How New Technology can Overcome the Barriers in Virtual Project Management

Master's Thesis in Product Development

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Abstract

In line with the increased digitalization and globalization of organizations, new demands emerge regarding how team members manage the work and information flow in an efficient way. This Master's Thesis covers an investigation of barriers in virtual project management, along with an analysis of existing digital tools that possibly can be used to overcome the identified barriers. The project was conducted at the global automotive organization, Volvo Group, which was used as a case company for the investigations.

The literature research showed that most of the identified barriers when working digital are connected to the organizational culture and trust. To support the virtual work, new management skills and tools are required. The implementation of digital tools creates greater opportunities for sharing and re-use knowledge and experience in the organization, which in turn could lead to a more resource-efficient way of working, to sustain competitiveness. The research also stated that it becomes even more important when working in virtual teams to focus on the methods and processes, before the implementation of a digital tool can be performed.

The existing barriers within a Case Project at the Case Company were investigated by interviews, observations, and surveys. The investigation resulted in a list of identified barriers, as well as a requirement specification list with functions that a software would require to be able to overcome the identified barriers. Further on, existing digital software were investigated and evaluated with the use of the requirement specification list. None of the existing digital tools was able to fulfill all the listed requirements. A conclusion was made that a tool might not be able to fulfill all the functions, but could still be useful and create value for the organization if the tool consists of the functions with the highest priority.

Most of the identified barriers had their roots in the organizational culture and norms of how to act in a virtual environment. With the increased digitalization the Case Company has tried to adapt and use old processes and methods in the new digital way of working, which in turn led to a wide range of digital tools, miss-matches, and variations in the work. Hence, the company needs to put the primary focus on the methods and processes, and secondly on the implementation of a digital tool.

Keywords: virtual project management, digitalization, knowledge management, lean, agile, cross-functional, new technology, software, tools.

Acknowledgements

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<div align="center">Jasmine Björk & Ellinor Hallberg, Gothenburg, June 2021</div>

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Introduction

The introductory chapter gives the reader an overview of the project and what it covers. First, the background of the Case Company and the Case Project is introduced, followed by a problem description. Further, the aim and research questions are being presented, followed by scope and limitations, report outline, and finally the stakeholders will be stated.

1.1 Background

The Case Company is presented to gain an understanding of the context for the project, along with a presentation of the Case Project which is a part of the Case Company, used for the investigation. Finally, the problem description is presented.

1.1.1 Case Company

The Master's Thesis is conducted on behalf of Volvo Group, at the department Volvo Production Systems at Powertrain Production. The Case Company is a global industrial company, operating in the automotive industry. Hence managing many different projects, suppliers, departments, and others involved, located around the globe.

The department where the project is located consists of 11 technical pillars: safety, cost deployment, focused improvements, quality control, logistics, workplace organization, autonomous maintenance, professional maintenance, early equipment management, people development, environment, early product management, and IT. For each of these 11 pillars a process owner is responsible. The department operates in five plants, distributed in different locations, both national and international. Each plant has a local process owner for each of the pillars. This creates a network, both horizontal and vertical in the organization.

One of the fundamental success factors for the Case Company is its ability to perform problem-solving. This creates a need for a rigorous problem-solving in all the technical pillars, and management to lead and support. One of their main factors in the ability of problem solving is the collection of data. It exists a unified data collection method, but with local variances. Currently, the process can be both time-consuming, complex and exhausting. Hence some of the plants have developed local technical solutions and system to manage the data collection, which require

both local resources to develop and maintain.

It has been identified that collaboration, especially early in development projects, involves a high degree of uncertainties and is of critical importance for the efficiency of the project. Different departments use different tools and software, which leads to difficulties and problems regarding sharing information and knowledge, since data is collected in different locations. In turn, this can lead to misunderstandings and rework that requires unnecessary resources and a waste of time.

Previous work has been done and tested locally in two of the plants, to develop a digital concept tool with the purpose to harmonize the root cause processes. Findings by Malin Hane Hagström, Ph.D. at Chalmers University of Technology, has together with her colleagues initiated the Case Project.

1.1.2 Case Project

The Case Project includes five plants and five of the pillars: safety, quality, environment, people development, and professional maintenance. The Case Project is divided into five phases. In the first phase, the problem-solving process is investigated locally on each plant. This is done to provide an increased understanding of the current situation in the different plants, to see what methods and processes are used, and how it works. A problem scenario will be conducted. Secondly, the problem-solving process for each of the five focus areas will be investigated further. When the background analysis and problem identification are performed, the next phase will be to define the future wanted situation of how to proceed. Whether the organization is satisfied with the current problem-solving process or if there is a need for further development needs to be considered. When actions have been carried out, the development of a common standard should be set, followed by a integrated software solution that will provide an more harmonized way of working.

Aligned with the digital transformation within Industry 4.0, a major opportunity is identified to digitize the problem-solving processes. Harmonizing the way of solving problems within the organization would benefit the pillars. It would be easier to support each other, cross-functional, and between the plants. In addition, it would create the ability to analyze and compare results. Making the processes digital would increase resource efficiency and create opportunities to share and reuse knowledge and experience among the organization, which could provide greater results.

1.1.3 Problem Description

In line with the increased digitalization and new ways of working in global organizations and supply chains, new demands emerge regarding how customers and suppliers interact to manage the work and information efficiently.

Along with the Covid-19 pandemic, new ways of managing projects and work are required. This changed the working environment, from traditional office work to

virtual work environments where people no longer meet face-to-face. This creates new challenges and puts higher demands on project management, as well as creating demands of new ways of leading projects remotely.

To stay competitive today in a fast-changing environment, with innovations and technology, it is rather a must to digitize than a trend. To be able to follow the digital transformation, opportunities and challenges need to be recognized and identified.

To be able to work efficiently in the organization, all possible resources should be used. With the application of digital tools, collaboration cross-functional between plants could increase, utilizing the full potential of knowledge and experience within the organization, independent of location. Today's market consists of a large amount of digital software and tools, but there is often a mismatch between what the technology offers and the need of the organization. Therefore is a deeper investigation of the situation is required before any tool can be implemented to make sure to solve the actual problems.

1.2   Aim and Research Questions

The project's goal and purpose are to identify existing barriers to be able to act more efficiently and to increase competitiveness. As well as to create an overview of why digitalization should be carried out and what in-house performance and metrics might be affected. To be able to solve the project's goals and purpose, the research is limited and concretized into two research questions:

- RQ1: What are the barriers for virtual project management in large global automotive organizations?
- RQ2: How can the barriers be addressed by using new technology?

1.3   Scope and Limitations of the project

The project is a Master's Thesis work consisting of 30 ECTS that was carried out full time during spring 2021. The project was performed at the institution of Industrial and Material Science, by two students from Chalmers University of Technology, both with a BSc in Mechanical Engineering and a future MSc in Product Development.

The project was carried out during the Covid-19 pandemic, which affected the ability to attend and meet colleagues face to face. That reduced the opportunity of getting to know the Case Company and learn from best practices. On the other hand, it created the opportunity to undergo a test of conducting a research study virtually.

The project research is limited to the Case Company in a unique Case Project. The research was performed on the five plants but only concerned five out of eleven different pillars. Neither other companies, nor projects were investigated.

1.4 Stakeholders

This Master's Thesis consists of two variants of stakeholders:

1. The Case Company, Volvo Group, at the department Volvo Production Systems at Powertrain Production, receive a conducted study of the barriers that exist in the organization and in their way of running projects. By overcoming the existing barriers, may contribute to an improved, more transparent way of working where knowledge is being shared among the organization. The company may therefore act more efficiently by using its full potential which may create good conditions for being able to act more competitively on the market.
2. Chalmers University of Technology, which gets closer industry contact with the case company and will create good conditions for future continued cooperation.

1.5 Report Outline

This report consists of the following chapters, in the following order: Theory, Methods & Tools Used in the Project, Results, Discussion, and finally Conclusion & Recommendations. The Theory chapter creates a common ground of previously performed research and works as a theoretical framework for the project. The chapter states how the research was conducted and how the analysis of the research was performed.

The following chapter, Methods & Tools Used in the Project, explains the process of the project as well as what methods and tools were used. The project is divided into three phases: Identification of Barriers in the Case Project, Analysis of Existing Digital Software, and Root Cause Analysis & Final Results. After the chapter Methods & Tools Used in the Project, the Results from each phase will be presented. The Result chapter is divided into three phases, where the result for each phase will be examined.

Finally, the report will be rounded off with the two chapters Discussion, followed by Conclusion & Recommendations. The Discussion chapter includes a discussion regarding the theory research, methods and tools used, and the results from each phase, as well as ethical aspects. The final chapter presents conclusions drawn based on the findings in the results in comparison to the theory, based on the aim and the research questions. Lastly, recommendations for future work and next steps for the project, and future research will be presented.

2

Theory

This chapter includes the theory research phase for the project and can be used as a ground for the following chapters to increase the theoretical background for the project, as well as investigate the state of research conducted about these topics in relation to each other. This creates a framework for the further investigations done in the project, with the project management in mind. In addition, it also servers as a basis for the identification of barriers in project management in virtual teams and the creation of requirements for a possible digital solution to manage these barriers.

2.1 Defining the Research Topics

To be able to define the research area and to know what theory to search for, a Venn diagram was created, see Figure 2.1. The Venn diagram created a visual overview of the relevant areas of topics to search in. The relevant research area for this project is located where the different areas of topics are overlapping in the Venn diagram. Four relevant areas for the research were defined to start with, which were Project Management, Knowledge Management, Lean and Agile Management, and Digitalization.

Project Management was select due to the high relevance to RQ1, and the need for new ways to manage the teams when working digitally. Knowledge Management correlates to previous findings from investigations done by the Case Company, as well as the identified opportunity to increase cross-functional collaboration and knowledge sharing. Lean and Agile Management is related to the strategies used at the Case Company. Lean and Agile methods are in addition, often the core in the existing tools developed for managing projects. The final area, Digitalization, was selected due to the correlation to RQ2, as well to the digital transition that exists at the Case Company. The following chapter is divided into the stated topics of the Venn diagram, with the purpose to create a foundation for the rest of the report and the project.
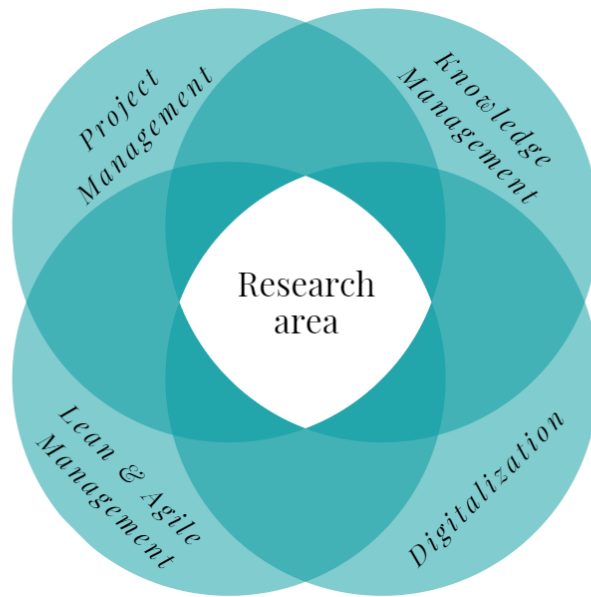
Figure 2.1: Venn diagram showing the areas for the research.

2.2 Analysis of Earlier Research

The used search engines were Scopus, Chalmers Library, and Google Scholar. Excel was used to compile the search findings. The searches were documented in Excel with search terms and the number of hits. To limit the search results, all search strings used in Scopus were limited to TITLE-ABS-KEY, meaning that the results refer to the title, abstract, and keywords. The search results can be found in Table 2.1. The relevant hits were saved and documented for later use. To analyze the articles, the abstract, introduction, and conclusion were read to identify useful and relevant information. Notations were made about what area of the research the article corresponded to. When the relevant collection of articles was found, each article was read and relevant information was collected and saved.

The research of project management and knowledge management gave broad findings and a lot of hits. Hence, the search was limited to Virtual Project Management and Knowledge Transfer. Virtual Project Management gave better results and was more appropriate since the Case Project worked in a virtual environment while the case study was conducted.

Digitalization and Virtual Project Management gave 44 hits, but most of the articles related to the area of construction and the use of digital tools specified for construction projects. Hence the search term Manufacturing OR Production was added in some of the searches.

When searching for lean and agile tools for project management or project planning in the area of production or manufacturing, a small amount of information was found. Most of the hits are related to the construction area and production in

construction, which is less relevant for this research. This indicated a research gap about existing digital solutions for project management built on the lean and agile approach, aimed for other areas than construction projects.

Table 2.1: Keyword used for the literature search and number of hits.

Search terms	nr of hits
(TITLE-ABS-KEY (knowledge AND transfer) AND TITLE-ABS-KEY (project AND management))	3551
(TITLE-ABS-KEY (management AND information AND system) AND TITLE-ABS-KEY (virtual AND organization) AND TITLE-ABS-KEY (knowledge AND management))	657
(TITLE-ABS-KEY (knowledge AND transfer) AND TITLE-ABS-KEY (virtual AND project AND management))	189
(TITLE-ABS-KEY (digitalization) AND TITLE-ABS-KEY (virtual AND project AND management))	44
(TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY ((new AND technology) OR (digital AND tool)) AND TITLE-ABS-KEY (lean OR agile) AND TITLE-ABS-KEY (scheduling))	25
(TITLE-ABS-KEY (virtual AND project AND management) AND TITLE-ABS-KEY (digital AND transformation) AND TITLE-ABS-KEY (manufacturing OR production))	23
(TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY ((new AND technology) OR (digital AND tool)) AND TITLE-ABS-KEY (lean OR agile) AND TITLE-ABS-KEY (scheduling) AND TITLE-ABS-KEY (manufacturing))	9
(TITLE-ABS-KEY (virtual AND project AND management) AND TITLE-ABS-KEY (virtual AND team) AND TITLE-ABS-KEY (supplier AND collaboration))	7
(TITLE-ABS-KEY (knowledge AND management) AND TITLE-ABS-KEY (digitalization) AND TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY (lean OR agile))	5
(TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY (new AND technology) AND TITLE-ABS-KEY ((knowledge AND reuse) OR (knowledge AND sharing) OR (lesson AND learned)) AND TITLE-ABS-KEY (lean OR agile) AND TITLE-ABS-KEY (industrial AND engineering))	5
(TITLE-ABS-KEY (knowledge AND management) AND TITLE-ABS-KEY (digitalization) AND TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY (lean))	3
(TITLE-ABS-KEY (virtual AND project AND management) AND TITLE-ABS-KEY (lean OR agile) AND TITLE-ABS-KEY (industry 4.0))	3
(TITLE-ABS-KEY (project AND management) AND TITLE-ABS-KEY ((new AND technology) OR (digital AND tool)) AND TITLE-ABS-KEY (lean OR agile) AND TITLE-ABS-KEY (scheduling) AND TITLE-ABS-KEY (industry 4.0))	2

2.3 Virtual Project Management

Projects, in general, are unique and look different in terms of size and complexity. Because of more complex systems, the project complexity has increased over time (Sohi, Hertogh, Bosch-Rekveldt, & Blom, 2016)(Cascio & Shurygailo, 2003). Projects that consist of many parties often lead to more complex project management. This may be partly due to the fact that the more people involved in a project, the more difficult it is to communicate, because of cultural differences (Rolstadås, Tommelein, Schiefloe, & Ballard, 2014). Looking at the fastest growing companies which are the global distributors, have since the 90s worked to find improvements regarding strategy and planning by exploring new ways of interacting by using state-of-the-art technologies with the aim to decrease the level of complexity among projects (Cakmakci, 2019).

