership, tolerances and borderlines are of great importance.
- **Establishing and solidifying language**: Solidifying the language used internally between different teams and facilities are of great importance to ensure good and efficient collaboration.
- **Full value chain perspective**: Having a holistic view which incorporates the entire value chain is of great importance to ensure the entire value is captured by the digital transformation.

Even though the company guidelines exist the individuals of the company does not clearly cite the guidelines when describing the company’s efforts. However, the respondents’ viewpoints correlate to the company stated guidelines but at most just some aspects of them. The respondents see the potential in having a companywide definition as it can be beneficial, and the existing ones may not be comprehensive enough and is not clear in the specific contents. An additional constraint that creates further challenges regarding digital terms are the lack of knowledge throughout the company resulting in unclear definitions being stated by the employees further generating insufficient communication of knowledge. This is however not a viewpoint that is unanimous where contradicting viewpoints are stated through the stating that the company have widely digested the term. This was exemplified by an employee through stating that when the company acquire new personal digital transformation knowledge is an important part of potential employees’ profile.

### 4.3 Strategical Efforts Towards Digital transformation

Strategizing of digital transformation is more prevalent throughout the digital transformation coordination project partners according to their key individuals. In contrast to the state of digital transformation definitions a majority of the partner companies as seen by their project participant has defined digital transformation strategies. Individual project participant understands how strategizing digital transformations differently but their viewpoints of their company’s digital transformation strategy are to some degree consistent. The consistency, however, differs on a company-to-company basis.

#### 4.3.1 Company A

Digital transformation was seen by Company A as companywide defined effort. Strategizing efforts of digital transformation is furthermore also seen to be defined unanimously, however, the specifics of what a digital transformation strategy should consist of differs. The inconsistency exists mainly within the personal views of the Company A’s project participant however, the project participant’s viewpoint of the company’s digital transformation strategy is unanimous. As aforementioned the project participant’s views on digital transformation strategy highly correlate with their views on how to strategize digital transformation. This may be a possible cause of clearly defined strategies impacting the understanding of the core definition of digital transformation causing a high correlation between the
two. Digital transformation strategies should involve a defining of the approach, technologies and who should be involved with performing the strategy. Priorities should also be set to further create a strategy. One of the project participants see that the most important aspect of digital transformation strategies is the implementation of technologies and that novel practices should be incorporated. Furthermore, the involvement of management is important to establish the right competence. Technologies which should be included within a digital transformation strategy as stated by the project participants were Industrial Internet of Things, Cybersecurity and Virtual Manufacturing. These technologies are commonly seen as essential parts of Industry 4.0 which is one of the elemental aspects of the company’s Factory 4 Tomorrow initiative. Factory 4 Tomorrow as stated by project participants of Company A specifies measurements regarding how training of employees and how the sharing of knowledge should be performed to achieve the right competence to support a companywide digital transformation. The management of innovative implementations within the company is also a subject that should be included to ensure optimal performance and to avoid insufficient and unnecessary investments. When evaluating their own company’s digital transformation strategy the project participants found that the main parts for their company’s digital transformation strategy does heavily involve manufacturing aspects. This viewpoint was further solidified with the main contents of the strategy seen as the processes and steps of utilizing data and digital means to further develop the capabilities data handling for manufacturing purposes.

Furthermore, development of automation capabilities throughout the company’s manufacturing processes and data communication enhancements to achieve smart manufacturing were the main strategical methods in achieving a digital transformation. Additionally, the use of teams such as smart factory teams, core governing teams of Factory 4 Tomorrow, manufacturing technology development board are used to enable the generating of innovations and development throughout every level of the company. The use of teams and similar initiatives are also set in place to dictate authority. The authority then can stimulate innovations based on challenges that may be specific to certain parts of the company that are not visible for the company as a whole but possibly will have impactful results. Key areas of the digital transformation strategy that the company has in place are seen as the authority distribution, infrastructure development, development of business practices, the establishment of communication protocols, enhance data handling capabilities and data utilization, establishing cybersecurity protocols and implementation of novel technologies. The communalties found throughout the project participant’s viewpoints of the company’s digital transformation strategy is a result from the company’s efforts to clearly communicate the strategy. Beyond clarity the strategy is also practical and broad. However, the strategy is mostly communicated to certain sections of the company which creates lapses of knowledge regarding both the definition of digital transformation and how to strategize it. Digital transformation strategies performance, however, are subject to possible challenges in realizing the full potential of digital transformation. The main hindrance for digital transformation strategy is the competence for the company. The level of competence needed does not currently exist according to the project participants and if it does exist the knowledge sharing systems are not sufficient. Prioritization was also identified as a critical challenge that may impact the performance of the digital transformation strategy due to the many different tasks that ongoing simultaneously which can create conflict and slow down the overall transformation process. Additional challenges identified are the prerequisite of a sufficient digital infrastructure to fully implement the innovations that are a part of the strategy. A knowledgeable capable and responsive top management who fully understand the vision and potential challenges that can impact the strategy are also seen as a vital challenge. Leadership therefore can be seen as a vital aspect of the strategy’s performance due to the many changes that the company is subject to during the transformation process.

4.3.2 Company B
The recognition of company defined digital transformation and digital transformation strategy are not equal throughout companies of the research project. However, for Company B, the viewpoints are not unanimous regarding a company defined digital transformation strategy. A majority of the project
participants who took part in the questioner saw that a definition for digital transformation strategy exists. Yet, the strategy is understood as a loosely define one with unclear abstract goals set at a wider perspective. This has then created a situation at the company when individual perspectives are not affected by the company’s definition to an extent. This allows the individual to understand and formulate their own opinion regarding the complex topic of digital transformation strategies. In the absence of a company definition for digital transformation strategy, project participants view on what the contents should be in a strategy correlate strongly with each other. Digital transformation as seen by the project participants should focus on the human factor. This is further expanded on in such strategical activities as competence development, how individuals will be affected by digitally transforming existing business practices and how personal can be involved throughout a digital transformation. The human factor is of large importance to the project participants as digital transformation is seen as a possible disruptive process for the company creating uncertainty. Therefore, establishing the human aspects can create greater involvement resulting in a more supported transformation as an effect of clear communication. Concretizing of digital strategies are also seen as an important aspect providing the employees with concrete steps get the transformation underway.