Depending on the execution of the project, different management methods are more suitable than others. The traditional management approach consists of the initiation, planning, executing, monitoring and control and closing phases (Cakmakci, 2019), that in the daily work no longer is efficient (Gallego, Ortiz-Marcos, & Ruiz, 2021) (Butt, 2020), but still companies continue to use even though the chang-

ing work environment. (Sohi et al., 2016) dispute that a change is needed to be performed of the traditional way of leading projects to be successful in managing upcoming challenges within the project management area.

The increased digitalization has contributed to the fact that it is no longer just a trend to work digitally, rather a need for companies to be able to grow and to act competitively (Butt, 2020). The covid-19 situation has accelerated the digital ways of working and has not only affected everyday life but also the way of education and the way of running projects. Whether the new work situation of working from home affects people and what psychological effects there are, is something that needs to be further studied, as well what kinds of working methods and how to keep the employees motivated, fulfilled and effective. What way and what technology is needed to be able to create a balance between private life and work. How companies continue to maintain a secure network climate is also something that needs to be further investigated. In the current situation, you do not interact face to face in project teams, therefore companies must in other ways find opportunities virtual to create the best conditions for being able to share information and still work according to project plan (Dwivedia et al., 2020).

Project management can be defined as a process in movement that is continuously being repeated. The project manager's purpose is to make sure teams work according to the determined goals, as well as monitoring and controlling the results. Virtual management is described rather as a way of visualizing the information as a guide through the project and it must be done in an easily and transparently way so that everyone involved by just a view understands the achievement. This is especially important since transparency leads to increased trust, which is one of the main issues when it comes to leading virtual teams (Eaidag, abdekhodaee, Najmi, & Maki, 2018).

Virtual teams have been explained in diverse ways in the literature. (Stechert & Balzerkiewitz, 2020) describes a virtual team as a crowd of gathered members that have been organized through a group of people with different backgrounds, such as culture and level of work. Overall the different sources have one common view of what a virtual team is and it can be defined as a group of people, who regardless of position and time work aligned as a team, towards the same goals, using some kind of communication and information tools (Eaidag et al., 2018)(Lee-Kelly & Sankey, 2008)(Newman & Ford, 2020).

A team consisting of people with diverse cultural backgrounds can be described as a multicultural team. The people involved in such a team usually come from different backgrounds and countries which have shaped their values and way of acting differently. Language, values, norms, knowledge, and working processes often look different depending on country and culture (Rolstadås et al., 2014)(Sohi et al., 2016)(Lee-Kelly & Sankey, 2008) (Eaidag et al., 2018)(Gallego et al., 2021). By further looking into virtual multicultural teams, the ways of interact take place virtually through computer-aided tools (Cagitay, Bichelmeyer, & Akilli, 2015).

2.3.1 Advantages of Virtual Project Management

The advantages of virtual management and teams are that the employees get more flexible and save time due to less travel time, which in turn leads to cost savings. The flexibility also creates a greater balance between private life and work life, but may as well act negatively since people have problems separate work from private life (Newman & Ford, 2020). It also makes it possible to more efficiently and easily take help from experts and their expertise, which further can be shared among projects. Working digital creates possibilities of scheduling meetings more continuously, which in turn provide and ensure that confusion among the teams does not occur and that everyone involved is on the same path and does not spend time on non-value-added tasks (Bal & Gundry, 1999). Increased flexibility, robustness, and responsiveness among the organization will be the result of having virtual teams. By working digital instead of being located at the office, increases the opportunities for companies can act more competitively because of increased quality among products/services, more efficient and cost-effective work processes (Eaidag et al., 2018).

2.3.2 Barriers in Virtual Project Management

Findings regarding barriers in the area of virtual project management and virtual teams display that time zones and cultural diversity are influencing the ways of interact and building relations working digitally (Chai, Zhou, & Wang, 2008) (Cagitay et al., 2015). Other recurring barriers cover obstacles within management and the approach of leading and supervise the team (Lee-Kelly & Sankey, 2008).

Barriers when Leading Virtual Teams

Current barriers that appear when leading and supervising teams virtually are many. When it comes to establishing a team, there are first and foremost complications regarding the identification of skills and knowledge for the people connected in the project (Gallego et al., 2021), this may act as a risk because of ambiguous appearance and lack of responsibility fields (Lee-Kelly & Sankey, 2008). In terms of building trust among the project members and at the same time create an environment where everyone is cooperative and works according to the same rules and norms is also one of the major challenges among multicultural teams (Cagitay et al., 2015). Today, it is well known that culture is an important aspect that needs to be considered when managing and leading teams. Working digitally no longer includes face to face communication, which in turn creates difficulties and no longer gives the same opportunities to establish valuable relationships (Newman & Ford, 2020)(Bal & Gundry, 1999)(Eaidag et al., 2018)(Lee-Kelly & Sankey, 2008)(Cagitay et al., 2015)(Gallego et al., 2021), which in turn may influence the universal perspective of the organizations value, culture and norms which in turn may lead to

misjudgment, struggles and decreased conditions of information (Stechert & Balzerkiewitz, 2020)(Lee-Kelly & Sankey, 2008)(Chai et al., 2008). People have since childhood being supplied with different cultural values and social rules, which in a digital world constitute supplementary difficulties understanding the other person's way of acting (Lee-Kelly & Sankey, 2008).

Through meetings online it is challenging for the project manager to discover ways of keeping the team members inspired and stimulated, as well as making sure everyone is on the right path and operating according to the same plan and goal. How to achieve a productive way to communicate virtually and to find communication criteria that fit in the group is as well a constraint(Gallego et al., 2021). Project managers encounter difficulties in guiding teams virtually due to lack of human interaction (Lee-Kelly & Sankey, 2008)(Bal & Gundry, 1999), meaning not acquiring the encouragement and assistance that teams would experience in a face-to-face condition (Newman & Ford, 2020). In terms of authority and control, (Lee-Kelly & Sankey, 2008) claims that leaders who don't operate nearby and actively with the virtual team have trouble guiding them as well as keeping control of deliveries and their progression, which in turn puts additional requisition on the team, that they take responsibility for their assignments and supply according to the set project plan (Stechert & Balzerkiewitz, 2020).

When leading projects digitally, barriers arose such as how to disseminate assignments among participants. There is also a threat that participants don't provide what is projected, which in turn can lead to the divergence concerning the outcome of a project. This might be the consequence of a lack of communication and understanding. It is also found, that it is complicated for the project manager to get a holistic view of the participants' workload. That workstream not being sufficiently well-developed and embedded, cause difficulties regarding documentation and handling of data. If the new tools do not fit the processes, people usually end up using the old ones, since it creates a sense of calmness and familiarity (Stechert & Balzerkiewitz, 2020). People are afraid of change and therefore react with resistance (Butt, 2020). People having different competencies may lead to a different results. When working digital there is also a risk that organizational aspects become vague, because of lack of definitions and responsibility areas (Stechert & Balzerkiewitz, 2020).

Barriers in Virtual Teams

The challenges among virtual teams increase with large and complex projects, especially in global virtual teams where people are working in different time zones which makes it difficult when planning and scheduling meetings (Lee-Kelly & Sankey, 2008) (Gallego et al., 2021) (Stechert & Balzerkiewitz, 2020) (Gallego et al., 2021). Teams that work from different places do not have the same opportunity of face-to-face meetings which can lead to misunderstandings (Cascio & Shurygailo, 2003). It may also lead to that people involved not receive the education and feedback they need. Teams working from different places may have challenges in creating a community where everyone is involved and works aligned towards the same goals

and scope. The terms of handling information and documents may look different among the team depending on local variants (Gallego et al., 2021). Working digital both creates confused and worried participants. Less social contact and new configurations of formats create fear of doing mistakes (Bal & Gundry, 1999), which in turn may lead to loss of time and no value-adding work (Stechert & Balzerkiewitz, 2020). Less face-to-face contact will decrease the level of information flow which in turn might limit the resources(Eaidag et al., 2018).

2.4 Knowledge Management

With the increased digitalization and increased growth of information technology, people play a crucial role for companies to be able to act competitively. In the virtual environment, people have established new and varied ways to interact and to find and share information and accomplishment. It can thus be said that the virtual world acts as a appliance for merging and sharing knowledge regardless of time and place. By handling knowledge sharing, companies/teams can use mature resources to conceive innovative solutions with a sustainable mindset, which in turn can create greater conditions for companies being able to act in a more competitive manner (Lila, Nabi, Mohammadreza, Aliakbar, & Shervin, 2019).

Companies today consist of immeasurable amount of data, which creates opportunities to use the already existing knowledge from preceding designs and apply it to new products. This conception is called "product gene" and is a developed concept based on a modular and rapid design where the objective is by using standardized information to be able to both handle, transfer and reuse data in a more effective way. The process of transferring knowledge takes place iteratively between the giver and receiver (Wang et al., 2021). Knowledge management creates conditions for companies to be able to develop new products and improvement proposals through a collection of knowledge. Knowledge consists of technology that can be described as units (Stenholm, Corin, Ivansen, & Bergsjö, 2019). For companies to realize their full potential, in the form of resources, it is important to create a holistic methodology that creates opportunities for transporting data (Noruzi, 2018). Organizational culture acts as an important factor in achieving a successful knowledge transfer, as well when archive knowledge to provide increased collaboration (Stenholm et al., 2019).

Categorization of knowledge is determined by the degree to which the information can be declared, gathered, and codified. Either knowledge is described as tacit or explicit knowledge (Stenholm et al., 2019). Tacit knowledge is more difficult to handle since the knowledge is based on individual experiences, thoughts, and insights and is therefore much more difficult to express, distribute and codify. Explicit knowledge enables both easier transfer of data but also reuse and action since the knowledge is more concrete and can therefore more easily be both documented and communicated to others within the company (Noruzi, 2018). (Stenholm et al., 2019) mentions that it is a lack of common view of what tacit and explicit knowledge means which in turn may give different perceptions. To enable that the codified knowledge can be

reused, it is important to describe the product information, why the previous design or execution worked or why not, and also convey important motivations regarding approval of the design, production information, usage information and evaluation of different design opportunities, and trade-offs. This is important because the next party who gets access to the material must understand the context to be able to apply the material in a new environment. The infrastructure of the organization is what determines the success of knowledge management. It is therefore of high importance to review the main structure, its processes, and tools (Stenholm et al., 2019).

To increase the growth of knowledge between different international plants, a common model could have increased the division and create opportunities for knowledge to flow in multiple directions. An overall picture could contribute to the company using its full potential in the form of resources, which in turn would create increased value for the company where employees are motivated to share and transfer knowledge. Sharing and transferring knowledge becomes more important for companies consisting of multiple plants. To increase the value of sharing knowledge, it is of importance to ask "why?" to understand what value it would create for the organization, "who is involved, and what is their relationship?". By creating a foundation built on trust will increase the possibilities of valuable knowledge sharing. It is also important to create awareness, define key resources, methods of flows, follow up, and how to measure its impact (Noruzi, 2018).

2.4.1 Transfer of Knowledge

Knowledge transfer can be described as the process where knowledge is being transported between different units within or outside the organization, to benefit and learn from the unique knowledge and further apply it within new areas (Noruzi, 2018). The process can be described as repetitive between the unit that imparts knowledge to the recipient (Wang et al., 2021). To be able to share and transfer knowledge between a multitude of entities, a common goal picture would act beneficially in the context (Li, Rasmussen, & W Björkman, 2015). Knowledge transfer creates conditions for constant development and extended learning. For companies to use their full capacity, information must flow between different parties to reach the right person at the right time. Knowledge transfer success is defined by four important factors, which include: the possibilities to understand and implement the knowledge, followed by how much time it takes to transfer knowledge between the sender and the recipient and the cost of the process (Noruzi, 2018).

There are several existing challenges in terms of transfer of knowledge and the main ones are based on ambiguity, regarding what knowledge is to be transferred, how to evaluate the actual way of transferring knowledge, who is responsible for the capacity, and finally that people are resistant against change (Noruzi, 2018). There are also other obstacles such as motivational factors, where people involved experience doubts of losing their job status, as well as not being rewarded and paid for

the performed work (Stenholm et al., 2019). However, it has been established that knowledge transfer increases companies' way of acting more competitive, because the outcome expands with increased knowledge sharing (Noruzi, 2018).

Knowledge transfer success is defined by four important factors, which include: the possibilities to understand and implement the knowledge, followed by how much time it takes to transfer knowledge between the sender and the recipient and the cost of the process (Noruzi, 2018).

2.4.2 Knowledge Sharing

To create an organization where knowledge transfer is performed in the daily work, it is recommended that a condition for how well employees perform in the area should be added. This because it would probably contribute to making employees become more motivated and make more effort in the matter, and thus share more information between each other. If the organization as well adds some form of financial compensation, it would probably give further riots. Sharing of knowledge can be described as the process by which information is transferred between two parties. Assessment of the efficiency of the process can be evaluated from the relationship of the two parties. A closer contact rise to more efficient sharing of knowledge (Li et al., 2015).

Knowledge is the decisive factor for the presence of a company. To make sure that the company's resources in the form of knowledge are implemented and used in the best way, one must review the conditions that exist to promote the sharing of knowledge. A contributing factor is an organizational community, which acts as an important factor. Creating it virtually is a challenging act, as the participants must be engaged and eager to share their expertise. By sharing knowledge between different parties and teams in a developing climate, an asset is created by taking advantage of human knowledge and thus creating innovative solutions that in turn contribute to increased sustainability and value-adding process (Lila et al., 2019). Dissemination of knowledge can also take place within a functional territory where people voluntarily participate regularly to share information and support one another. This session can be performed during meetings or email conversations. Management support is always recommended (Stenholm et al., 2019).

2.4.3 Reuse of Knowledge

Reuse of technology and information can be described as a step of two events: re-context arrange of the product background and a transfer of knowledge between two different parties within the organization. Reuse of previous knowledge may contribute to increased development and improvement opportunities of consisting products. The process could be explained as more efficient and less expansive. Reuse of knowledge is described to occur specifically during four different circumstances. The first circumstance: when several people work in the same area or in the same project, which contributes to the people being able to benefit from each other's

competencies and knowledge. The second circumstance: when people from different areas work with a common type of problem. The third circumstance is when a person without knowledge explores new areas of expertise and at last: when trying to establish innovative expertise within new areas. What determines and contributes to whether knowledge is of usability is how well one has taken into account and studied the development of technology and been focusing on strategies regarding reuse of knowledge (Stenholm et al., 2019).

2.4.4 Barriers in Knowledge Management

With an increased virtual community, challenges arise regarding knowledge and its arrangement, as well as the desire to share knowledge with others due to self-interest (Li et al., 2015)(Noruzi, 2018)(Wolf, Semm, & Erfurth, 2018)(Lila et al., 2019). The virtual community is growing which leads to an increased number of network applications and new information technology. Integration of the techniques creates a large amount of complications when processing the data, which puts a high demand on the knowledge transfer methods and how to express product design information and organization. If units have diverse visions and goals, there is a risk that the transfer of resources and knowledge will not act complementary. What skills and knowledge will be transferred between the units is competence and relationship-based (Li et al., 2015).

In digital societies when generating and distributing knowledge, humans acts as a critical factor. By identifying and contributing to an increased understanding of the virtual society and its flow, problems within the organization and information systems can be identified. One is well aware that human virtually can learn and share knowledge, an area that is not touched on any deep level. Depending on the participant and their role, knowledge sharing can be regulated and limited. The current research regarding knowledge sharing is particularly implemented in the areas: business, technology, economics, and computer science, and increases mainly in Asia and the United States (Lila et al., 2019).