The company’s digital transformation strategy is seen to be existing by a majority with the differing viewpoints resulting in widely differing viewpoints regarding the contest of the company’s strategy. Through the viewpoint of an existing defined digital transformation strategy the main points of interest are the authority of the strategy, expected outcome and possible weak points. Main strategical efforts are seen by the project participants as the establishment of autonomous data management through digitalization and the involvement of the workforce’s digital competence creating a digital mindset. These are the main points of the strategy enhance the competitive capabilities of the company to ensure future performance. A potential of these actions is a strategy which enables a sustainable production. Dictating the contents of the strategy is suggested to be the Chief Digital Officer in combination with the company’s existing digitalization strategy. However, the contents of the existing strategies must be broken down more clearly to further ensure the strategy’s performance. A project participant views the company strategy as an overarching defined strategy and specific activities as a part of the strategy in combination with technological road maps. The project participants who saw that their company did not have a defined digital transformation strategy in place interpret the company’s digital transformation correspondingly. The main viewpoint of digital transformation is the bottom-up perspective through enabling the involvement of different initiatives and that there is no clearly defined road map. This is suggested to be common for the company’s strategy to stimulate initiatives and creativity. The transformation is therefore handled in various differing ways and employees are suggested to through their own interpretations formulate activities to stimulate the company’s digital transformation. However, the need for a more clearly defined roadmap with required steps exist due to the complexity of the subject. Establishing competence and clarifying the focus of the strategy are essential parts that should be included throughout the strategy. Therefore, education is seen as a vital part of the strategy. Current viewpoints suggest that the company’s strategy is an unclear, poorly communicated bottom-up strategy. Which also seeks to create an understanding of the digital transformation and the focus relying on individual’s initiative to further establish its contents, resulting in a strategy that is in its initial mostly undefined steps. The main challenges seen by the project participants are obstacles related to decision making and clarity regarding authority when transforming. Other challenges were the speed of the transformation, short term problems, the time and effort it takes to build and acquire the right competence.

Financial aspects are also a possible challenge as investments may not be so plentiful along with hesitation of said investments and challenges regarding the traditional viewpoint of return on investments does not apply strongly to digital transformation strategies. In addition to the hesitation of investment it is seen to be challenging to create a profound widely accepted viewpoint of the beneficial aspects of digital transformation strategies and the benefits it can bring. Coordination and cooperation are a vital part to acquiring velocity for the transformation. There are no one solution that fits all and
can solve all problems regarding the challenges which creates a circumstance of uncertainty. Challenges are also seen to be the ambiguity of the subject of digital transformation and how to pragmatically strategize. Prioritization and concretizing are requirements of a successful strategy to avoid challenges and to further ensure a companywide supported transformation.

4.3.3 Company C

Due to the unique situation of Company C and the acquiring, their capability to communicate with their employees has been affected. Which has created a situation where the project participants do not decisively know the current state of its digital transformation initiatives if they exist. This has resulted in viewpoints that are scattered, most prevalent regarding the state of their digital transformation strategy. Through expressing their own personal viewpoints regarding digital transformation strategy, the project participants state correlating viewpoints. The essential parts of such strategies are found to be concrete initiatives supporting the formulating of novel activities and the implementation of technologies to support the transformation. Technologies and concepts as Big Data, full automation of internal logistics, fully digital communication and system integration are seen as essential parts of digital transformation strategies. Nonetheless, the project participants stress that clarity and concretizing are essential parts of a strategy for it to succeed, which resembles the current state at the company regarding its digital transformation efforts.

The company has defined digital transformation strategies according to the project participants but their descriptions of said definition lack substance and clear elements resulting in a situation where the credibility of that observation is insufficient. Nonetheless, the strategy is seen to be the process of eliminating or transforming analog and paper bound processes throughout the company’s production and logistics. Development of competence and the acquisitions of data to further perform analytical processes are also seen to be fundamental aspects of the company’s strategy. The insufficient communication of the strategy is further seen by some project participants to be a challenge for the company. How the strategy should be performed, and its contents are not communicated well to individual sites creating lapses of knowledge. This is further seen regarding the motivations and the outcomes of the strategy resulting in a vision that is not perceived clearly by the company as a whole. Even though some of the project participants see the strategy as unclear some still see it as a main part of the company’s developmental efforts. The company’s main focus as seen by one project participant are the identification of possible digitalization areas to increase the performance of the company in areas such as quality, productivity, and safety. However, the company’s digital transformation strategy faces many challenges according to the project participants. The main challenges identified are the implementation of digital solutions due to the high effort requirement and how to specially perform this is not communicated well enough to specific sites. Other challenges are communication, the concretization of vision into specific actions, needs and challenges, implementation of production systems and business tools. A point of interest is the workload aspect of digital transformation strategies which is a hindrance because majority of the focus is on the value creation for the customer that development does not get the attention it requires to perform optimally. Furthermore, digital transformation is perceived to bring a substantial change to the workforce if it should be properly strategized and implemented.

4.3.4 Company D

The respondents’ see a digital transformation which has specific focus areas and concrete activities and information regarding what to do, how it should be done and when it should be done. Further stating the importance of clarity when stating that specific tasks and actions that should be made is seen as important to achieve a digital transformation strategically. Which technologies that should be implemented and utilized throughout the transformation along with its potential impacts are also a point of interest according to the project participants. The management of employees throughout the transformation and how development of competence is also of great importance to ensure that the transformation can be fully supported by the workforce. Standardizing the transformation on a companywide level the
company is a large task but seen as an important part of a digital transformation strategy. Without standardization the benefits and impacts of digital transformation may be lost and possible challenges when different unstandardized systems are set in place. To achieve the possible benefits of the transformation throughout the entire company. The company’s digital transformation strategy mirrors the project participants’ individual viewpoints regarding the subject. Company D has a companywide strategy which seeks to through the implementation of technologies generate and enable novel business practices.

Main parts of the strategy are organizational aspects such as the development of competence through training and the communication of the transformation to ready the company for a change. The technological aspects of the company’s strategy focuses on technologies which are scalable ensuring future utilization. State of the art infrastructure and digitalization are also main points of the strategy. Connectivity to enable practices as data analytics to support decisions are of importance. Further corresponding aspects found in both the project participants’ viewpoints of digital transformation strategy and the company’s vision, purpose, governance, impacts and expected outcome. However, these aspects are not further elaborated, and specifics are not brought forward. The individual project participants’ opinion regarding the company’s strategy is mostly unanimous, identifying similar existing and possible challenges. The project participants’ view the strategy to be operating on a site to site based and to some extent process to process based and may be missing some parts focusing on standardization and how to handle possible conflicts when local and global levels do not cooperate. However, one of the respondents view it as very focused and communicated well and the vision is clear but that there are still many steps to take in areas of organization, knowledge, and technology. There are many challenges according to the project participants that are facing the company’s digital transformation strategy. They further explain that the new roles and methods that are seen to be a part of the strategy are of concern. How to internally transform is a challenge and one of the project participants exemplifies this in the company’s prior efforts to scale down on the outsourcing of IT and internally develop it and it took great effort and time to gain the right momentum. The essence of local ownership is an additional challenge as it may hinder transformation efforts. Similarly, another project participant perceives the aligning of strategic plans as a hindrance as the maturity level differs greatly throughout the whole organization.
5 Analysis and Discussion

This section of the thesis analyses the different data sources in the context of the research questions: Which are the crucial aspects of digital transformation? How should digital transformation strategies be approached? Which resulted in several accompanying analytic themes.