Reuse of knowledge is a field that often is forgotten despite its availability. It is therefore a need for developing a strategy of how to re-use existing knowledge. An area that in research has ended up somewhat below the surface. The existing research consist of reuse of systems but no explicit target on technology, nor the creation of a framework to increase re-use of knowledge (Wang et al., 2021).

2.5 Lean and Agile Management

The strategic planning process within the organization has become a struggle for numerous organizations that operate in a global environment. Strategic planning has an impact on the global coordination of the resources, as well as on the alignment of goals between the different participants in the organization. This can create a gap between the expected and performed outcome in the organization (Watson,

2019).

A common strategy is required to deal with the global work environment in an organization, as handling changes of collaboration projects between multiple departments or functions, nationally or internationally distributed. Lean management is one way to manage these situations. Lean strategies are common in manufacturing, nevertheless, the implementation of lean strategies in administrative areas requires further research (Stechert & Balzerkiewitz, 2020).

To be able to adapt to the project-specific contexts a more agile process is suitable. The agile engineering perspective increases the ability for reflection due to the step-by-step adaptation of processes in regular intervals (Bashin, Inkermann, & Vietor, 2019). Agile methods are known from the development of software. Today agile methods are more and more common, as well in the area of production and manufacturing (Wolf et al., 2018).

2.5.1 Lean Management

In comparison to traditional project management, the goals, phase structure, relationships between phases, and the participants in each phase are distinguished in Lean Management (Cruz, Tereso, & Alves, 2020). Lean is defined by Womack et al. in *The Machine That Changed the World* from 1990 as "Doing more with less" (Cruz et al., 2020). (Cruz et al., 2020) think of projects as temporary production systems and define lean projects as "systems that are structured to deliver the product while maximizing value and minimizing waste". Lean management is driven by the need for speed, quality, and flexibility, which requires clear and structured communications in multiple directions. This makes the relationships to one of the leader's main objectives (Jackson, 1996). (Cruz et al., 2020) define Lean Project Management as "the application of Lean Thinking principles to Project Management".

There are three key factors of lean management: top management is a part of the process, secondly is that each employee can shape the implementation, and thirdly is that the implementation process is characterized by continuous improvements (Stechert & Balzerkiewitz, 2020). (Stechert & Balzerkiewitz, 2020) also describes the four dimensions of lean management. The first dimension is transparency, the second is standardization and optimization, the third is leading by key performance indices, and the fourth is the culture and organization. Therefore (Stechert & Balzerkiewitz, 2020) states that "lean management is more than an aggregation of management tools, but an attitude of each employee".

According to (Jackson, 1996) lean management overcomes the traditional weaknesses of strategic planning by integrating: 1) managers plan and day-to-day learning and improvement, 2) continuous organizational learning and improvement through a framework, 3) involvement of employees through teamwork and 4) cross-functional management.

When working in a global organization it is especially important to have transparency in the work to be able to use the available resources efficiently. With lean strategies, transparency will be created through visualization, the processes will be standardized, there is a rapid reaction on deviations in the work, and waste will be eliminated through continuous improvements (Stechert & Balzerkiewitz, 2020).

Lean management coordinates and cooperate vertically and cross-functionally in the organization, making managers and leaders contribute with their knowledge and skills in teams. This aligns the company's skills and competence to compete in a unified manner against competitors (Jackson, 1996).

2.5.2   Lean Thinking

The five main principles of Lean Thinking are: 1) Value, 2) Value stream, 3) Flow, 4) Pull production, and 5) Pursuit perfection, which means to aim for continuous improvement in every activity (Cruz et al., 2020)(Dalal, 2011).

The first principle, Value, meaning that the performed activities should create value for the clients. (Cruz et al., 2020) state that it exists three types of activities, the one that creates value, the one that does not create any value but is necessary to perform, and activities that do not create any value and are unnecessary to perform, which are referred to as waste, or Muda as it is called in Lean Philosophy.

(Santos, Whysk, & Torres, 2006) state that waste is any activity that does not add any value, and work is the task that adds value. Finding the real cost can be difficult but are necessary to be able to reduce the activities that not are necessary to perform, and by that reducing the waste and decrease the costs.

By mapping all the processes, it is possible to identify all the different activities and find the correct value stream, the second principle, that adds value for the organization. The third principle, flow, has the meaning that production and work should be pulled from the client. If a pull methodology is applied only what is required will be produced, which is the meaning of the fourth principle, pull production. To achieve the fifth principle, pursuit perfection, an iterative approach is required to support continuous improvements against the ideal (Cruz et al., 2020).

(Dalal, 2011) state the following examples of how Lean Thinking can be applied in any project:
1. In many projects, stakeholders are included that do not provide any value for the project due to lack of contribution of work. That is resource-consuming and a waste of time for both the stakeholder and the project leader.
2. Another principle is the gathering and inclusion of unwarranted requirements in the project. These increase time of duration for the project as well as using available resources for non-valuable work.
3. It is also common that project leaders do not use lean thinking in projects, which meaning that focus is allocated more on tasks rather than on developing

the team members. This means that critical tasks are assigned to unqualified people, which in turn lead to re-work, project delays, or project failure.

4. Another critical element is the quality of the project objectives, meaning that the project leader should put attention to quality planning, assurance, and control to achieve the expected quality of the outcome of the project.

2.5.3 Agile Methods

Agile methods originate from the development of software to manage large-scale projects and are today more and more common in production (Wolf et al., 2018). The agile approach aims to increase the business value, relevance, quality, and flexibility (Sohi et al., 2016). Also, (Christopher, 2000) states that flexibility is the key characteristic of agile organizations. Agility is achieved when the three core elements are integrated into an interdependent system, which according to (Murray, 1996) are "innovative manufacturing structures and organization, a skill base of knowledgeable and empowered people, and flexible and intelligent technologies".

Agile methods are less structured and pre-planned than traditional management methods (Cruz et al., 2020). Agile methods are built on short iterations to adapt and update the requirements by time with the use of the accurate data available at the moment (Watson, 2019). This results in reduced uncertainties and a more accurate result due to continuous adaptation of the currently available information and knowledge. Agile methods embracing and accepting changes as something good and important (Cruz et al., 2020). Especially in the early phases of projects, it can be difficult to understand the full functionalities, continuous requirement updates are common, and the conditions for the project are still to be stated. Agile methods are therefore suitable to use in dynamic environments, which require quick changes and adaptation according to the situation (Cruz et al., 2020).

When working in an agile way, the first thing to do is to define a future vision. The project work should then be divided into smaller work packages, to be able to reach the vision. These smaller parts are called sprints and are supposed to be accomplished during short intervals, normally during two to four weeks. During the sprint, the team meets daily in a short meeting to check the status and discuss what has been done and what should be done, in so-called scrums. During these daily scrum meetings, issues will arise and be discussed. At the end of the sprint, the team reviews the result with the client to ensure that the result is aligned with the client's requirements. This agile model is highly comparable with the PDCA (Plan, Do, Check, Act) model integrated into each sprint (Watson, 2019).

With an agile way of working the organization achieves an ability to rapidly respond to changes and unexpected happenings. It helps to manage situations and projects where the conditions and demands are unpredictable and changeable (Christopher, 2000). (Bashin et al., 2019) states that "Agile process engineering is of high relevance for the development of complex products or coordinate and control the activities of different engineering domains and locally distributed teams".

To perform efficiently and to do the right task at the right time, the tasks need to be focused on the most important things at the time, as well as communicate it efficiently. Agile methods, such as scrum or Kanban-boards, can be useful to visualize tasks to perform more efficiently (Stechert & Balzerkiewitz, 2020).

2.5.4 Combining Lean and Agile Methods for Success

Since the traditional management in projects is built on a more linear process, the feedback between the phases will be lacking (Cruz et al., 2020). This can lead to re-work, errors, and delays of completion of the project or tasks, which indicate an inefficient way of working. While traditional project execution might be suitable in some circumstances, the operations in a global cross-functional environment require more flexibility (Cruz et al., 2020). Especially when working in distributed teams across the world there is a need for a new way of leading the team and the project. It requires more communication, alignment of goals, and the allocation of responsibilities should be clear and well defined.

In many projects, poor performance is related to the complexity of the project. In these situations, an agile and lean approach, could be useful (Sohi et al., 2016). Development projects have unique and non-repetitive tasks which can act as a challenge for the lean strategy (Stechert & Balzerkiewitz, 2020). In some situations, a pure lean approach is suitable, when the demand is predictable and the variety of the requirements is low. (Christopher, 2000) states that the problem with lean will arise when the circumstances are less predictable and the requirements have a high variety, which consequently requires a broad variety of resources and non-standardized work.

When working in an agile and lean way the days consists of daily meetings, circulation of information, tracking of performance, and periodical detail planning. Due to the complexity of the project, the visualization of information and to make the information transparent is necessary and entails that all team members have access to the information independent of location, day, or time (Sohi et al., 2016).

The three groups of complexity elements, which are technical complexity, uncertainty, and organizational complexity, have a notable connection with agile and lean planning elements. This means that having established planning can reduce the complexity of the project and therefore also reduce technical and organizational complexity (Sohi et al., 2016).

The significant correlation between organizational complexity elements and communication elements of lean and agile enlighten the importance of communication between all involved in the project. The communication needs to be done in an efficient way to increase the level of awareness between the team members, along with making the task responsibilities clear. A consequence is an increased level of available resources since everyone is aware of the situation and knows what everyone is doing. As the awareness among the team members increases, also the communi-

cation increase (Sohi et al., 2016).

There are certain situations where a pure lean or agile strategy is useful and efficient to apply, but in most circumstances, a combination of the two strategies may be more appropriate to adapt (Christopher, 2000). Lean is in some way integrating some agility, but it will not solve the problem of enabling organizational precision in meeting rapidly changing demands and requirements alone (Christopher, 2000). Lean and Agile are more flexible (Cruz et al., 2020) and are assumed to be a combined solution for dealing with project complexity (Sohi et al., 2016).

2.6   Digitalization

The digital transformation has become a must for businesses today to be competitive for now and in the future (Butt, 2020). The Covid-19 pandemic has further fueled the trend of digital transformation. A shift in the company's strategy is required to synchronize work among the participants independent of location or function, to maximize the effectiveness and maintain the competitiveness (Chai et al., 2008).

Due to the increased teamwork between different locations, national, international, and cross-functional, in organizations, there is a greater need for information exchange between the team members. This created the need for new technologies and new forms of communication media, the development of new technologies, in turn, made it possible to work collaboratively with distributed teams. In particular, in virtual environments, the teams need to be able to communicate and organize the work and learning. New technology web-based tools are used to support and facilitate collaboration in distributed teams and global organizations (Cagitay et al., 2015).

(Rolstadås et al., 2014) define technologies as the range of different tools and infrastructures that the employees are using to perform their activities or which the organization is dependent on. In the context of a project, this can mean project control systems, technologies for communication and collaboration, or it could be the office layout among others.

According to (Bashin et al., 2019) "Digitalization is simplifying the exchange of data and information across all fields of daily life.". (Srai & Lorentz, 2019) define digitalization as the technologies that analyze the data in a predictive purpose based on big data, the Internet of Things, social media, cloud and mobile technology, additive manufacturing, virtual reality, cognitive technology, and security. While the manufacturing and supply chain contexts are more related to the concept of Industry 4.0, the digitalization of the project management might be more related to big data, Internet of Things, social media, cloud and mobile technology, and data security (Srai & Lorentz, 2019).

2.6.1 Barriers within Digital Transformation

Digital transformation can be challenging for several reasons. According to (Butt, 2020) some of the biggest challenges are lack of standardization of implementation, documentation, and processes, the assessment of new digital tools without clear role and purpose in the organization and business, different digital initiatives from different departments, and the implementation of digitalization on a large scale without a realistic view on economical return. (Srai & Lorentz, 2019) also states that the lack of defined processes, roles, and responsibilities are major challenges for, digitalization. In addition, (Srai & Lorentz, 2019) implies that the data security and the quality of data can be challenging as well for digitalization.

The challenges for digital transformation can be divided into structural and cultural challenges. Established big structures in the organization can hinder the digital transformation. Complicated administration is common in bigger organizations, which can hinder innovation. Digitalization can also be affected negatively due to the hierarchy, which prevents change due to strict structures in the company (Wolf et al., 2018).

Cultural challenges as diversification of the employees to gain both enthusiasm for the transformation, as well as wisdom and knowledge are important challenges to overcome. Especially the diversification of generations is important, to bring both young enthusiasms together with the wisdom from the older. To use the younger generation's enthusiasm, it is efficient to involve younger employees in the management for the transformation (Wolf et al., 2018). When working in virtual teams, new actions are required to underpin the culture in the organization. Culture creates a work environment where the team member's and the leader's goals and objectives are aligned with the organization, through policies, processes, and communication (Newman & Ford, 2020). Other cultural challenges for digitalization can be lack of openness to change and collaboration, which can depend on a lack of knowledge exchange respectively lack of tolerance or incentives (Wolf et al., 2018).

2.6.2 Industry 4.0 Technologies

Industry 4.0 has become an important strategic approach in the technological transition in the manufacturing area (Bittencourt, Alves, & Leão, 2020). Real-time capabilities, modularity, service-oriented, decentralization, and virtualization are some of the main drivers for Industry 4.0 according to (Srai & Lorentz, 2019). (Srai & Lorentz, 2019) therefore state that the four principles of Industry 4.0 are interconnection, information transparency, decentralized decisions, and technical assessment. In addition, (Srai & Lorentz, 2019) states that Industry 4.0 "emphasize smart factories and production systems as the main themes, characterized by 'self-organized multi-agent systems assisted with big data-based feedback and coordination."

The industry 4.0 technologies are defined by (Zheng, Ardolino, Bacchetti, & Perona, 2020) as the Internet of Things (IoT), Big Data Analytics (BDA), Cyber-Physical Systems (CPS), Cloud Technology, Blockchain, Artificial Intelligence (AI), Simula-

tions and Modelling, Automation, and Industrial robotics, Visualization Technologies and lastly, Additive Manufacturing (see Figure 2.2).
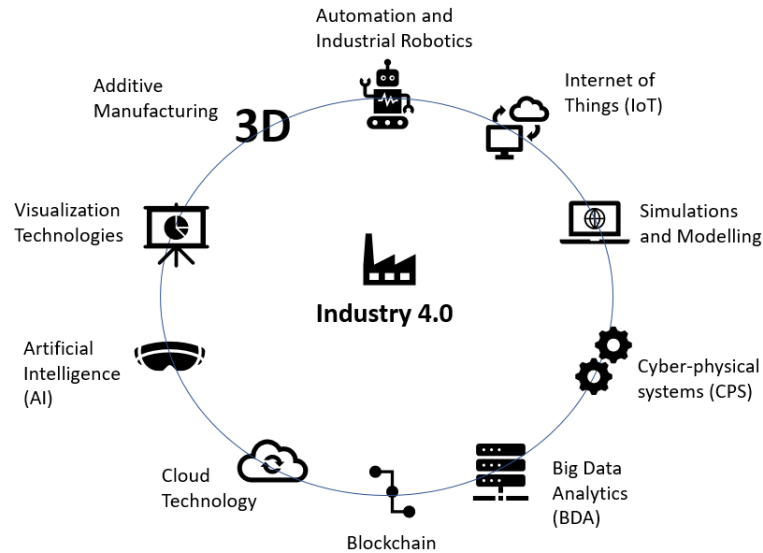
Figure 2.2: Visual overview of the Industry 4.0 technologies as (Zheng et al., 2020) defines it.

Today the real-time control is mainly implemented at the production level, and especially at the machine level. When looking at the project planning level the real-time control is lacking behind, the existing concepts are mainly based on cyclic data processing and rescheduling (Cakmakci, 2019).

New intelligent systems and technologies enable the way of working in the areas of project design and planning in the virtual workplace and value chain. Due to the increased work in distributed teams and global projects, the communication flow becomes more intense, which makes the job for the project managers more difficult. (Cakmakci, 2019) state that the decentralized project management from the Industry 4.0 approach can help to cope with that challenge. Project managers and project members need to use the new way of digital collaboration and communication technologies to facilitate the work.

Blockchain is another part of Industry 4.0, associated with the synchronization of work and data among project participants (Zheng et al., 2020). Which therefore would increase the collaboration and efficiency of communication among team members working virtually.

The three technologies IoT, BDA and Cloud work together in the entire product lifecycle, from development to end-of-life. Interconnection between all departments, functions and areas in the organization is required. Each of these three technologies enables each other. The IoT allow the creation of networks including a lot of data, the cloud enables the storage and distribution of data, and the BDA offer processing

and extraction of knowledge from the collected data (Zheng et al., 2020).

The application of Industry 4.0 technologies has improved productivity and efficiency, increased the level of knowledge sharing and collaboration, reduced costs and increased the revenues, and made it easier to deal with regulations due to higher flexibility and agility in the organization. The increased efficiency in the analysis of data, as a result of the combination of the three technologies IoT, BDA and Cloud, are well aligned with the purpose of Industry 4.0, to decentralize decision making and use real-time data to support in real-time (Butt, 2020).

2.6.3 Platform Technology

The technologies from Industry 4.0, as IoT and Cloud, make it possible to create platforms that are used to synchronize information among the stakeholder along the value chain, which increase the collaboration and efficiency in the projects, as well as the ability to plan and work predictive (Bashin et al., 2019).

Methods and tools used in previous work or projects can be stored and reused in other projects later. The desired method or tool can be fined and selected with the help of predefined characteristics and a search function. When a suitable method or tool is selected, it is possible to add that to the current process and make changes to adapt it (Bashin et al., 2019). In the creation of competitive advantage, one important ability is to share knowledge and transfer knowledge effectively between different functions and locations (Wang et al., 2021).

Therefore are (Wang et al., 2021) suggesting that the platform should include eight modules. The first module should be a support for background management, it should have user authentication, file upload, a common system for annotations, a tag selection function, chat function, a message board and lastly a search engine.

Everyone in the project needs to have access to the updated project plan and have the latest version of the documents. This can be done through emails, but it is inefficient and requires that someone have the responsibility to make sure that everyone is updated to maintain the project control and prevent errors and re-work due to outdated versions of documents (Cascio & Shurygailo, 2003). Using third generations technologies, as web-enabled shared workplaces such as platforms, are a more suitable and efficient way (Lee-Kelly & Sankey, 2008).

According to (Elevandowski et al., 2012), one of the challenges of the implementation of a platform in an organization is that it requires a major change in the organization. The process needs to be front-loaded to be able to create knowledge that can be used later. Another mentioned challenge is data security. The platform needs to make sure that only authenticated project participants have access to the information on the platform, to make sure no sensitive information reach unauthorized persons. IoT in combination with cloud creates platforms that will facilitate efficient and precise planning and increase abilities to collaborate between multiple parts, independent

of location (Zheng et al., 2020).

2.6.4   Visual Planning

Visualization of the situation is an efficient and effective way to communicate a situation and create a common understanding among team members. Visual planning is a planning method and synchronizes projects and work as it helps teams to focus, manage resource allocation, ensure delivery, and align the work with the common goal (Stenholm, Bergsjö, & Catic, 2016). Agile methods as scrum and Kanban boards are types of visual planning, that set the focus on the tasks and communicate it in a visual and effective way to the project participants, to "do the right task at the right time" as (Stechert & Balzerkiewitz, 2020) explains it.

Visual planning is traditionally done with sticky notes on a physical board, but due to the increased application of distributed virtual teams, the use of new technologies is applied to involve everyone in the planning (Stenholm et al., 2016). Using a digital tool for visual planning increases the collaboration and ensures that the knowledge of the participants is used and included in the project, hence improving the accuracy and quality of the work (Kifokeris, Tjell, Viklund-Tallgren, Farah, & M Roupé, n.d.). According to (Kifokeris et al., n.d.), the benefits of using a virtual planning tool is that it gives a higher detail of the deliverable, access independent of location, increased documentation of progress, and increased allocation of responsibilities.

On the other hand, a large variation can exist in the understanding of the tool, which can create variations in the use of the tool. Another challenge is that the employees put too much focus on the tool, leading to the loss of actual work methods. Finally, one identified challenge is that digital information often is misinterpreted, hence leading to misunderstandings (Kifokeris et al., n.d.).

These identified challenges are mainly due to a lack of understanding and knowledge about the digital tool aligned with the work process. To overcome these challenges the focus should be on creating a common ground of knowledge about the tool in the team by including knowledge into the concept of the tool (Kifokeris et al., n.d.).

2.6.5   Digital Transformation

To be able to gain the benefits of the digitalization of the organization the change process must be built on some fundamental elements. According to (Stechert & Balzerkiewitz, 2020), all activities must be built around the value chain and all waste must already be eliminated, which refers to the non-value adding activities. The change process must be driven by everyone in the organization, all employees, leaders, and managers need to be included and working aligned with the same holistic approach for digitalization. To optimize the organization the KPIs of the firm should be the basis of the measurements of the achievements of the team, and standardization is the key to optimization of work.

The transformation against digitalization starts with a preparation phase with a clear analysis of the value stream and clearly defined objectives with the digital change. The preparation phase has five key steps. Starting with the definition of the transformation team. Someone needs the have the main responsibility for the digital transformation to make the transform happen. The next step is to define the objectives of the digitalization, as well deciding how the objectives should be measured and tracked. Followed by the definition of who should be involved and what their maturity levels are to be able to plan for the education and training. Following the main value stream should be defined to be able analysis the flow of information, both informal and formal communication included. This should be done with the purpose to define the ideal value stream and being able to map the way to achieve the ideal. The last action should be to set up a detailed plan for the introduction phase (Stechert & Balzerkiewitz, 2020).

During the introduction phase, communication is the core element to success, nevertheless, communication can be difficult in virtual teams due to cultural or geographical distances (Stechert & Balzerkiewitz, 2020)(Stenholm et al., 2016). Therefore are new time management skills and communication tools are required, in combination with policies and systems to support the distance team members to prevent uncertainties (Newman & Ford, 2020). (Newman & Ford, 2020) also states that the goal setting and performance management are of greater priority for the success of virtual teams compared to traditional teams, hence apply tasks according to SMART: specific task goals that are measurable, actionable, realistic, and time-limited.

2.7 Summary and Output from Literature Research

Today there is an increased pressure to be efficient and effective in the work, as well as flexible and able to quickly adapt to a changing work environment. Aligned with the increased digitalization, which has contributed to the fact that it is no longer just a trend to work digitally, but rather a must for companies to be able to grow and to act competitively. The Covid-19 situation has accelerated the digital transformation, not only the everyday life but also in the way of running projects.

Virtual teams for managing project replaces the previous traditional ways of working in office environments. These changed ways of working, create new possibilities, but also new challenges are born. The identified barriers from the theory research were gathered in a table to get a visual overview of the existing barriers, see Table 2.2. The identified barriers from the theory were compiled and listed based on how many times they were mentioned in the articles. This was done to see what barriers that existed. The barriers that were mentioned the most number of times are considered the largest and most common ones.

Some of the main challenges for working in virtual teams are related to organiza-

tional culture and trust. When working in global virtual teams the creation of trust and common work culture will be of superior importance. Especially due to the difficulties in building personal relations when working virtual, as mentioned in nine of the studied articles (see Table 2.2).

New time management skills and communication tools are required, in combination with policies and systems to support the distance team members to prevent uncertainties (Newman & Ford, 2020). (Newman & Ford, 2020) state that the goal setting and performance management are of greater priority for the success of virtual teams compared to traditional teams, hence projects should be applied according to SMART: specific task goals that are measurable, actionable, realistic, and time-limited. The lack of common goal, scope, and structure are mentioned in eight of the studied articles as shown in Table 2.2.

With the new digital tools available, new opportunities are created to use the full potential of experience and knowledge within the organization, independent of where the employees are located. By implementing new tools or systems, knowledge can be shared more efficiently, hence using the resources within the organization more efficiently to sustaining competitiveness. To increase the knowledge and the organization's ability to transfer and re-use the gained knowledge, the organization requires a reflective mindset. Therefore is an agile way of working suitable to increase the reflective ability. The agile mindset divides the work into smaller work packages and includes reflections after each sprint before moving on to the next sprint. In this way, the knowledge gained from each sprint will be sustained and available to pass on to future projects.

To implement lean management approaches in development projects with distributed teams, the tools, methods, and strategies need to be digital (Stechert & Balzerkiewitz, 2020). It is even more important to focus on the methods and processes behind the work, before the implementation of digital tools when working in distributed teams. The lack of defined processes, roles, and responsibilities are major challenges for the digitalization (Srai & Lorentz, 2019).

Table 2.2: Barriers found in theory and number of articles they where included in.

Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles
Difficult to build personal relations working digital	9	Problems in cross-cultural communication	5	Different problem solving approaches	4	Documen-tation of work and access to the latest version	3	Lack of leadership capacities	2	Lack of proceses for archiving important written documentation	1	Still learning the existing tools	1
Lack of common goals, scope and structure	8	Lack of collaboration	5	Lack of control, leading projects digital	4	Asymmetry in processes	3	Lack of collaboration and coperation in the team	2	Monitoring team performance	1	Different national rules and regulations	1
Lack of trust	8	Adding new tools, but still keeping the old ones	5	Different time zones	4	Lack of face to face communication	3	Risk for miscommunication or misinterpreation	1	team members disengagement	1		
Various dimensions of culture	8	Resistance against change	4	Limited time resources	3	Resistance against change	2	Unnecessary documentation and emails	1	Lack of digital readiness	1		
Division of labour - divide tasks and responibility	8	Lack of education and support	4	Not learn from best practice	3	Complex systems and project complexity	2	A common pitfall is for E-leaders to be available	1	Lack of education	1		
Lack of communication between different functions	7	No matching categorizes between sites	4	Old project managment methods are no longer effective	3	No social norms and standards	2	Lack of boundaries between home and work	1	Unstructured and unorganized work	1		

3

Methods & Tools Used in the Project

The following chapter describes the methodology used to realize the Master's Thesis project. The project process will be described, followed by a description of used methods during each phase.

3.1 Project Process

The project process was divided into three different phases: Identification of Barriers in the Case Project, Analysis of Existing Digital Software, and finally Root Cause Analysis & Final Results, see Figure 3.1. The first phase, Identification of Barriers in the Case Project, investigates and analysis the existing barriers in the Case Project. The method used during this phase is further described in Chapter 3.2. The following phase, Analysis of Existing Digital Software is described in Chapter 3.3, which investigates and analyzes the existing software and its functions. The final phase, Root Cause Analysis & Final Results is described in Chapter 3.4, where the root causes of the barriers will be further investigated, which concludes the final results from the project.

Figure 3.1: The project process divided into three phases.

The previous literature research explained in Chapter 2 was used as a ground for the following work. During the initial phase, the current situation was examined and the barriers that existed within project management and users' voice were mapped. During the second phase, existing solutions were examined. In the third and final phase of the project, the output element from the previous two phases was combined

to create a final result about the identified barriers and the functions required for a digital tool.

3.2 Identification of Barriers in the Case Project

T create fair research of the current situation, a identification of barriers in the Case Project was performed by using observations, followed by interviews. In addition, a survey was conducted by the project leader in the Case Project, that was used as a comparison of the identified barriers. The collected data were then further used when creating a list of barriers which in turn acted as the base for the creation of the requirement specification list.

3.2.1 Activity Theory

The Activity Theory was used during the identification phase to ensure that all elements that affect an activity were included in the investigations made. The Activity Theory framework relates human activity to its social context (Hall, Cruickshank, & Ryan, 2018). Contextual elements as Community, Rules, and Division of Labour are the various influencing elements included. In addition, the Activity Theory also focus on the actions of tools between the Subject and the Object (Duignan, Noble, & Biddle, 2006). Later on in the project, the identified barriers were analyzed and categorized according to the elements in the Activity Theory, with the purpose to connect the barriers to the social context of the Case Project.

The elements of the Activity Theory are described in Figure 3.2. For the context of the Case Project, these elements are interpreted as follows:

- **Subject** is the group of people, in this case the team members of the Case Project
- **Object** is the central issue that the team try to solve or overcome.
- **Outcome** is the desired new situation, which could be the desired pattern or tool used to increase the collaboration.
- **Community** is the stakeholders that affect the shape of the activity, in this case the organization of the Case Company.
- **Division of Labour** is the division of work between the team members.
- **Rules** are the laws, codes and agreements between people involved in the Case Project.
- **Tools** are the objects, systems and software used to accomplish the activity. It can also be the methods and processes used to achieve the goals.
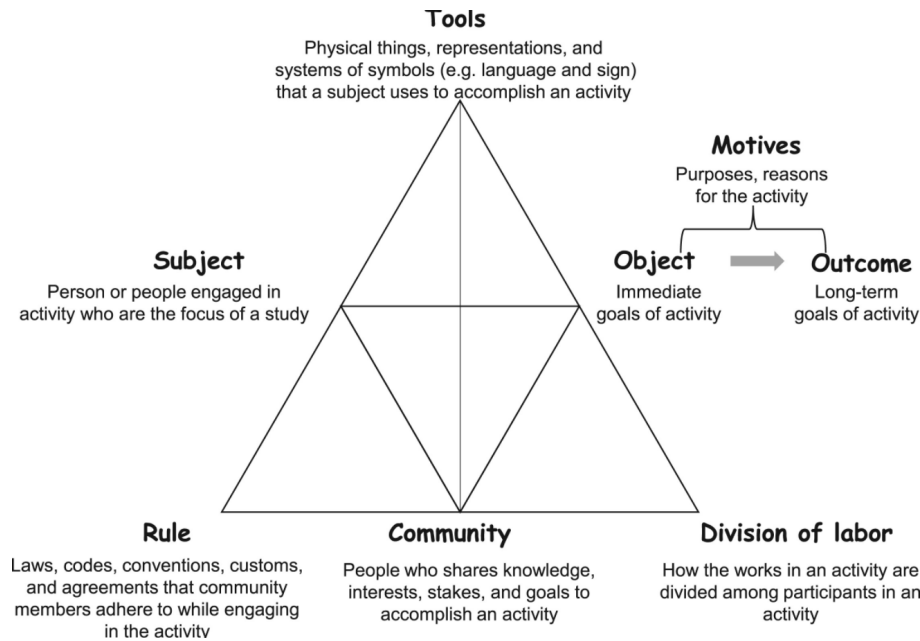
Figure 3.2: The elements of the activity theory model (Kain & Wardle, 2002).

3.2.2 Observations

The observation is a method for data collection, which during an early stage of a project often is used to create an understanding of the current situation in the form of customers task and goals (Sharp, Preece, & Rogers, 2019). Data was collected by registering impressions during meetings. This was done by passively participating, listening and taking notes. The observations aimed to create a holistic view of the project situation by understanding what methods and tools that were used, how project management was performed, and what actual barriers arose working and managing teams virtually. The user was also defied during the observations.