5.1 Which are the crucial aspects of digital transformation?

An assessment of how digital transformation as a concept is being characterized throughout academic literature and how the case companies describe their efforts as well as their project participants’ understanding. This further results in four different analytic themes:

- The different views and meanings of digital transformation: Comparing the coordination project as a whole with the academic literature.
- Technologically driven digital transformation: Exploring the technological aspect of digital transformation.
- Organizationally driven digital transformation: Exploring the organizational aspect of digital transformation.
- Fundamental aspects of digital transformation: Concluding the different aspects of digital transformation and viewing the properties of digital transformation definitions as found by Vial (2019) and specified in Table 2 with viewpoints from the case companies.

To decipher the phenomenon of digital transformation crucial aspects were identified such as: What is the current state through analysing the different driving forces of digital transformation. Furthermore, through analysing the different driving forces, a comparison with the properties of digital transformation definitions as presented in Table 2 and the empirical findings a viewpoint of the fundamental aspects of digital transformation could be identified.

5.1.1 The different views and meanings of digital transformation?

As both the theoretical framework and the empirical finding presents, Industry 4.0 and digital transformation as concepts are far from universally defined. Industry 4.0 as a concept is a widely adaptable one with several different technologies and practices included, resulting in an ununified understanding of the current industrial era. The different technologies and concepts that it includes has its own set of possibilities, challenges, and prerequisites that companies have to adapt to their own unique situation to make the concepts of Industry 4.0 approachable. Realizing the full potential of Industry 4.0 through becoming Industry 4.0 is a vague statement as the great scope present a situation where it becomes too non-specific to fulfil all the prerequisites. Efforts towards transforming once’s company to a state where it becomes Industry 4.0 can have unforeseen implications as the impacts are difficult to accurately forecast. But understanding that Industry 4.0 is a possible vague concept that may not be fully achievable but focusing on the individual technologies, concepts, and practices that it encompasses. Through concretizing Industry 4.0 it can work as a basis to focus digital transformation efforts more precisely. However, the current state of digital transformation is also subject to scattered definition. Efforts towards defining digital transformation throughout the academic literature consist of numerous varying definitions with conflicting viewpoints creating a scattered state of academic literature. However, through analysing 10 digital transformation definitions as stated in Table 2 based on the viewpoint that digital transformation definitions have four common properties: target entity, scope, means and expected outcome, common viewpoints was found.

The current state for the digital transformation coordination project partners correlates to the academic state of digital transformation in the sense that definitions vary to a high degree. All the companies find themselves in unique positions with varying extent of digital transformation initiatives and the use of the term digital transformation may be in question. This is due to the fact that the companies have undergone digital transformation to some extent has to a high degree done so through the means of creating their own initiatives which they have ownership of. These company owned initiatives in
themselves comes with new terminology which often was used as a substitute or contain elements which are highly comparable to terms as digital transformation. Such initiatives and terms were also found in some cases to be used for Industry 4.0 initiatives which can possibly dilute the distinctions between the two different terms. Nonetheless, common themes were identified throughout the case companies’ project participants’ viewpoints of digital transformation even though it was to some extent a novel concept. The exact usage of the term digital transformation may not be a focus of the case companies but to some degree equivalent concepts are being utilized. Therefore, the case companies’ initiatives are being analysed and presented by their project participants throughout this thesis.

To further facilitate an understanding of the current state of digital transformation a comparison of the definitions found throughout the academic literature and the case companies will be presented. Based upon the findings of Reis, et al. (2018) and Van Veldhoven, et al. (2019) regarding the dimension of digital transformation being driven by technological, organizational, or social aspects. Based upon the case companies the social aspect of their digital transformation dimensions is disregarded for this thesis since the empirical findings does not support the fundamentality of a social digital transformation aspect. The digital transformation definitions are further viewed through the proposal of the essential digital transformation properties as identified by Vial (2019), target entity, scope, means and expected outcome. This is done to further identify the essential components of the definitions and the stated viewpoints of digital transformation to determine they are mainly technologically or organizationally driven.

5.1.2 Technologically driven digital transformation

The empirical findings support the importance and the possible impact of technologies to drive digital transformations. Inclusion of technologies is seen as a way of transforming existing processes and be a main enabler of novel business practices and utilization of existing processes, mainly through further data utilization. Technologies are often seen as a means to achieve flexibility and enhanced productivity to further the company’s competitive capability to guarantee future survivability. The importance of technologically supported digital transformation is further supported by Mergel, et al. (2019). The industrial project partners see technologies as a changing component of digital transformation and a supporting factor in achieving a holistic continuous transformation which brings customer satisfaction and competitiveness. The communication and utilization of data is seen by the case companies as a main component of a technologically driven digital transformation. Increasing accessibility through implementing supporting systems to increase communication capabilities internally and externally is seen as a value generating possibility. The importance of implementing data communication technologies in combination with other technologies is found by Vial (2019), who sees the technological aspect as a main component to achieve a transformation to any given entity. The implementation of novel technologies is seen as a transforming factor that can evolve the entire product development process as well as production generating value to all stakeholders. Technologies are often seen as a concrete pragmatic possible first step of a digital transformation. This further makes digital transformation tangible and possibly more approachable instead of the possible additional viewpoints which requires overhaul of organizational structures. The specific technologies cited by the case companies varies greatly but are often the ones included within the Industry 4.0 framework. The specification of technologies that are a part of the Industry 4.0 framework is also stated throughout the academic literature. Heilig, et al. (2017) and Van Veldhoven, et al. (2019) states that concepts and technologies such as IoT, cloud computing and data analytics as essential parts of technologically driven digital transformations. However, specifically stating which technologies that should be included in digital transformation is not a unanimous viewpoint. Mergel, et al. (2019) and Zaoui, et al. (2020), states that the unique situation of each individual company presents a situation where all technologies may not be applicable. Therefore, specifying which technologies which should be included can be contra-productive, which results in a less approachable digital transformation. The viewpoint of not specifying which technologies which should be included are also found throughout the digital transformation coordination project. However, this may be the consequence of a lack of clarity and a company-to-company level where technologies are not specified. However, corresponding to the academic literature
the case companies which had a clear definition for digital transformation had contradicting viewpoints regarding the need for specification of which technologies that should be a part of a transformation. Both specific technologies as digital twin, virtual manufacturing, and additive manufacturing were stated as essential of a company’s digital transformation. Project participants however also stated that an open approach to ensure that a wide array of technologies can be applied was of good practice. Other viewpoints within the case companies sees the digital transformation as the effort to achieve a change that novel digital technological applications can be utilized and not a means of a digital transformation. Viewing digital technologies as an essential driving part of digital transformation is a viewpoint that is commonly found throughout academic literature. This viewpoint is supported by Ismail, et al. (2017) who sees the implementation of novel digital technologies to enable enhanced connectivity to increase competitive capabilities and to ultimately support a holistic transformation to ultimately reach superior performance. Terms as digital technologies are often used to describe the technologies in which digital transformation encompasses which is a point of interest throughout the academic findings. Viewpoints regarding the use of the term digital technologies differs. Vial (2019) avoids the term, to further explain that using the term digital technologies as he sees it as an unclear term which may cause for future negative impacts for digital transformation as it may become less approachable. However, Ismail, et al. (2017), Reis, et al. (2018), Shahi, et al. (2020) and Van Veldhoven, et al. (2019), all include the term digital technologies in their effort to defining digital transformation. Furthermore, they all included highly correlating technologies such as automation enabled through IT, internet, advanced AI, and social applications. This was also commonly found to be the technologies cited by the other authors that saw technologies as the main means of digital transformation that did not specifically use the term digital technologies. This is seen through the technologies included by Heilig, et al. (2017) which mirrors the contents of previously stated digital technologies as included within the term digital technologies. The term digital technologies can to some extent be seen as a term including state of the art technologies with digital properties. However, this may affect the approachability as stated by Vial (2019). Due to the fact that technologies are ever changing and over time the term digital technologies are prone to change which possibly will cause unclarity regarding which technologies it includes. However, a conflicting viewpoint regarding the impact of using the term digital technologies to describe technologies involved is stated by Morakanyane, et al. (2017), who purposefully use the term without specifying which technologies that are included further than stating that they are novel information and communication-based technologies.

As seen the current state of technologically driven digital transformation is a scattered one with different viewpoints being found throughout both the case companies and academic literature. However, commonalities are found in the focus of utilizing the potential impact of technology with data and digital components. To further enhance existing internal and external organizational aspects resulting in a holistic digital transformation. Which will provide companies and its stakeholders with value through data driven novel business practices enabled by applicable technologies which are suitable for companies’ unique situations.

5.1.3 Organizationally driven digital transformation
As stated by Van Veldhoven, et al. (2019) and Reis, et al. (2018) organizational and business aspects are an essential core element of digital transformation commonly found throughout the literature. Further explaining that organizationally driven digital transformation strives towards transforming operations, internal structures, workforce competence and business models to ultimately achieve radical performance improvements and value creation for the company’s stakeholders. Organizational aspects as a fundamental part of digital transformation are also found throughout the case digital transformation coordination partners viewpoints. All parts of a company are seen to be subject for change when discussing digital transformation. Organizational structures, communication infrastructure, horizontal and vertical communication, value-chains, and supply-chains are suggested to be the main entities that are going to affected by digital transformations. One of the main organizational point of interest found throughout the viewpoints of the case companies are the importance of the human factor, mainly the
impact of digital transformations on the workers. The state of digital competence throughout the companies as an entirety is seen by the case companies as insufficient to some extent and development of competence is therefore seen as a need. A cultural change of companies to further stimulate competence and to create an inclusive transformation is also seen as an essential part of an organizational perspective of digital transformation throughout the empirical findings. The project participants’ significance as seen by the case companies may be a main concern due to the perception that the current competence is not sufficient and may be a possible hindrance. Therefore, the case companies state that realizing changes are primarily achievable through incremental and continuously improving and integrating changes throughout organizational structures. The case companies further state that achieving digital transformation through breaking down long-term goals into sections of mid- and short-term ones to concretizes and ultimately makes transformations approachable. This was mainly found throughout the case companies concern regarding the possible challenges that face digital transformation strategies. Furthermore, concerns regarding the affect that digital transformation has on individuals’ sense of ownership, creating a situation where the possibility to affect a transformation is highly sought after but can also generate possible challenges when scattered initiatives does not synergize. Corresponding findings regarding the importance of acquiring the right competence is not widely found throughout the academic definitions of digital transformation. Workforce competence is mentioned to some extent as a prerequisite to some of the technologies but is not a focus to the same extent as technologies. This viewpoint is also elaborated on by Reis, et al. (2018) who sees that the competence of workforces is subject to change and are to some extent a target of digital transformation to achieve efficiency and customer satisfaction. However, Heilig, et al. (2017) perceive competence’s place in digital transformation as a consequence of the efforts of transforming organizational structures and not a specific entity which company’s focuses their digital transformation on. Heiligs, et al. (2017) viewpoint is further established by the case company’s view, as they often cite technologies as the main component of their digital transformation. Mainly the means of achieving one or in some cases the sought-after outcome while competence development is a point of interest generated based upon the requirements of the novel business practices that company’s seeks to utilize. Similar findings can be seen throughout the academic literature discourse regarding workforce competence and authority shifts affecting operators and managers that comes with Industry 4.0. The academic literature strongly suggests that organizational shifts which evolves the operator role to a more authoritative and competent one. Lall, et al. (2017) and Thun, et al. (2019) state that operators will have more responsible roles in the future and may overtake the tasks managers currently has to some extent. Further supporting the empirical findings of viewing competence as an important part of digital transformation is seen by Raj, et al. (2020), who sees that even if novel practices are successfully implemented, they still require the right skills and tools from the operators and managers to optimally operate. This viewpoint can, however, be seen as apparent, since an implementation of novel business practices or a shift of organizational structures will always require the right competence to be supported and to have optimal performance.

The importance of engaging with organizational shifts instead of only focusing on implementing novel technologies and business practices is seen both by academics and the case companies. Nambisan, et al. (2019) explain that development of internal entities including digital technologies, platforms and infrastructure is of great importance since such action can fundamentally change organizational aspects of companies and therefore impact their business practices. This is also supported by the guidelines found by Company D which proclaim that the capturing of value is of more importance than chasing the next innovation. Further stating that capturing and establishing implemented practices and perfecting them are of greater importance than trying to acquire attractive novel technologies that may not bring all the beneficial aspects promised.

The organizational aspect of digital transformation is also found throughout the case companies’ internally created initiative: Factory 4 Tomorrow by Company A and World Class Manufacturing and Supply Chain 4.0 which were company owned initiatives formulated by Company D. Companywide
efforts including digitalization and strategical efforts which requires organizational changes to achieve the sought-after outcomes. However, the terms are not fully explored and clearly defined with the exception of Factory 4 Tomorrow to some extent, resulting insufficient knowledge regarding the maturity and the exact contents of those initiatives. However, these initiatives as described by key individuals as holistic efforts of digitally transforming their company. Holistic viewpoints are found throughout the empirical findings, suggesting that the entirety of companies, including the organizational structure are subject of transformation. Internal and external aspects are suggested to be subject of change which should support digital transformation efforts. Which results in a digital transformation that is open for individualism for specific companies as specific aspects of organizational structure that should be subject of change are challenging to determine on a general level. The focus on holistically engaging with digital transformation initiatives are also set as a guideline for digital transformation through suggesting that small initiatives with large scale optics are an optimal way of creating change. Which is supported by the findings of Mergel, et al. (2019) and Van Veldhoven, et al. (2019) who emphasise the importance of having holistic goals when engaging with digital transformation to deter from individual prospects with little to no companywide positive aspects. Zou, et al. (2020) also sees the subject of driving digital transformation similarly through stating that internal initiatives should be the accelerating factor for external goals, suggesting that internal aspects should be the initial focus of digital transformation. This viewpoint is also supported by the empirical findings where bottom-up initiatives are highly valuable when generating digital transformation momentum. An additional aspect of bottom-up approaches as seen by the case companies are the competence development and local ownership, that was suggested to be an outcome. However, bottom-up initiatives are perceived as some as insufficient due to the possible constraints that those efforts may have on a global company level. Furthermore, bottom-up initiatives may not be suitable to be a driving force to change organizational structure, prompting the need of having a combination of top-down and bottom-up perspectives which is also suggested by the case companies.