3.2.3 Interviews with Participants in the Case Project

Interviews were the primary data collection method used to identify the existing barriers, as well as gaining a deeper understanding of the current situation regarding project management at the Case Company. Semi-structured interviews were used, which combined both closed and open-ended questions. To start with, predetermined questions were asked and then the interviewee probed until no more useful information was forthcoming (Sharp et al., 2019). The interview questions were created based on the Activity Theory framework. This was done with the purpose to make sure to cover all elements in the project context that could affect the Case Project.

The interviews were conducted through digital meetings and documented through video recordings. The interviewees were selected based on their participation in the studied Case Project at the Case Company. These participants were directors and coordinators for the different plants, regional process owners, and project managers

for the Case Project. In total 10 interviews were conducted with participants in the Case Project. The interview questions can be found in Appendix A. The duration of the interviews varied from 45 minutes to 90 minutes.

To analyze the interviews the KJ-method was used. The KJ-method is a tool used to group the gathered information into common themes to find important needs and problems mentioned or expressed during the interviews (Wallgren, 2020). The interviews were transcribed and user statements were further marked and listed. The statements were then placed in groups depending on the theme of the statement. Statements that were mentioned by more than one interviewee was marked with the number of times they were mentioned. The created groups of statements were triangulated to identify and further organize the statements and the identified barriers. The statements were also analyzed and organized according to the elements of the Activity Theory.

3.2.4   Survey

To investigate the current situation in the Case Project, a survey was created by the project manager. The purpose was to map how the employees experienced certain ways of working, with a focus on processes and data collection regarding problem-solving. The survey had seven options for answering, ranging from one to six, where one meaning "Not at all satisfied" and six meaning "Very satisfied", in addition the option "Not applicable" also existed (Malin Hane Hagström, personal communication, February 24, 2021).

The answers were analyzed by the project manager and used as a pre-study for the Case Company to make further decisions regarding the need for future actions. In this Master's Thesis, the results were used as a comparison with the results from the observations and interviews. The purpose was to investigate if the areas of problems and perceptions from the employees correlated.

3.2.5   List of Barriers

From the analysis with the use of the KJ-method, a list of the identified barriers was created based on how many times they were mentioned in the interviews. Some of the barriers were similar and were therefore merged. To create an increased understanding of the significance of barriers, a brief description was performed.

3.2.6   Requirement Specification List

The requirement specification was designed based on the identified barriers from the interviews and observations. After impartially analyzing the interviews, by using the KJ-method, the barriers were transformed into functions and listed based on which group in the activity theory they belonged to. For each function criterion, it is listed whether the function is a requirement or a wish, as well as what goal value, stakeholder, and level of need the criterion has. The Kano model was used to identify the needs for the different functions, which in turn acted as the base for

the weighting. The Kano model describes different ways of expressing needs. The needs are divided into three different groups: Basic needs, Performance needs, and Excitement needs. The Basic need is a requirement that the customer expects and can therefore be described as a must. The performance need can be described as linear since customer satisfaction increases with quality. The requirement called delighter contributes to increased excitement as the function increase customer value (Malmqvist, 2020).

The functions were weighed between 1 to 5 depending on the type of needs: basic, performance, or delighter. The weight was based on how many times they had been mentioned in the interviews, including what type of need the function was categorized as. Some of the functions were not mentioned during the interviews but were described indirectly. After analyzing the result from the interviews and the observations, values could be set. For a tool to be relevant, the requirements must be met. Wishes are the functions that increase customer value. Functions with highly weighted wishes are the ones that would provide the most increased customer value. This becomes relevant when evaluating and selecting concepts for future development.

3.3   Analysis of Existing Digital Software

The investigation and analysis of existing digital tools were divided into two parts. Starting with the Initial Benchmark followed by a Detailed Benchmark. The Initial benchmark started with the identification of possible tools that could be useful to overcome the identified barriers. The most promising tools were then further analyzed in the Detailed Benchmark to be compared in a more detailed manner. The Detailed Benchmark was done through a virtual demo meeting, demo tests, interviews and finally compared and scored in a scoring matrix.

3.3.1   Initial Benchmark

A competitor product benchmark was done to investigate existing solutions on the market. Benchmark is a tool for the identification of existing technologies and products, as well as obtaining an understanding of their functions in form of what they are doing and how they are doing it. The purpose of the benchmark was to investigate if there already exist possible digital tools that can overcome the identified barriers within project management. Otherwise, it is a useful tool to gain information about competing products, which is crucial to support the decision of how to target the development of a new concept (Ulrich, Eppinger, & Yang, 2019).

To start with, digital tools mentioned during the interviews as well as tools identified during the observations were investigated through their web pages in combination with video tutorials. Additional digital tools were discovered by hand and investigated. All identified tools were checked against the initial requirement list to see what functions and barriers the existing tools were able to overcome. The tools that

gained a remarkable high requirements fulfillment were further investigated in the detailed benchmark, see Chapter 3.3.2.

3.3.2 Detailed Benchmark

A detailed benchmark was performed on the four winning concepts from the Initial Benchmark. The methods that were used during the investigation consisted of a virtual demo meeting, demo testing, and interviews regarding the tools.

Virtual Demo Meeting

A virtual demo meeting was performed with one of the tools, to examine whether it fulfilled the requirements from the requirement specification list. The criteria from the requirement specification were translated into functions, which acted as requirements that the software company was supposed to fulfill to be of interest. The demo meeting took place in such a way that questions were asked regarding existing and desired functions, which then visually were displayed and discussed.

Demo test

Demo tests were performed on the three remaining software tools to ensure that the requirements from the requirement specification list, see Appendix F were met. Each criterion was examined by watching educational videos, followed by testing of the features. A board was built for each software to get a fair comparison of how the software would act in reality in a project. The tools were mainly tested internally by the project group.

Interviews

The same interview method was used as in Section 3.2.3. Two interviews were held with users of the software in the construction area, to gain knowledge of how the digital tool was used and to evaluate their experiences. The purpose was to understand what obstacles that existed within the tool, as well as to find valuable information. These questions can be found in Appendix B. Also, one interview was conducted with an employee working for one of the digital tools. The person worked with the board set-up. This interview had the purpose to give an understanding of what the digital tool can do, how it is used, and what obstacles that are most common among the users. These interview questions can be found in Appendix C. The duration of the interviews varied from 45 minutes to 90 minutes.

Score Matrix

To compare and differentiate between the different tools, a Score Matrix was used. The criteria were weighted with relative importance and focused on a more refined comparison concerning each criterion. The method uses a weighted sum of the ratings, which results in a ranking of the tools (Ulrich et al., 2019).

The criteria came from the functions defined in the requirement specification list, with their internal weights concerning to each other. The rating scale for each criterion ranged from 1 to 5, where 5 was the ideal and 1 was the worst. To get the total performance value for each criterion and tool the weight was multiplied with the rating. The total for each criterion was then summarized to make it possible to rank the tools. Since some of the criteria from the requirement specification were similar and were therefore merged for the Scoring matrix. Also, some of the criteria were not useful to compare since they were mandatory to fulfill, and were therefore excluded.

3.4 Root Cause Analysis & Final Results

To identify and investigate the root causes and find the root causes of the problems, the 5 Whys method was applied. This resulted in the creation of a priority list and a function list.

3.4.1 5 Whys Method

After identifying and organizing the barriers based on how many times they were mentioned during the interviews, a root cause problem-solving analysis was performed based on the 5 Whys Method. The 5 Whys Method is performed by asking the question "why is it a problem" for every listed barrier, to easily distinguish the symptoms and cause of the problems (Benjamin, Marathamuthu, & Murugaiah, 2015). The question why was asked until the result circulated around the same problem. The main causes and symptoms were listed for each barrier.

3.4.2 Priority List

The listed causes and their symptoms from the 5 Whys method were further analyzed and categorized using the Activity Theory. Causes were analyzed by reviewing whether different barriers had the same cause. Those who had got an increased priority. The categorization provided a clearer structure of which areas the different causes belonged to. At last, the causes were listed as problems according to which priority and area of activity the cause belonged to. Priority was determined based on how many times the barrier had been mentioned during the interviews and whether different barriers had the same cause was also taken into the calculations.

3.4.3 Function List

To overcome the stated problems from the priority list, the barriers were converted into functions. These functions were listed according to the order in the priority list. The functions were also categorized according to the Activity Theory, with the purpose to find out what functions a possible tool would require, as well as what functions belonged to other elements in the Activity Theory.

The created list of functions was then further categorized into two lists. One list included the functions for the Tool, while the other list stated functions for the Community and Rules. The list of functions for the Tool was created to know what functions to prioritize for the selection of a digital tool. The function list for the Community and Rules had the purpose to state what functions the organization was required to handle, independent of the selected tool.

The priority of the functions was based on the priority of the problems. Some of the problems in the priority list were equally prioritized. Therefore were functions, that belonged to equally important problems, ranked higher depending on how many problems they solved.

4
Results

The following chapter explains the results from each phase of the project. Starting with revealing the results from the first phase, where the barriers were identified from the investigation of the case project, and a requirement specification list was created. The next section in this chapter will examine the results from the investigation of existing digital tools, which in turn resulted in a scoring matrix that showed a ranked list of tools regarding the fulfillment of functions. Finally, the results from the root cause analysis will be revealed, together with the summarized results consisting of a priority and function list.

4.1   Identification of Barriers in the Case Project

This section describes the results from the first phase of the project, as shown in Figure 4.1, starting with the results from the observations, followed by the interviews and survey. These three investigations resulted in a list of identified barriers and a requirement specification list.

Figure 4.1: Visualization of which phase of the project the results corresponds to in this section, which is Phase 1.

4.1.1   Observations

The observations contributed to an increased understanding of the Case Company, the current situation of the Case Project, and where it was headed. It also gave an awareness of who the customer and user were.

The first perceived barrier was that there were difficulties in scheduling meetings with the project participants due to different time zones. The second identified barrier was that the process owner had different views over the current situation, some

managers seemed happy while others experienced major problems. The managers that felt that there were no problems with the current process, opposed the project and to changes. The old ways of working were rather preferred.

The project manager asked each individual process owner how data was collected today, what tools were used and if there was a process map of root cause analysis. It did not seem to be a clear picture of the current situation and it looked different for each pillar and plant. There was neither a clear picture of the process map nor what methods and tools were used. Silos were discovered both between pillars and plants. Neither information, knowledge or best practice was shared between the plants, which shows that the Case Company do not use their full potential. Thus, time is spent on solving tasks that other plants already may have found a solution for.

Meetings were also held with directors and coordinators and similar barriers arose. There was no common view over the project and a lack of common goals and scope, which resulted in an unmotivated team. There were also difficulties in planning and scheduling of meetings due to different time zones and the fact that directors and coordinators seemed to be participating in many other projects and therefore had a lack of time to spend in the Case Project. It was noticed that directors were busy and left meetings to attend the next one. When the project manager asked for access to various information/data, it took a much longer time than expected to receive the information. It seemed to be due to a hierarchical detour in the flow. The information/data was retrieved from several links down in the chain, which shows that there is a lack of transparency. The information/data from the different pillars and plants was neither collected in a commonplace, which may have contributed to no value-adding work when the time was spent on searching for information.

Directors and coordinators work from different parts of the world and therefore communicate through teams, emails, meetings, and posts among others. The wide variety of tools can easily lead to confusion and loss of information. On the other hand, it felt like there was a good atmosphere in the team, people were joking and treated each other with respect. In virtual meetings, some people were perceived to be more engaged than others, which may act as a negative impact of working digital. It was difficult to see people's reactions and first impressions. Some people, without thinking, expressed their thoughts in a way that could hurt others. Which also could be a negative impact on working digitally, when hiding behind the screen.

Although the directors had the same position, it seemed to be quite different in the different plants. The different plants had different strategies, some were working more towards Industry 4.0 and some not at all. Some plants had developed their own tools, and some preferred to use old ways of working. It seemed like the level of innovative solutions depending on the employee's engagement and knowledge if he/she was driven and curious about new opportunities.

After observing meetings with different people involved, the primary and secondary user was identified. The primary user was defined as the project user, which includes

the directors, coordinators, and the project leader. The secondary user was defined as the overview user, who rather would prefer an increased overview of the current project situation. This, to see which projects are in progress, follow the time frame and allocate the right resources needed to reach the goals. Overview users would use the current data of the projects to be able to make future strategic decisions.

4.1.2 Interviews with Members in the Case Project

The interviews were analyzed according to the KJ-method and organized according to the elements of the Activity Theory as described in Section 3.2.3. The number of times each statement was mentioned was noted, see Appendix D. The resulting themes from the KJ-method were, *Organizational Barrier, RCR Goals, Project Management Barriers, Barriers in Existing Tools, Solutions, Processes, Thoughts and Digital*. Where the theme *RCR Goals*, are the statements about the goals of the Case Project. The problem of "adding new tools, but still keeping the old ones", was the most mentioned. It was mentioned by eight out of ten interviewees. Secondly, the statements "resistance against change", "result depends on the person", and "lack of common goal, scope, and structure" was mentioned by six out of ten interviewees. All of these tops mentioned barriers correspond to the theme *Organizational Barriers*, except "lack of common goal, scope, and structure", which corresponds to the theme *Project Management Barriers*.

The statements were further analyzed and categorized according to the Activity Theory. A part of the result from the organized statements can be found in Table 4.1, for the total result see Appendix E. The statements from the interviews are in this context viewed as possible barriers for respective element of the Activity Theory. As an example, the statement "lack of common goal, scope, and structure", was a barrier for reaching the *Object*. Most of the identified barriers corresponded to the elements *Tools* and *Community*.

Table 4.1: Statements from the interview organized according to the elements of the activity theory.

Activity Theory elements:	Definition:	Statemenst from Interviews				
Object	Barriers for reaching the goals	no time frame	lack of common goals, scope and structure	no common responsability	none value adding time and work	is there a need for change?
Subject	Barriers in the project managers and participants in the project (teamet)	involved in many project at the same time	resistance against new way of working	whip or carrot	need the right knowledge and experience in the right area	lack of support
Tools	Barriers in tools and working methods	a lot excel files	just adding a tool will not solve anything	no overall view	loosing material and notes with analog tools	to many tools and systems
		difficult to work many in the same tool at the same time	no system that can solve everything you need: leads to trade-off	the more functions leads to difficulties in the learning of the tool	forced to use new tools, such as office 365 and teams	a lot of meetings
Community	Barriers in the environment where the project is carried out (organization)	silos	no focus on cooperation	big variations in the way of working	different opinions about what data to visualize	more dynamic collaboration
		much administrative work	lack of collaboration in the network	gap between production and the one taking decisions	complex processes	prestige in old working process
Division of labor	Barriers in taking responsibility, dividing work, taking charge	tight margins: important with documentation to follow up	forced to work with new people	division of resources (e.g. time and people)	who is taking charge of strategic decisions	
Rules	Barriers for the rules, guidelines, ethics, co culture and norms for the work	no concensus regarding working methods	different experiences	co-located culture	ambiguous bounderies regarding project meetings	iterative process: not possible to set up a strict structure that all projects can follow

At the beginning of each interview, the question about the goals and objects of the Case Project were asked. The answers to this were diffuse, as some participants answered that the project was more a pre-study than a project, some said it was a program, and some were not aware of the goals and purpose at all. According to (Pereria & Freitas, 2019), "a project is a written and/or graphical representation of stages for achievement of an enterprise with predefined time, resources and scope.". The results from the interviews showed that the Case Project lacked both scope, defined time, and defined resources, which made it act more as a pre-study rather than a project.