Organizational change as a driver and a fundamental aspect of digital transformation is both found throughout the theoretical and empirical findings. However, specific aspects are not thoroughly established, creating a situation where an organizational viewpoint can be understood as vague and unclear. The nonspecific aspect of organizationally driven digital transformation is a result of the unique situation that companies, mainly their current organizational structure, infrastructure, and competence. Competence as an organizational aspect, is the one most explored throughout the literature and case companies due to the importance of having the capabilities to drive and utilize the contents of digital transformation. The viewpoint of requiring further competence often originates from the need of handling the technologies that companies might implement when digitally transforming. However, without clearly defining organizationally driven transformations strategical viewpoints often are included. This is a problem found throughout both the academic literature and the case companies which no clear distinctions between organizational shifts and strategical efforts are found. Which further deteriorates to some extent the distinction between digital transformation definitions and digital transformation strategies.

5.1.4 Fundamental aspects of digital transformation

Digital transformation as a subject can safely be viewed as a scattered unclear one with many different viewpoints. This is further established by academic literature and empirical findings. However, common themes are found, the implementation of technologies and transforming company entities. The relation between these two main themes as seen by the theoretical framework and empirical findings may differ but a relation is still commonly found. The case companies most often find the relation between them through identifying that technologies, most often digital, require organizational changes to support them. Most commonly through establishing adequate workforce competence, infrastructure, and changes to horizontal and vertical communication. This further emphasises the importance of holistically approaching digital transformation. Understanding that to fully achieve digital transformation great changes has to be performed. However, great changes are not the way of approaching digital
transformation. The empirical findings, Mergel, et al. (2019), Morakanyane, et al. (2017), Schallmo, et al. (2018) and Val Veldhoven, et al. (2019) both indicate that incremental continuous approaches to transformations are the most efficient which does not make digital transformation as a phenomenon unachievable. The academic literature further indicates that continuously integrating technologies with business and organizational elements will enable the creation of novel business practices. The literature and empirical findings therefore indicate with certainty that technological implementation that interacts with existing organizational structure to change business practices are the fundamentals of digital transformations. Evaluating the common viewpoints found by the digital transformation coordination project partners and the academic literature of digital transformations through the properties established by Vial (2019) some fundamental aspects can be identified.

- **Target entity:** Company controlled entities both internal, external which affects the company’s stakeholders (employees, customers, partners, and company management).
- **Scope:** Holistic substantial changes reached through incremental and continuously integrating the digital transformation initiatives throughout the organizational structure to ensure optimal performance. Without sufficiently recognizing the importance of having a holistic understanding of digital transformation efforts may be ultimately insufficiently supported and possibly fail.
- **Means:** Technologies that contain digital characteristics that can further utilize and enable the utilization, communication, and enhancement of data. The technologies of Industry 4.0 are often seen as the essential technologies that are approached through digital transformation with the emphasise on data enhancing technologies.
- **Expected outcome:** The enabling of implementing and utilizing novel business practices to further generate value for company stakeholders.

Individual circumstances as found throughout the academic literature and empirical findings greatly dictate the extent of digital transformation and the contents that may be applicable. Therefore, exact define contents are impossible to determine while sustaining any possible approachability and generality digital transformation. This further initiate the importance of creating an internal companywide viewpoint of digital transformation that is well communicated to establish company specific target entities, scope, means and expected outcomes.

### 5.2 How should digital transformation strategies be approached?

To generate an understanding of how digital transformation strategies should be approached two analytical themes based upon the different data sets of this thesis were identified:

- **The key factors of digital transformation strategies:** Comparing the academic view of digital transformation strategies with the empirical findings to identify the key elements to strategize.
- **The constraints of digital transformation strategies:** Analysing the main concerns of digital transformation strategies that the empirical findings present with comparisons to the academic literature.

To present an approach of how to strategize digital transformation accordingly the key factors are presented, and the different constraints are identified through analysing the data retrieved from the case companies in comparison to current academic literature.

#### 5.2.1 The key factors of digital transformation strategies

As seen throughout the academic literature and the empirical findings, approaching digital transformation strategically is a demanding task that require adequate understanding of certain key factors. Furthermore, viewpoints regarding the contents of the strategies vary throughout the academic literature as is presented by the suggested strategies by Schallmo, et al. (2017), Tillväxtverket (2017) and Vial (2019) which correlates with the empirical findings where the focus differ from case company to case company. However, a universal finding regarding digital transformation strategies is what the
literature suggest that it set it apart from traditional IT strategies is the holistic aspect (Chanias & Hess, 2016; Matt, Hess, & Benlian, 2015). However, the case companies present situation where strategical efforts are mainly scattered but project participants state a need of engaging with the strategetical efforts strategically on a companywide scale. Furthermore, the case companies also suggest mainly that manufacturing aspects are the main focus of the initial digital transformation strategical efforts, with the need of engaging with the strategy on additional organizational aspects to fully support it, generating a need of a holistic strategy as found in the literature (Chanias & Hess, 2016). Specific actions to further understand and how to engage successfully with digital transformation is suggested throughout the academic literature (Bharadwaj, et al. 2013; Correani, et al. 2020; Matt, et al. 2015; Mhlungu, et al. 2019; Tillväxtverket, 2017; Ziyadin, et al. 2019). These are presented through different approach methods, varying from roadmaps, dimensions or just key elements that should be considered which all seeks to generate an understanding of how to adequately approach digital transformation strategies successfully. Even though the key factors that should be considered are presented differently, commonalities are still found:

- Generating and understanding of the current state to understand which activities should be a part of a digital transformation strategy. Which is of great importance due to the unique situation of every company (Matt, et al. 2015; Ziyadin, et al. 2019).
- Establishing which aspects of that will be affected by a digital transformation strategy and how these aspects will affect each other. Understanding how implementation of novel technologies will require organizational shifts to support the technologies accordingly (Bharadwaj, et al. 2013; Correani, et al. 2020; Matt, et al. 2015; Tillväxtverket, 2017).
- The communication of strategical efforts to generate an organizational wide cultural shift which generate support through practices such as establishing competence through training and enabling bottom-up initiatives through clarifying governance which results in employee empowerment. Communicating the contents through prioritization and specific activities are essential to generate supportive culture (Correani, et al. 2020; Matt, et al. 2015; Mhlungu, et al. 2019; Schallmo, et al. 2019; Tillväxtverket, 2017; Ziyadin, et al. 2019).
- Understanding how the financial aspect will affect the strategical efforts, how value generating activities will be changed to appeal to customer demand and how the value will ultimately be captured (Bharadwaj, et al. 2013; Correani, et al. 2020; Matt, et al. 2015; Mhlungu, et al. 2019; Schallmo, et al. 2019; Tillväxtverket, 2017; Ziyadin, et al. 2019).