At first, most of the interviewees expressed that they were quite happy with the way of working and that there were no problems. When questions arose about how they are collaborating and learning from each other between the different plants and functions, *Interviewee 3* said "I can easily retrieve information from how others have done, etc. and what's nice is that we stand on the same methodology at the bottom in some way, and it's more about how good we are at using that methodology.". Later on, when explaining how the information was retrieved *Interviewee 3* said, "it is inconvenient to gather all the data from all the plants". It also occurred that there

is no common way of collecting data and no common gathering place where information easily can be found. Hence emails, phone calls, or other personal initiatives are required to gain information from other plants or functions. *Interviewee 2* said "there are excel files to the right and to the left, and you don't know where to look". As the interviews went along, more and more problems arose as the participants were asked to describe their way of working.

Depending on the interviewee's position in the organization, the experience regarding the work differed. The participants that worked in a pillar that required information from other pillars were less satisfied with the way that information was shared. While people who worked in pillars independent of information from others were more pleased. This could be because they had different perspectives on the situation. As *Interviewee 4* expressed "data is not transparent through the organization". In line with that, *Interviewee 2* said "It is very jumpy between the different system" and that data could be more coordinated. While *Interviewee 4* said "we can pull data out of these different tools whenever we like to", meaning that they are able to reach the required data when it is needed.

Another problem that arose was that many participants were involved in multiple projects and teams. *Interviewee 4* said "I think I have 25 teams... and it's a little bit overwhelming." and *Interviewee 6* said that a more visual way of working would be useful since "now I have about 100 chats here and who is in which". Most of the interviewees also expressed that there exist too many options in the way of working in the existing tools. *Interviewee 3* said "I feel that it exists too many functions" and that it "almost are as many systems to handle as it exists ways of working". When involved in many projects and teams, in addition to the many options of the way of working, much of the time goes to looking for information and allocating in the tools and between the projects, which is waste of time and no value-adding work.

4.1.3 Survey

The most problematic results from the survey conducted at the Case Company were:
- The problem-solving process was slow and often delayed.
- Employees were unsatisfied about the way data was visualized, analyzed, and used for prioritization of work.
- The teams experienced that they lack the right competence and conditions to perform problem-solving effectively.

The most satisfying results were that:
- The employees experienced that they were encouraged to follow the stated problem-solving approach.
- Problems that are most critical for the customers are solved.
- The problem-solving approach reduces the total production lead time and costs.
- The employees felt that the problem-solving approach creates a learning organization.

The results from the survey could lead to the conclusion that there is a big spread in the performance of the plants, meaning that each plant is applying the systems in different ways. Each plant also has problems with analyzing the data in a convenient way. Another conclusion was that the respondent was most dissatisfied with the resources, lead-time of the problem solving, as well as how the data was used. In addition, also the aspect of competencies in the teams was dissatisfying. The results showed that there was a high satisfaction regarding the problem-solving approach, which supports the customers and addressing lead time and production costs. Finally, the survey showed that many systems are used and are developed locally, which results in a multitude of solutions and problems with hand-overs between the systems.

4.1.4 List of Barriers

From the analysis of the KJ-method, all mentioned comments from the interviews were carefully evaluated and further categorized. The found barriers were listed based on how many times they were mentioned in the interviews, which resulted in a total of 16 barriers, see Table 4.2, which also includes a brief description of the various barriers. The numbers describe how many times the barrier was mentioned in the interviews.

Table 4.2: Identified barriers and brief description

	Barriers	Description
8	Adding new tools, but still keeping the old ones	By adding new tools and still maintaining old working methods creates a risk that employees will refuse to learn the new tools which in turn will create diversity in terms of leading projects. Since employees often participate in more then one project, a large amount of tools may create confusion and unnecessarily complex working processes.
6	Resistance against change	Employees often prefer the already existing working methods and tools and are not open for changes.
6	Results depends on the persons competence	Since working methods are not fully standardized, the result depends on who is performing the tasks. Different local variants of methods also depends on what resources the different cites has.
6	Lack of common goals, scope and structure	In case project, there were no common view over the project situation, which creates a risk for unmotivated participants.
5	Lack of system support	There is a lack of system support in the available methods and tools, no support function regarding usage and best practice.
4	Limited time resources	There is a lack of time resources due to many participants also are involved in other projects.
4	Difficult to build personal relations working digital	Virtual communication does not create the same opportunity for building relationships as during face to face meetings.
4	Still learning the existing tools	People in the project were not that interested in trying out new software tools due to the fact that the learning of a tool was still in circulation and people still exploiting the functions.
4	Need to pull data out of the different systems to analyse it	Data and information is gathered in different systems which creates difficulties when analyzing and comparing data.
4	Lack of communication between different functions	There is a lack of cross cultural communication between the different sites among the organization
4	No matching categorizes between sites	Which means that the plants are using different expressions for the same categories which creates difficulties when analyzing data.
3	Hierarchy - creates detour in the flow	Since the whole organization is built on a hierarchical structure, processes are becoming more time consuming due to detours in the flow. It also creates lack of transparency among the organization.
3	Not learn from best practice	Since the plants do not share their expertise and knowledge between each other, employees may working on already solved problems.
2	Unstructured and unorganized work	Organization and structuring of data takes place in different ways and is gathered in different places. Do not follow the working processes.
1	Apply method after solving the problem	By first solving the problem and then applying the method, similar problems will not always be solved in the same way. No standardized problem solving may lead to variation in the results.
1	Different national rules and regulations	Each country consist of different laws and regulations that affect the working methods

4.1.5 Requirement Specification List

A requirement specification list, which was explained in Chapter 3.2.6, was created based on the identified barriers. The requirement list states functions that will overcome the listed barriers stated in Chapter 4.1.4. As shown in Appendix F, each function is stated and categorized based on the elements from the Activity Theory. The functions that are listed as requirements and given a weight of 5, are

the functions that a possible tool is expected to have. Hence the most important functions to include, are the following:

- **Project Plan** - Including a project plan is important to align the team members. The project framework, goals, and strategy should be included. This is a basic need for a project management tool and is important for both *Overview user* and *Project user*

- **Alignment of strategy** - The purpose of this function is to make sure that the project is aligned with the strategy of the company. It is important for the goal achievement of an organization that the projects are aligned with the organization's strategy, hence it is a basic need. The stakeholder for this function is the *Overview user*.

- **Individual status check** - To know what tasks each team member is responsible for, and to easily allocate between each task, an individual status check is beneficial. It is a basic need to know what to do in a project. The stakeholder is the *Project User*.

- **Easy to communicate** - To be able to collaborate efficiently, it should be possible to quickly communicate with team members in the project. As comments on tasks and files, or Q&A possibilities. The user *Overview user*, as well as the *Project user* are benefiting from this function.

- **Continuous updates of project** - If someone comments or make any changes in the schedule or tasks, all participants involved must get updates to make sure that the work is aligned and uses the latest version of data. The stakeholders are both the *Overview user* and the *Project user*, since both can come with important input regarding the project.

- **Documentation of work: track decisions, the status of tasks, date, and responsibility** - This is a function that was not mentioned during any of the interviews and is categorized as a delighter since it is valuable to get an overview of the project and its status. In addition, this was a function that existed in some of the investigated tools that seemed to be appreciated and useful for the *Overview user*.

- **Documentation of work: share and re-use knowledge** - The second approach of documentation of work is regarding the knowledge obtained during the projects. This information is good to capture for re-use in other projects, where a similar situation can appear, to not reinvent the wheel. It was mentioned that there is a lack of sharing knowledge within the organization, hence the function is categorized as a performance need. The stakeholder for this is the *Project user* since they are the on that required the knowledge.

- **Handling data** - The data should be shared and stored safely. Only authorized people should have access to data. This is important to not leak any sensitive or vulnerable data and is a basic need since it is an organizational requirement. Both *Overview user* and *Project user* are defined as stakeholders.

- **Intuitive** - A possible tool should be easy to learn and ideally possible to use without instructions since the purpose of the tool is to make the work easier for the team members. The function is categorized as a performance need since it was discovered that many of the employees still learning the current tools. Having a tool that is easy to use and understand is important for both

Overview user and *Project user*.

- **Resource allocation** - Resources such as time, money, and people need to be considered when scheduling the tasks and planning the project. By visualizing the required and used resources in a tool makes it easy to track and evaluate progress and performance. It is a basic need that is expected by a tool.
- **Respectful work environment** - A safe work environment to make people feel included, both emotionally and physically, is important to reach good results. People should feel engaged and needed in the project and feel that they are free to express and share their knowledge and experiences. This is a basic need for all projects and it is important for both the *Overview user* and the *Project user*.
- **Cybersecurity** - The tool must follow the security policies in the organization to not leak any vulnerable information, hence it is a basic need.
- **Code of Conduct** - The tool must be aligned with the companies policies regarding code of conduct and is, therefore, a basic need.

How all these functions are solved could vary and be done in different ways. The important thing is to solve the problems to overcome the identified barriers.

4.2 Analysis of Existing Digital Software

The results from the second phase of the project include the analysis of the existing tools, which is described in the following section, see Figure 4.2. The section starts with the results from the Initial Benchmark, followed by the results from the Detailed Benchmark.

Figure 4.2: Visualization of which phase of the project the results corresponds to in this section, which is Phase 2.

4.2.1 Initial Benchmark

The Initial benchmark resulted in four tools that gained the highest fulfillment of requirements. Nevertheless, no tool was able to fulfill all stated requirements. It was discovered that many of the tools were specifically developed for the construction area, including functions for handling 3D drawings and 3D-views of the construction sites, which is irrelevant for the project. Other tools consisted of digital checklists or to-do lists, which did not fulfill the requirements, hence not valuable to apply in the context of the Case Project. The unsuitable tools were marked with the color

red in the matrix for the initial benchmark, see Appendix G.

The most promising tool, Tool A, seemed to be able to fulfill all the requirements except the function *Measure data*, which was marked with a question mark since it was not found in the investigation what the tool was able to do in that matter.

The next tool that gained the top fulfillment of requirements was Tool B. This is a tool used to plan, execute and track projects. This tool gained no minuses, but a few questions marks. Functions that were questioned were *documentation of work, access to all data, clear directives* and *one tool*. Tool B can connect to other tools to integrate the information into one tool. Nevertheless, it is required to investigate deeper how the tool can connect, with other tools, and how the data security is handled. The ability to document the work is questioned due to a lack of explanation about the tool's abilities on the website.

Tool C was the tool used in the Case Company, and was therefore included for further investigation and since the existing tool had many possibilities of unexplored functions due to the multiple apps possible to connect. Tool C was not the best performing tool according to the benchmark, but not the worst either. *Create an overview of the project, user-friendly, intuitive, visual, easy to share knowledge* and *work related to the process* were the requirements that were not fulfilled. In addition, *increase transparency* and *clear directives* were areas where Tool C had question marks. Tool C tool was difficult to evaluate since it can integrate and synchronize many apps and cloud services. Due to the multiple options and the flexibility to include different apps, the broad options of choices lead to the lack of fulfillment of the requirements *create an overview of the project, intuitive, visual* and *work related to process*.

The fourth promising tool was Tool D. The requirements that the tool was unable to fulfill were *analysis of data, screen data, measure data* and *one tool*. Tool D also gained some question marks regarding *evaluation of work, user-friendly, access to all data, easy to share knowledge, work-related to process* and *clear directives*. The tool was able to share files, but the only place to do that was in the comments of the tasks, hence it gets difficult to allocate and find information. The tool also lacks clear directives regarding how to work in the tool, which needs to be decided within each team to gain a common way of working to minimize misunderstandings and errors. Other additional tools will be required to manage a project, for example, to manage project description, project plan, storing of files, and meetings.

4.2.2   Detailed Benchmark

From the Initial Benchmark, it was decided that the four tools that fulfilled most of the functions from the requirement specification would be further investigated, which were Tool A, B, C, and D. The tools were examined according to what material was available. Tool A was examined through a virtual demo meeting since there was no possibility for testing the platform since it is customized for every client. Tool D

was at first investigated through interviews and further demo tested. Tool B and C were investigated by demo tests, where the functions were tested and evaluated.

Virtual Demo Meeting

The result from the demo meeting with Tool A created a greater idea of the digital platform and its features, as well as the advantages and disadvantages. The digital platform is mainly used for data collection and is tested and evaluated by one of the plants in the Case Company. The tool was introduced during one of the interviews, and was therefore further investigated, because "one tool would be ideal". Since the digital platform is created according to customer needs and wishes, Tool A was able to perform most of the desired functions but is recommended to be further investigated. However, there was a gap regarding the handling and documentation. Tool A did not have a good solution for how to collect data in one common place but allowed solving it by connecting the platform to other existing software. Similar problems existed regarding virtual meetings, the platform needed to be connected to other software. One of the identified barriers is that too many tools are being used in daily work, leading to additional barriers regarding processes and working methods, which in turn may contribute to inefficient work and confusion among employees.

The advantage of Tool A is that the font was intuitive and user-friendly, which is of high relevance when implementing a new tool. Everyone should be able to understand the tool without too much time for learning. Another advantage is that the customer can choose what data to display on the daily board, which can be adapted differently depending on the project. Employees often participate in more than one project, which puts a high demand on the simplicity to parry between different project boards and tasks, which Tool A seemed to cover. Since the platform would be used both in the daily operations when sampling data and project management, the transparency, awareness, knowledge sharing, and reach of knowledge will increase.

Interviews with user in other contexts

The interviews regarding Tool D were held with three persons, who were familiar with the tool, but used it in a slightly different way. Person 1 worked as a method specialist at a company that used the software in construction projects. The second person worked at the software company and worked both with the preparatory, as well as the set-up of the board. The third person worked as a project manager and used Tool D in construction projects.

As mentioned from all of the interviews, it is required that a pre-study of the companies process must be analyzed and examined before applying any tool. Adding a tool without analyzing the methodology and process will not solve any problems. Tool D is mainly used in construction companies, both within design and production areas. The design and production template of projects looks different since that the design phase does not consist of repetitive tasks, which it does within production.

Different functions are therefore required within the different areas.

Person 1 described Tool D as a pull planning tool that triggers a series of events, but can also be described as a lean-based tool that handles questions and answers. The tool is based on old recognized technology (sticky notes), but by using the method digitally it contributes to the opportunity to increase the number of notes and at the same time make sure that notes do not fall and disappear. The second person described the tool as a synchronization tool.

The second person mentioned that it takes about 16 weeks to produce a finished board, according to an identified need. The board is based on customer's needs and processes, what functions that is needed, and what notes that are required. An initial meeting is usually held with the customer where the basic structure is built. The customer can then further add details on their own. Person 1 described the importance of creating a common mindset of how the software should be used and contribute knowledge to guide the project members to make the right decisions before even starting to use the digital board.

The first and the third person described that the tools are used in combination with other tools, and therefore act as a compliment. The tool is perceived to be relatively simple and it is good in the sense that it creates a holistic perspective over the project. The tool also creates a community where everyone feels involved, but it requires that everyone attend the common meetings.

Person 2 mentioned that the advantage of the software is that the visual board is being perceived by customers as simple and good-looking. The software is more colorful than others and therefore applies the visual impression. The colors provide a simpler way of recognizing whom the note belongs to. The tool also seems to increase the level of communication, since the people involved easily can comment on notes and tasks. Person 3 experiences that the interface of the visual board is lame and does not feel that professional.