The key elements presented throughout the academic literature are supported to some extent by the empirical findings. However, since the digital transformation strategies of the case companies are in their initial stages, analysing sought after strategetical elements as stated by the project participants still support the academic findings. The case companies state that the most essential aspect of a successful digital transformation strategy is the communication of it since the project participants often see this as a main lacking feature of their companies’ strategy. Organizational aspects, mainly competence and governance are seen as vital aspect to generate a supportive culture with a knowledgeable workforce which can adequately perform digital transformation activities. Furthermore, the establishing of governance is seen as a way of generating innovations on different organizational levels, which is seen by Mhlungu, et al. (2019) as an essential aspect of upholding a culture that supports digital transformation strategies. Additional organizational aspects are the sharing of knowledge since the project participants see the lack of knowledge as a key factor for the current situation of differing viewpoints of how strategetical activities should be performed, resulting in a non-uniform support. Organizational aspects as seen by Company A does not only focus on cultural but also leadership, which will guide through the changes and have a holistic view to ensure that the right activities are performed. The relationship between technologies and competence are a main concern for the case companies, but also a main motivator since technology is seen as the main transforming factor which can affect the companies’ capabilities. Technologies is seen as an impactful part of the strategy which can change the
organizational structure due to the perceived data that can be utilized through novel technologies and
the novel business practices that are enabled. This coincides with the findings of Matt, et al. (2015), who
understand the elements of digital transformation strategies as dimensions which affect which affects
each other through the use of technologies. Matt views the technological aspect of digital transformation
strategies as an element that will affect both organizational elements but also the way value generating
and capturing activities are performed. Which is a main common theme seen throughout the case
companies view, the need of generating an understanding of how technologies will affect the companies’
activities and which organizational measurements which has to be performed to adequately support
novel disruptive technologies. Company B view roadmaps as an adequate method of assuring that
technologies are implemented with optimal performance. The use of roadmaps is also suggested by
Ziyadin, et al. (2019) who presents a roadmap which considers the many different aspects of digital
transformation strategies to assure that the different activities fit their specific context and that the full
value is captured. Regarding value Company A stress, the importance of capturing the value from
innovations to ensure that investments are not wasteful and that innovations are fully implemented.
Ziyadin, et al. (2019) see the capturing of innovations are mainly enabled through first understanding
which innovations will fit into the current organizational and technological structure to avoid possible
complications which may diminish the impact of innovations. Ensuring value capturing is also seen by
Company D who states that the technologies and novel business practices that comes from digital
transformation strategies must be scalable to ensure that they are still useful in future settings and not
wasteful. However, Company C view the implementation of novel disruptive digital solutions as a
challenging aspect of digital transformation strategies due to the vast amount of effort it requires. This
may hinder their digital transformation strategy since the majority of academic literature view the
technological aspect of strategies as the cause of transformation and the means to acquire novel business
practices which can capture new value. However, as seen by Tillväxtverket (2017) understanding the
specific context of companies are an essential aspect of identifying which technologies that are
applicable and impactful. Based upon the academic literature and the empirical findings the key factors
of digital transformation strategies can be seen as the:

- Understanding the current unique context to identify which aspect that can or should be subject
  for transformation to have the most sustainable and attainable positive impact.
- Identifying which technologies that are suitable to be a part of the digital transformation strategy
  and understanding how the technologies will impact the organizational aspects.
- Transforming the organizational aspects to support the strategical efforts of the company
  through training to gain competence, governance to stimulate innovation generating and
  leadership to guide through the changes with a holistic scope.
- Understanding how the value capturing activities will be changed by a digital transformation
  strategy to capture the full value by gaining competitive advantages and sustaining the value of
  the transformation. With further financial understanding regarding the resources that a digital
  transformation requires to avoid unsuccessful unsatisfactory strategical initiatives.

However, there are many constraints regarding the performance of digital transformation strategies that
must be considered to assure optimal performance.

5.2.2 The constraints of digital transformation strategies
The industrial project partners focused on the possible challenges that may become constraints to a
digital transformation strategy, both current and future, this coincides with the findings of Ziyadin, et
al. (2019). The main constraints of digital transformation strategies as seen by the case companies are
the organizational, in that competence are not currently adequate to fully support a transformation.
Therefore, the main focus of the strategical efforts is seen as competence related. Additional
organizational aspects are the concern of specifying the governance which would more clearly define
which activities and obligations specific employees have in performing a transformation. For example,
Company C view a constraint of their strategy as the amount of effort it takes to support the
transformation, stating that optimal performance cannot be reached when organizational aspects are unsupportive. Company B site the main challenges as the unclear nature of their strategy which results in many uncertainties regarding how coordination, decision making and authority, further insinuating that the organizational aspects of the case companies are inadequate to fully support a digital transformation strategy. The lack of clear concrete activities which can be tangible for the employees are also a consequence of the lack of clarity regarding strategical contents. Financial constraints related to digital transformation strategies were found by Company B as they see that the implementation of novel practices is highly resource demanding and traditional return on investment does not apply to digital transformation strategies. As the value may not present itself as a specific direct consequence of a specific implementation of a novel practice. The bottom-up perspective that some of the case companies understand as a beneficial aspect is also viewed as a possible constraint. The constraints as suggested by Company D may present themselves when the different innovative initiatives that are performed on individual local plants does not properly corporate with each other. The holistic aspects may be lost, and the full capturing of value will be hindered due to the relatively short extent the local initiatives can spread. This is further established when Company D continuous to suggest that strong local ownership may be a hindrance for change and that the different levels of technological competence will limit the spread of a digital transformation. Company A further facilitate this viewpoint by stating that the transformation is not fully spread and that the gaps of knowledge and the different ongoing initiatives may not fully synergise which may cause waste and an impaired digital transformation strategy. Therefore, strategical efforts must be adequately understood in the different situations that may be found throughout an entire company to ensure that the strategy is holistic and will capture the full value of its efforts. Without standardization the benefits and impacts of digital transformation may be diminished and possible challenges when different unstandardized systems are set in place may halt the transformation.
6 Conclusions, Discussion and Recommendations

This section will present the important findings that were identified throughout the course of this thesis based upon the frame of reference and empirical findings. Further recommendations are also stated for future research on the subject of digital transformations.