One of the software's biggest advantages mentioned by person 1: is the digital handling of decisions, which helps to see the connection between questions and the decisions made. Person 2 mentions the easiness to synchronize and have everything documented. An additional advantage is that people can be tagged in tasks that affect them, which minimizes email conversations. It is also possible to put ownership on tasks which by the filter function creates a personal view over the project. Barriers that the software overcomes are silos between different people and departments. The software provides a sense of collaboration and shared responsibilities. There are big variations in the way how projects are being managed today. Person 1 said that "some people still live in the past". Some people do not feel that digital tools provide any increased value and therefore stick to old processes and methods. The third person mentioned that people involved in projects have different work backgrounds and a simple tool is therefore required. People that have problems with the digital tool need to get further support. Working digital creates laziness because the

visual board always are available. All decisions are taken at the meetings, which in turn require that everyone is participating.

The first and the third person described another emerging problem, which is that notes by anyone can be moved around, which can create confusion. It is also of high importance to express and to write notes clearly, to make sure that the question is not being misinterpreted. Misunderstandings may contribute to wrong deliveries. The third person believed that a protocol function is desired to help the project manager to be able to control the project and people's involvement. Another mentioned wish from the first and third person was to improve the search function in the decision list. The third person described how 3.5 thousand cases were displayed on one page. An app on the phone was also a required function. Work often needs to be done twice, since documentation first is done on a piece of paper and then further added to the digital board.

Person 3 believed that it was possible to apply the digital tool in the automotive industry, especially if it is preferred to get a holistic view of a project instead of seeing data in bucket lists.

Demo Test

Demo tests were possible to execute on three out of four tools. The purpose was to get to know how the tools and their functions worked. No educational learning except video tutorials was performed.

Tool B was investigated further with a demo test executed internally within the project group. Tool B is a tool created for planning, executing, and tracking project progress. Tasks can be assigned to team members, prioritized, dependencies can be shown, milestones and timelines can be visualized. A fictional project was created with a schedule, deadlines, tasks, and responsibilities. Many different possibilities existed within the tool to create different views of the project. A personal view was also available to see what projects and what tasks were assigned to the participants. Different charts were available to visualize the progress. A drawback was that the tool was not that intuitive and easy to understand without instructions, and the colorful lock sensed non-professional. A search function existed and was used to find wanted files. Tags, name, file type, or time could be used to make the search more efficient. The tool follows international standards regarding security to keep the information safe. Tool B allows information to be sampled in one place since it is possible to synchronize and integrate the tool with over 40 other existing tools.

Tool C was already used in the case company, and therefore easy to access for testing. This tool was tested internally within the project group. The plan and tasks for this project were scheduled and planned using Tool C for an evaluation. Due to the possibility to add and synchronize a wide range of apps with Tool C, it created confusion about what app to use in what project and in what team. Since the information and documentation are done in different apps, it did not create any visual overview of the project. Even though the tool was able to visualize the progress of

tasks to some extent with pie charts or labels of the tasks where the status could be filled in. The advantage with Tool C was that the different apps were synchronized and all employees at the Case Company had access and an account for the tool. The drawback is that an invitation of a team is required to be able to work in it. Another drawback with the tool was that it did not exist any standardized work process. It was up to the user and project manager to create and decide the way of working, which was perceived to create confusion among employees when being included in many projects. This because different apps and tools depend on the preferences of the project manager. It was neither possible to access project documents for re-use of knowledge in other projects. Most of the project documentation depends on the project participants and their way of working. The documentation was managed through excel files, documents, or status on task planner that showed what tasks had been done and by who.

Tool D was as well demo tested. This tool has been developed for and is mainly used, in the construction area for project management. A demo test was created with the Case Project structure as inspiration. The tool was built as a board where digital notes can be placed with deliveries or tasks, used as a Q&A board. It was possible for the team members to comment on the notes and to attach files. The files did not have any commonplace for storing, which made the knowledge sharing and re-use of knowledge a bit difficult. The decisions made and the status of the notes can be tracked. Tasks' dependencies can also be visualized. Tool D acts more synchronized then as a detailed planning tool. Hence, additional tools are required to manage overall planning, project description, progress rates, resource allocation, and sharing of knowledge. Tool D can be useful for project managers to create a more visual view over the short time planning, to increase transparency through the project, and create responsibilities of tasks. The tool has a handshake function, that shows what deliveries and tasks have been accepted.

All three tools can be useful to apply, to get a more visual and detailed plan of the project, as well as a higher level of commitment to delivering the promised tasks. The three tools are lacking in their ability of documentation. The tools are neither that intuitive and easy to understand. There is also a lack of standardized ways of working in the tools. Hence each team needs to decide or create a common way of working within the tools, to not create unnecessary misunderstandings.

Score Matrix

The Score matrix was used to rank the top four existing tools. The matrix can be found in Table 4.3. The rating for each criterion can be found in Appendix H. *Tool A* got a total weight value of 448 compared to the ideal total weight value of 595, which is 75 percent of the ideal value, resulting as the top-ranked tool. *Tool B* got a total weight value of 419, which is 70 percent of the ideal solution, hence reached to second place in the ranking. The third-ranked tool is *Tool C*, with a total weight value of 362, corresponding to 61 percent of the ideal. Finally, *Tool D* got a total weight value of 304, meaning 51 percent of the ideal tool, and was, therefore, the lowest-ranked tool.

The number of strong and weak points was noted to investigate if some tool had criterion that was extremely low or high, which could imply that a tool was extraordinary good, respectively bad, at this criterion independent of the total ranking. The weak points are ratings under two and the strong points are ratings over four. As shown in Figure 4.3, *Tool B* is the tool with the lowest number of weak points, with only two weak points. The two weak points are "Parallel work in files" and "Access to data". All tools except *Tool C* have these criteria as weak points. This means that even the number one ranked tool, *Tool A*, has lower ability in these two criteria, meaning that the functions of *Tool C* should be added to *Tool A* to get an even better fulfillment of function in *Tool A*.

Table 4.3: Score Matrix for the top four tools.

Chalmers		Scoring Matrix							
Issuer: Jasmine Björk, Ellinor Hallberg		Created: 2021-04-09				Modified: 2021-04-09			
Criteria		**Alternative**							
		Ideal		A		B		C		D	
Name	Weight	Rating	t	Rating	t	Rating	t	Rating	t	Rating	t
Short time project plan	5	5	25	5	25	5	25	4	20	3	15
Project plan	5	5	25	3	15	4	20	1	5	2	10
Create overview of the project	2	5	10	5	10	3	6	3	6	4	8
Synchronize work	3	5	15	3	9	3	9	3	9	3	9
Screen data	3	5	15	5	15	5	15	3	9	1	3
Alignment of strategy	5	5	25	5	25	4	20	1	5	1	5
Individual status check	5	5	25	5	25	5	25	4	20	4	20
Easy to communicate	5	5	25	3	15	3	15	4	20	3	15
Continous updates of project	5	5	25	5	25	4	20	4	20	5	25
Documentation of work: track decisons, status dates	5	5	25	2	10	5	25	5	25	4	20
Documentation of work: share and re-use knowledge	5	5	25	2	10	2	10	2	10	2	10
One tool	4	5	20	3	12	4	16	4	16	1	4
Handling data	5	5	25	3	15	3	15	3	15	3	15
Parallel working in files	5	5	25	1	5	1	5	3	15	1	5
Access to all data	4	5	20	1	4	1	4	3	12	1	4
Increase transperency	3	5	15	5	15	3	9	2	6	3	9
Analysis of data	2	5	10	5	10	4	8	4	8	1	2
Measure project data	2	5	10	5	10	4	8	4	8	1	2
Handling multiple projects	3	5	15	4	12	5	15	1	3	1	3
Intiutive	5	5	25	4	20	2	10	2	10	3	15
Usability	4	5	20	4	16	3	12	3	12	3	12
Support team	5	5	25	1	5	2	10	3	15	3	15
Honesty	5	5	25	5	25	5	25	5	25	5	25
Common work structure	5	5	25	5	25	5	25	1	5	2	10
Resource allocation	5	5	25	5	25	4	20	3	15	3	15
Meeting planning	5	5	25	4	20	4	20	5	25	3	15
Visualize strategy	4	5	20	5	20	3	12	2	8	2	8
Create solidarity	5	5	25	5	25	3	15	3	15	1	5
T (Total weighted value)		140	595	108	448	99	419	85	362	69	304
T / Tideal		1,00	1,00	0,77	0,75	0,71	0,70	0,61	0,61	0,49	0,51
Nr of weak points (<2)		0		3		2		4		9	
Nr of strong points (>4)		29		14		7		4		3	
Ranking					1		2		3		4

4.3 Root Cause Analysis & Final Results

The following section examines the results from the third phase of the project, see Figure 4.3.

Figure 4.3: Visualization of which phase of the project the results corresponds to in this section, which is Phase 3.

The third phase can be divided into three steps, see Figure 4.4, where the root cause of the barriers was investigated and prioritized. The first step includes a root cause analysis using the 5 Whys method to identify the cause and symptoms of the barriers. The second step categorizes the main causes in the Activity Theory, which further in step three is categorized into a priority list based on how many times the barriers were mentioned during the interviews. Barriers with common main cause were higher graded in the priority list. Following, the final results from the two previous phases along with the results from the root cause analysis resulted in a priority list as well as a function list.
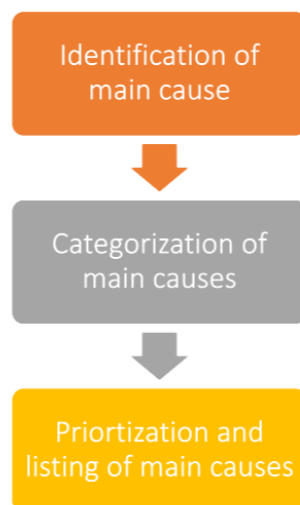
Figure 4.4: Phase 3, consisting of three steps.

4.3.1   5 Whys Method

In step one in phase three, see Figure 4.5 the identification of the main causes was performed. The 16 identified barriers were further investigated using the 5 Why method to find the main cause and symptom for each barrier. This was done to create an idea of what the underlying causes were or whether it was the identified barrier that acts as the main cause of the barriers.
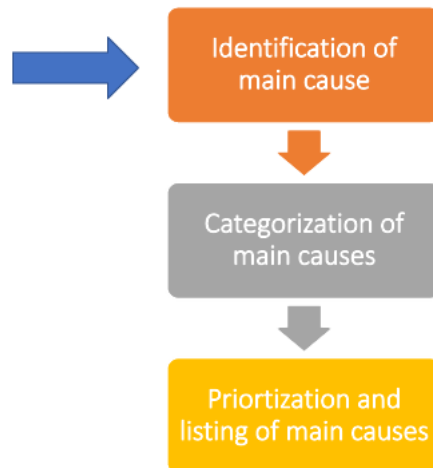
Figure 4.5: Phase 3, step one.

The performed analysis resulted in a Barriers-Cause-Symptom matrix, see Table 4.4, which shows that most of the identified barriers did not act as the root cause of the existing problem. After asking the question "why is this a problem?" the chain of problems became long, which showed that a barrier usually was based on more than one problem. The barriers that emerged from the observations and the interviews were based on other underlying problems. The barrier: hierarchy creates detour in the flow, was the only barrier that acted as the main cause. It could also be seen from the analysis that many of the barriers had the same or similar underlying problems, causes, and symptoms. From the Barriers-Cause-Symptom matrix, it can be noticed that main causes result in a few common symptoms: wrong prioritization of work, loss of competitiveness, tasks take more time than required, none value-adding work, none value-adding results, and that projects take longer time than required. The full version of the analysis can be found in Appendix I.

Table 4.4: Barrier-Cause-Symptom matrix.

	Barrier	Cause	Symptom
8	adding new tools, but still keeping the old ones	data collected in different locations	takes more time than required
			wrong prioritization of work
		doesn't use the full potential in the company	lose competitiveness
6	resistance against change	Data collected in different locations	takes more time than required
			wrong prioritization of work
		lack of collaboration and sharing of knowledge cross-functional	loss of competitiveness
6	results depends on the persons competence	to many options of work process	wrong prioritization of work
		incorrect use of tool	
		Lack of motivation and engagement	
6	lack of common goals, scope and structure	lack in project management and communication	loss of competitiveness
			wrong prioritization of work
5	lack of system support	method gaps in existing systems	project taskes longer time to complete
			wrong prioritization of work
			Loss of competitiveness
			takes more time than required
4	Limited time resources	involved in many projects at the same time	project taskes longer time to complete
			wrong prioritization of work
			Loss of competitiveness
4	difficult to build personal relations working digital	Hide behind the screen	loss of competitiveness
			wrong prioritization of work
4	still learning the existing tools	lack of motivation and engagement	wrong prioritization of work
		Tool is to complex	Takes more time than required
		Adding new tools, but still keeping the old ones	takes more time than required
			wrong prioritization of work
			loss of competitiveness
		Resistance against change	loss of competitiveness
			takes more time than required
			wrong prioritization of work
4	need to pull data out of the different systems to analyse it	To many systems/tools	Takes more time than required
			Wrong prioritization of work
			Loss of competitiveness
			none value adding work
4	lack of communication between different functions	lack of communication between different functions	Loss of competitiveness
			Wrong prioritization of work
			None value adding work
4	no matching categorizes between sites	No common work structure /no standard	loss of competitiveness
			None value adding results
			wrong prioritization of work
			takes more time than required
3	hierarchy - creates detour in the flow	hierarchy - creates detour in the flow	loss of competitiveness
			wrong prioritization of work
			none value adding work
3	not learn from best practice	spending time on solving problems that already are solved	loss of competitiveness
			None value adding results
2	unstructured and unorganized work	Lack of project strategy	Loss of competitiveness
			None value adding results
			wrong prioritization of work
1	apply method after solving the problem	Unstrandardized working methods	wrong prioritization of work
			none value adding work
			loss of competitiveness
1	Different national rules and regulations	No matching categorizes between sites	Loss of competitiveness
			None value adding work
			Wrong prioritization of work
			takes more time than required

The Barrier-Cause-Symptom matrix was further investigated to take a closer look at if some of the main causes resulted in the same symptoms, which it did. The main causes that resulted in the same symptoms, can be interpreted as more important than the rest. However, the number of times the barriers were mentioned in the interviews must also be taken into account.

4.3.2 Priority List

Further on in step two during phase three, see Figure 4.6, the main causes were categorized using the Activity Theory. This was performed to gain an increased understanding of what certain elements the different causes affected.
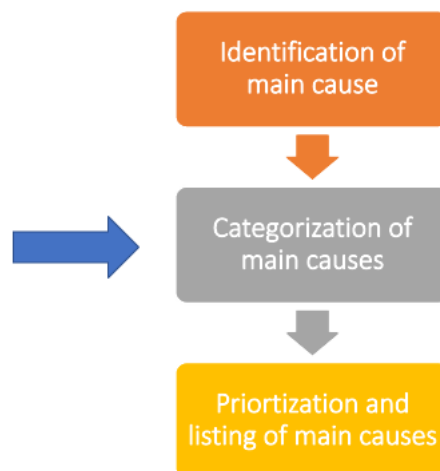
Figure 4.6: Phase 3, step two.

As can be seen in Table 4.5, most of the main causes are within the areas: Subject, Tools, and Community. To be able to reach the set goals, the Object, efficiently, the main barriers under the remaining categories: Subject, Tools, Community, Division of Labour, and Rules must be met.