6.1 Conclusions

This thesis performed a multiple case study within a digital transformation coordination project with the aim of deciphering the phenomenon of digital transformation. Prior academic research has resulted in varied definitions and viewpoints regarding the contents of digital transformation. However, the academic literature still state that digital transformation and Industry 4.0 are vital phenomenon that companies must consider to ensure survivability and competitive capabilities. Digital transformation strategies are also a widely researched, which suggests many varying methodologies to approach it. To make digital transformation and strategizing of it approachable, two research questions were formulated:

RQ 1: Which are the crucial aspects of digital transformation?

RQ 2: How should digital transformation strategies be approached?

The research questions have provided the opportunity for this thesis to contribute to the academic literature of digital transformations in that essential contents of digital transformation and strategical efforts. To answer RQ 1, the thesis analysed the digital definitions set by prior academic literature with comparisons with the empirical findings to validate the different definitions or diminish the relevance of others. The properties of digital transformation definitions as found by Vial (2019), operated as a framework to analyse additional definitions of digital transformation to find commonalities and different viewpoints. The main crucial aspects found were the focus of transforming company-controlled entities, both internal and external. Which through transformation has the potential to impact and affect stakeholders positively. Understanding digital transformation as a holistic phenomenon that not only focuses on technological aspects of companies is one of the main crucial aspects of digital transformation as it is one of the defining features. Viewing digital transformation as a continuous process and not a single event process is also a crucial aspect in understanding the holistic scope and the impact that it will have on the organizational structure of companies which seeks to digitally transform. Furthermore, understanding the relation between the impact that novel technologies and organizational structure has is a crucial aspect in the sense that they both heavily rely on each other in achieving optimal performance. Digital transformation relies on the right balance of supportive organizational structure to engage with novel disruptive technologies achieve competitive advantage to generate value for all stakeholders and appeal to customer demands. Therefore, the crucial aspects of digital transformation are found to be: the identification of internal and external company entities that require a holistic, organizational changing continuous process that utilizes the potential of novel disruptive technologies to develop novel business practices to generate value and competitive capabilities.

To answer RQ 2, the thesis analysed the key factors of digital transformation strategies and the possible constraints. Prior academic literature with statements regarding which key factors should be considered when strategizing digital transformation was compared to the current state of the case companies and their viewpoints of digital transformation strategies to find the most relevant factors. The essential factors were found to be the understanding of the unique context of each company which seeks to strategize digital transformation. Due to the different methodologies that may be appropriate for every unique company understanding the context to adequately strategize. Furthermore, understanding and determining which entities that are subject of transformation is vital to identify the appropriate technologies that are applicable and can generate a satisfying impact. Approaching digital transformation strategies requires appropriate organizational measurements through the development of competence, appointing authority and communicating the strategies contents are a key factor for successfully strategizing digital transformation. Furthermore, breaking the strategy down in pragmatic
tangible activities are an essential aspect of assuring that the strategy will be supported and adequately communicated since the potential complexity of the strategy may deter employee involvement and support. The final key factor as found based on academic literature and empirical findings is the financial factor. Establishing which aspects that will be transformed by the strategy and how the impacts affect the value generating activities and how the value should be sustained without wasteful loss. Furthermore, the possible constraints of digital transformation strategies were found to be the organizational culture and support for digital transformation activities based on the lack of competence and infrastructure required for proper innovation implementation. Additionally, the lack of financial clarity regarding the beneficial aspect of digital transformation possibly causes the lack of resources required for optimal performance. Finally, the lack of a total holistic unanimous approach may cause disparity throughout the company which causes lack of synergy and limitations on the potential benefits of transformation initiatives. Therefore, the right approach towards digital transformation strategies is suggested to be: through creating a current state understanding to identify the appropriate activities that must be performed and understanding the financial aspects of said activities and formulating them in a pragmatic holistic way to assure adequate organizational support. Furthermore, understanding and communicating each strategical step is vital to assure that the organizational aspects can support the digital transformation process by distributing authority of activities with attention to achieving synergy effects of initiatives to avoid isolation of positive transformation efforts.

The thesis researcher found that the usage of the term digital transformation varies greatly throughout the academic literature and the empirical findings. The empirical findings may suggest that the usage of the term digital transformation may not be widespread and vital in discussing the phenomenon of digital transformation as the case companies sought to utilize company owned terms which may diminish the relevance of the term digital transformation. This point was further facilitated by the findings that the company that had made the progress in digitally transforming their company had company owned initiatives which replaced the terms of digital transformation. Therefore, the use of the specific term digital transformation on an internal company level may disrupt the communicative capabilities since the phenomenon is currently subject to many varying interpretations and viewpoints.

6.2 Discussion

Further themes that were identified during the course of the thesis which were outside of the scope of the existing research questions are discussed. The additional themes were the differences found throughout the research project regarding the situations of the case companies and academic literature regarding the viewpoints of digital transformation, the extent of knowledge and the methods used to communicate.

6.2.1 The cause of digital transformation disparity throughout the case companies

Seen throughout both academic literature and the empirical findings great differences are seen throughout the viewpoints of digital transformation. This is also seen for the case companies internally and the case companies among themselves. For the most knowledgeable case company, Company A the company owned digital transformation and Industry 4.0 initiative Factory 4 Tomorrow is seen as a clearly defined initiative which guides the employees to the same directions. The effort made from Company A to clearly formulate an initiative which consist of elements from digital transformation and Industry 4.0, resulted for them in a workforce which found similar viewpoints of what the company’s goals and efforts are. This further sets a situation where digital transformation efforts can be further supported through consensus. It can also be seen that individual opinions are strongly affected by the company’s digital transformation initiatives, further solidifying the importance of forming a company specific initiative. However, all company owned initiatives does not communicate effectively and spread as the formerly mentioned. For Company D the initiatives had been named but the similar viewpoints of its contents were not clearly found. World Class Manufacturing which was suggested to be a part of the Company D's digital transformation efforts, however this initiative, if containing digital transformation elements was not well broadly found throughout the company. The initiative was
suggested by a manufacturing manager which has had potential impact of the viewpoint regarding which company initiatives are focusing on digital transformation and Industry 4.0. In addition to the existence of World Class Manufacturing, the case company has guidelines in place regarding how to approach digital transformation. The guidelines however were not commonly found throughout the viewpoints of the company’s project participants, suggesting that a lack of communication exists. The situation at the case companies that did not state that any company initiatives as their digital transformation had very different situations. For Company B the individuals understanding of the company’s digital transformation efforts were similar to a great extent. Focusing on the integration of novel technologies to enable further handling and utilization of data to generate value for customers and stakeholders. Nonetheless, common viewpoints can be formulated without the creation of company owned initiatives, but one is still insinuated to be needed by the company’s project participants to further clarify and concretize digital transformation efforts. The uniqueness of the partner companies is further found for the company that operates within the transportation industry. The specific case company has been recently acquired which sets a new unestablished state where a lack of clarity is found throughout the project participants’ viewpoints. It is not clear if the company, now after the acquiring of their prior company has any digital transformation initiatives set in motion. The company therefore site their developmental plans as their digital transformation efforts. This might possibly insinuate that efforts towards digitally transforming entities of companies are already in place and may not be directly labelled as digital transformation.

The state of digital transformation is highly individual for the case companies. Their unique situation creates different interpretations of what the contents of digital transformation is. The unclear nature of the company owned initiatives support the findings regarding the maturity of digital transformation as a whole. Which often, as seen throughout the empirical findings, result in unclear undecisive definitions concerning its contents and fundamental aspects. This viewpoint is further supported by the findings of Schallmo, et al. (2017) and Tillväxtverket (2017) who suggests that due to the relatively young state of the research subject definitions often lack clarity and a consensus is far from being established. Even though digital transformation and its company owned equivalents are in their early stages digitalisation and digitally enhancing internal and external components are still a constant part of companies’ developmental efforts. However, great differences are still seen and implementing companywide initiatives has shown to be a good platform for solidifying digital transformation and makes it as a phenomenon more approachable and understandable.

6.2.2 The communication of digital transformation

Clearly communicating factors that are used to change components of companies are of great importance. Employees value the ability to be knowledgeable to understand the contents of said changes. This is an important aspect of digital transformation, which can be seen for the case companies, as insufficient. Lack of clear communication creates many differing opinions and hurt the internal collaborative capabilities. This is furthermore found to be a possible issue for not only the communication of digital transformation but other abbreviations and terms that are used in day-to-day communication. Therefore, the introduction of digital transformation needs to be adequately communicated to establish consensus and cooperation. Factory 4 Tomorrow can therefore to the extent that it has been communicated throughout their company as a whole a success. The initiative has created a sense of consensus and has given the company concrete activities and concept that it can more instructively communicated. For the other case companies, the viewpoints greatly differ, and the viewpoints that was presented was of those who have manager, director, and leadership roles. The specific contents have to be established at a managerial level to be further communicated throughout companies as a whole. Because if the managers that have research and development roles cannot find consensus, communication of digital transformation to operators and the company as a whole will be an overwhelming challenge. Clarifying the specifics of digital transformation and Industry 4.0 that is applicable and approachable for the specific context and unique position that companies exist in are of great importance. To communicate digital transformation, in the specific terms of digital transformation
and Industry 4.0 are not of great significance. Establishing what the digital transformation efforts are through clearly communicating what should be transformed, to which extent, through which means it should be transformed and what the goal outcome of the transformation is. Specific terminology has found to be a factor which confuses the communication capabilities of companies, both internally and externally. Therefore, creating an understanding of what digital transformation is to you is of great importance since achieving in digitally transforming one’s company is of vital significance.

6.3 Recommendations
This study has provided a view on digital transformation and the strategical efforts of it through analysing academic literature and four case companies it has limitations in the depth of understanding each case company. Therefore, suggested future research is to evaluate the validity of these findings on a specific company level to determine the accuracy and applicability. To also further evaluate how communication of the digital transformation is performed and to understand how companies should reduce the internal disparities.
7 References


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8 Appendix

8.1 Survey KODIT

8.1.1 Background

“Digital transformation” and “digital transformation strategy” are closely related topics. However, in both theory and practice there is no clear consensus of the meaning of these terms. Read through the questionnaire before answering the questions.

8.1.2 Purpose

The purpose of this survey is to explore the different perspectives, views and understanding of the terms digital transformation and digital transformation strategy. The survey is the first step to gather data and will thus be the foundation for further studies in the project. Preliminary results will be presented at the coming project meeting.

8.1.3 Data

Data collected will be anonymized in terms of the name of the respondent.

Note: The answer column is dynamic which means that you can fill in as much text that you need. You can answer the survey in Swedish or in English.

8.1.4 Respondent: Background information

<table>
<thead>
<tr>
<th>Respondent: Background information</th>
<th>Answer</th>
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<tbody>
<tr>
<td>Name</td>
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<tr>
<td>What company are you working at?</td>
<td>☐ A</td>
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<tr>
<td>☐ B</td>
<td></td>
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<tr>
<td>☐ C</td>
<td></td>
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<tr>
<td>☐ D</td>
<td></td>
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<tr>
<td>What is your position/title?</td>
<td></td>
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<tr>
<td>Is your position Global/Local or both?</td>
<td>☐ Global ☐ Local</td>
</tr>
<tr>
<td>If applicable, which factory?</td>
<td></td>
</tr>
<tr>
<td>What areas are included in you work tasks? (Multiple choice possible)</td>
<td>☐ Information Technology (IT)</td>
</tr>
<tr>
<td>☐ Operations Technology (OT)</td>
<td>☐ Big data analytics</td>
</tr>
<tr>
<td>☐ Implementation of digital technologies</td>
<td>☐ Development of digital technologies</td>
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<tr>
<td>☐ Digital transformation</td>
<td>☐ Coordination of digital transformation</td>
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<tr>
<td>☐ Development of digital transformation strategy</td>
<td>☐ Roadmapping of digital technologies</td>
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<tr>
<td>☐ Maturity assessment of digital technologies</td>
<td>☐ Other</td>
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8.1.5 Digital transformation

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>1 What is digital transformation to you? Describe your view of what digital transformation implies in a production context or your company context.</td>
<td></td>
</tr>
</tbody>
</table>
2 Has your company defined the term **digital transformation**?  
(If yes, go to question 3)  
(If no, go to question 4)  
☐ Yes defined as (fill in)...
☐ No

3 If yes, what is your view on the company’s definition of the term **digital transformation**?  
(e.g., clear/fuzzy definition, narrow/broad, missing parts, etc.)  
(Go to question 5)

4 If no, what do you interpret as the company’s view of the term **digital transformation**?

### 8.1.6 Digital transformation strategy

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 What should be included in a digital transformation <strong>strategy</strong> according to you?</td>
<td></td>
</tr>
</tbody>
</table>
| 6 Does your company have a defined digital transformation **strategy**? (Yes/No)  
(If yes go to question 7)  
(If no, go to question 11) | ☐ Yes  
☐ No |
| 7 What are the main parts of the digital transformation **strategy**? |        |
| 8 What is your personal view on the company’s digital transformation **strategy**?  
(e.g., clear/fuzzy, missing parts, high-level/to detailed, etc.) |        |
| 9 What are the main challenges in realizing the digital transformation **strategy**? |       |
| 10 What are the main possibilities in realizing the digital transformation?  
(Questionnaire completed) |        |
| 11 If no, what do you interpret as the company’s digital transformation **strategy**? |        |
| 12 If no, what could be the reason for not having a digital transformation **strategy**? |        |