Table 4.5: Main causes listed in the Activity Theory

Object	*Barriers for reaching the goals*							
Subject	*Barriers in the project managers and participants in the project (teamet)*	Lack of motivation and engagement	Lack in project management and communication	Resistance against change	Lack of project strategy			
Tools	*Barriers in tools and working methods*	Data collected in different locations	To many options of work process	Incorrect use of tool	Method gaps in existing systems	Tool is to complex	Hide behind the screen	Unstandardized working methods
Community	*barriers in the environment where the project is carried out (organization)*	Doesn't use the full potential in the company	Lack of collaboration and sharing of knowledge cross-functional	Adding new tools, but still keeping the old ones	To many systems/tools	Lack of communication between different functions	Hierarchy - creates detour in the flow	No matching categorizes between sites
Division of labor	*Barriers in taking responsibility, dividing work, taking charge*	Involved in many projects at the same time						
Rules	*Barriers for the rules, guidelines, ethics, co culture and norms for the work*	No common work structure /no standard						

Further on in phase 3, step three, see Figure 4.7 the main causes were further prioritized and listed into a priority list. The priority of the main causes was listed based on how many times the barriers were mentioned in the interviews, which can

be seen in Table 4.4. Barriers that were caused by the same problem were higher ranked in the Priority list.
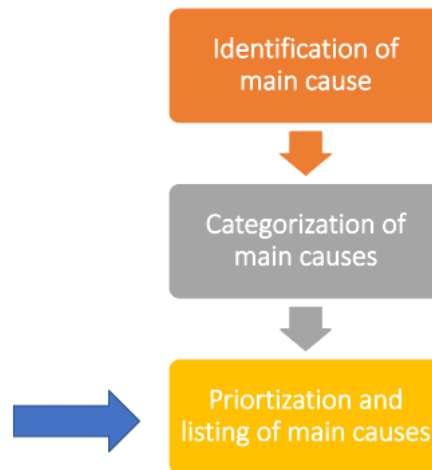
Figure 4.7: Phase 3, step three.

The Priority list, which can be seen in Table 4.6, both shows the priority of the main causes of the barriers, as well what area within the Activity list the main cause belonged to. The priority of the main causes describes in what order the main cause should be performed to create an increased value.

Table 4.6: Priority list

Problem	Priority	Activity area
Data collected in different locations	1	Tools
Lack of motivation and engagement	2	Subject
Lack of collaboration and sharing of knowledge cross-functional	3	Community
Resistance against change	3	Subject
doesn't use the full potential in the company	4	Community
lack in project management and communication	5	Subject
to many options of work process	5	Tools
Incorrect use of tool	5	Tools
Method gaps in existing systems	6	Tools
Tool is to complex	7	Tools
Hide behind the screen	7	Tools
Adding new tools, but still keeping the old ones	7	Community
To many systems/tools	7	Community
Lack of communication between different functions	7	Community
Involved in many projects at the same time	7	Division of labor
No common work structure /no standard	7	Rules
Hierarchy - creates detour in the flow	8	Community
Lack of project strategy	9	Subject
Unstandardized working methods	10	Tools
No matching categorizes between sites	10	Community

For companies to be able to lead projects and reach the set goals, it is not necessary that all listed barriers must be solved, even though it is of high priority. By solving the listed barriers, a company may be able to work and lead projects in a much more effective and efficient way which in turn, from a long-term perspective will create a more competitive organization. Since the problems in the priority list already were categorized, it created possibilities to divide the problems further into 2 final lists consisting of functions that were needed to reduce certain problems.

4.3.3   Final List of Functions for a Tool

Based on the priority list, see Table 4.6, a function list was created, see Table 4.7. The list states what functions that are required to overcome the listed problems, as well as what area of the Activity Theory the function belongs to.

Table 4.7: Problems from the priority list converted into functions with corresponding area of the activity theory.

Activity area for problems	Problem	Priority Problem	Function	Activity area for functions
Tools	data collected in different locations	1	collect data in a common system	Tools
Subject	lack of motivation and engagement	2	show goals and directives for the project	Tools
			involve organizational culture and values	Tools
			recognize and encurrage good performance	Community
			standarize way of working	Rules
			create intuitive and userfriendly interface	Tools
Community	lack of collaboration and sharing of knowledge cross-functional	3	increase transparency among projects	Community
Subject	resistance against change	3	prepare for change	Community
Community	doesn't use the full potential in the company	4	increase cross-functional collaborations and sharing of knowledge	Community
Subject	lack in project management and communication	5	create a common project view	Tools
Tools	to many options of work process	5	standarize way of working	Rules
Tools	incorrect use of tool	5	create intuitive and userfriendly interface	Tools
Tools	method gaps in existing systems	6	collect data in a common system	Tools
Tools	tool is to complex	7	create intuitive and userfriendly interface	Tools
		7	include limitied amount of functions	Tools
		7	standarize way of working	Rules
Tools	hide behind the screen	7	personal profile vizualising progress and performance	Tools
		7	show task dependencies in a time plan	Tools
Community	adding new tools, but still keeping the old ones	7	limit the amount of tools	Community
Community	to many systems/tools	7	limit the amount of tools	Community
Community	lack of communication between different functions	7	increase cross-functional collaborations and sharing of knowledge	Community
Division of labor	involved in many projects at the same time	7	easy to parry between project profiles	Tools
		7	collect individual tasks in a common place	Tools
		7	set labels on tasks	Tools
		7	notifications about work updates regarding personal tasks	Tools
Rules	no common work structure /no standard	7	include limitied amount of functions	Tools
		8	collect data in a common system	Tools

Community	hierarchy - creates detour in the flow	8	increase cross-functional collaborations and sharing of knowledge	Community
Subject	lack of project strategy	9	show goals and directives for the project	Tools
Tools	unstandardized working methods	10	limit the amount of tools	Community
		10	include limitied amount of functions	Tools
Community	no matching categorizes between sites	10	create common definitons and standards	Rules

To increase the comprehension of the listed functions, each function will be further described. Starting with the first problem from the priority list, which was *Data collected in different locations*, which could be solved by the function:

- **Collect data in a common system** - one tool would be the ideal solution, which would increase transparency and make it easy to find, share and re-use information.

The second problem was *Lack of motivation and engagement*, which could be solved by the functions:

- **Show goals and directives for project** - clear defined goals and objectives should be stated for each project and well understood by all team members. If changes are made regarding the goals during the project, everyone should be updated to make the team aligned. Working aligned with a common goal creates a common purpose and a feeling of unity, which can influence motivation and engagement.
- **Involve organizational culture and values** - with the purpose to create common values and thoughts about how the work should be performed, as well as increasing the understanding of the participants, and creating a respectful work environment with common norms.
- **Recognize and encourage good performance** - if responsibility areas are clearly defined and divided between the team members, it may increase engagement and performance. If tasks and responsibilities are well defined, and each member can see how their tasks correspond to the overall project purpose, people can feel more committed and included, hence increasing the engagement.
- **Standardize way of working** - the results should not depend on the person who performs the task. Having standardized ways of working, to some extent, limits the variations in the results. It can also provide the work to be more efficient since misunderstandings due to deviation in tool and process perception will be limited. A more intuitive tool corresponds to more motivated and engaged participants. At the same time, standardized processes limit the ability to be innovative and flexible, which can limit the work in projects in fast-changing environments. A trade-off is required to not get too many variation in the work, and at the same time allow flexibility to some extent.
- **Create intuitive and user-friendly interface** - an overload of possible tools and different ways of working increase the complexity, which can lead

to confusion and lack of motivation. The tool should be intuitive and user-friendly without too much time for learning. The purpose is to make the work processes easier for the employees. If the tools are too difficult to handle and manage, it would decrease engagement and motivation, which in turn will affect the work and the performance.

Lack of collaboration and sharing of knowledge cross-functional was the third problem. The converted function was:

- **Increase transparency among projects** - it would increase the possibilities to communicate and sharing knowledge and experience cross-functional and between projects. With the purpose to use the available knowledge, expertise, and experience in the organization, therefore use the full potential of the company.

Another problem that also was on priority three was *Resistance against change*, for which the created function was:

- **Prepare for change** - to make employees aware of the situation and involve change management, the reasons why should be clarified, how it will increase value for the employees, and the process of change should be explained. It is important that everyone feels included in the process and not only being forced into something new without knowing why.

Doesn't use the full potential in the company was the fourth prioritized problem, which was converted to the function:

- **Increase cross-functional collaboration and sharing of knowledge** - the reason why the organization does not use the full potential is due to a lack of collaboration within the organization. Another reason could be lack of collaboration Since it is difficult to find material due to lack of documentation. The processes are not transparent which makes it difficult to find needed information and to further re-use it.

The fifth prioritized problem, *Lack in project management and communication*, was converted to the function:

- **Create a common project view** - which could be done by implementing a tool that can visualize tasks, schedule, increase communication, planning and visualize the goals and resources. It is important that all team members feel included and synchronizes their work, which is difficult if the management and communication are lacking.

Another problem on priority five was *To many option of work process*, for which the function was:

- **Standardize way of working** - which is explained for the problem *Lack of motivation and engagement*

As well *Incorrect use of tool* was a problem on priority five, which could be solved by the function:

- **Create an intuitive and user-friendly interface** - which is explained for the problem *Lack of motivation and engagement*

Method gaps in existing systems was the sixth prioritized problem, which was converted to the function:

- **Collect data in a common system** - data is collected in a wide range of systems, and different plants use different categories and definitions of problems. The evaluation of performance and results between different functions, plants, and projects are therefore becoming difficult to manage. Too many systems and methods leading to no consensus in the way of working. Collecting all data in a common system would close the gap between the different systems.

Tools are too complex was the next prioritized problem, for which the following functions were stated to overcome the problem:

- **Create intuitive and user-friendly interface**
- **Include the limited amount of functions** - a tool consisting of multiple functions that are doing the same things leads to variations in the results. Only functions that are needed and creates any value should be included in the tool. Hence, it is important to think about the purpose of the tool and why it is required, before implementing it. Many functions can create confusion and misunderstandings, resulting in deviations in the result and lack of efficiency.
- **Standardize way of working**

Another problem on the same priority as the previous problem, were *Hide behind the screen.* The functions was:

- **Personal profile visualizing progress and performance** - this would increase the transparency within the projects. All team members would be able to see the different responsibilities connected to the project's progress. The project manager would also quickly get an overview of each team member's responsibilities and project progress, hence facilitate resource management. If everyone can see what each employee is responsible for, it will increase the motivation to deliver what is required. Hence limit the possibility to hide behind the screen.
- **Show task dependencies in a time plan** - By visualizing how each task is dependent on each other, it could make the team more committed to deliver their responsibilities.

Adding a new tool but still keeping the old ones was another problem on priority seven, which was converted to the function:

- **Limit the number of tools** - tools that don't deliver any value, as well as tools whose functions are covered by other tools, should be eliminated. The more options that exist, the more variations will arise. When implementing new tools or processes, the old ones should be deleted if the new tools cover the same functions that the old ones had.

To many systems/tools was as well on priority seven. The problem was translated to the function:

- **Limit the amount of tools**

The problem *Lack of communication between different functions* was translated to the function:

- **Increase cross-functional collaboration and sharing of knowledge**

Involved in many projects at the same time was translated to the functions:
- **Easy to parry between projects** - it should be easy for the people involved to allocate between the different projects and tasks. It should be clear what task corresponds to which project and to see how the progress is going for each project.
- **Collect individual tasks in a common place** - to easily allocate and find the information that is valuable for the person, all the tasks and updates concerning the individual work should be collected in a commonplace in the tool.
- **Set labels on tasks** - labels on tasks and deliveries should be used to easily allocate and find the information needed. Labels could be used, to create organized work.
- **Notifications about work updates regarding personal tasks** - when updates or changes are made regarding tasks, the affected person should be notified. Project changes that affect the personal tasks, milestones, or major deliveries for the project should be communicated. The notifications could be made via email or within the tool.

No common work structure/ no standard was converted to the function:
- **Include limited amount of functions**

The problem *Hierarchy - creates detour in the flow*, was on priority eight and was converted to the functions:
- **Collect data in a common system** - data that the whole organization, or at least more than the current functions or project, would have an interest in should be more transparent and collected in a commonplace. With the purpose to make the work more efficient and create possibilities to share and re-use experience and knowledge within the organization. Information should be transferred independently of where in the organization the employee belongs, and encourage direct contact instead of long processes to reach the desired information.
- **Increase cross-functional collaborations and sharing of knowledge**

Lack of project strategy was on priority nine. The problem was converted to the function:
- **Show goals and directives for the project**

The first problem on priority ten was *Unstandardized working methods*, which was converted to the functions:
- **Limit the amount of tools**
- **Include limited amount of functions**

The second problem on priority ten was *No matching categories between sites*, and was converted to the function:

- **Create common definitions and standards** - which would make it easier to compare data and results between different projects and plants. A common definition and standard would make it easier to understand each other which in turn would create a common view of the situations. The interpretation of information and data would be equal, and not depending on the culture or which plant you correspond to.

The listed functions were then further divided into one priority list for the functions regarding the tool, see Table 4.8. Respectively one priority list of functions regarding the organizational problems, see Table 4.9.

Table 4.8: Priority list of functions for a digital tool to overcome the problems.

Priority	Function	Problem
1	collect data in a common system	data collected in different locations
		Method gaps in existing systems
		hierarchy - creates detour in the flow
2	create intuitive and userfriendly interface	Lack of motivation and engagement
		incorrect use of tool
		Tool is to complex
3	show goals and directives for the project	Lack of motivation and engagement
		Lack of project strategy
4	involve organizational culture and values	Lack of motivation and engagement
5	create a common project view	lack in project management and communication
6	include limitied amount of functions	Tool is to complex
		No common work structure /no standard
		Unstandardized working methods
7.1	Personal profile vizualising progress and performance	Hide behind the screen
	Show task dependencies in a time plan	
7.2	easy to parry between project profiles	involved in many projects at the same time
	collect individual tasks in a common place	
	set labels on tasks	
	notifications about work updates regarding personal work tasks	

The priority for the functions was ranked primarily according to the priority of the problems in the priority list. Since some of the functions corresponding to more than one problem, the priority for these functions was stated according to the highest prioritized problem. As example: the function *Collect data in a common system* was a function to the problem *data collected in different locations* with priority one, *method gaps in existing systems* with priority six and *hierarchy - creates detour in the flow* with priority eight. Hence is the priority for the function priority one.

If the same function existed for multiple problems with the same priority, the number of part-problems that the function solved was estimated to a higher priority. Meaning that the function *Standardized way of working* was prioritized higher compared to the function *Recognize and encourage good performance*, since *Standardized way of working* contribute to solving three of the problems, while *Recognize and encourage good performance* only solved one.

By finding a tool that includes the stated functions in Figure 4.8, would help overcome the identified barriers. Nevertheless, it can be difficult to find a tool that includes all the functions. Whit that said, it does not mean that the tool is useless if it does not include every function. Rather than the tool can overcome some parts of the problems, which can be more useful than not doing anything.

Table 4.9: Priority list of functions to overcome the organizational problems.

Priority	Function	Problem
1	Standarize way of working	Lack of motivation and engagement
		to many options of work process
		Tool is to complex
2	Recognize and encurrage good performance	Lack of motivation and engagement
3	increase transparency among projects	lack of collaboration and sharing of knowledge cross-functional
3	prepare for change	Resistance against change
4	increase cross-functional collaborations and sharing of knowledge	doesn't use the full potential in the company
5	limit the amount of tools	Adding new tools, but still keeping the old ones
		To many systems/tools
		Unstandardized working methods
6	increase cross-functional collaborations and sharing of knowledge	lack of communication between different functions
		hierarchy - creates detour in the flow
7	create common definitons and standards	No matching categorizes between sites

The functions listed in Table 4.9, are functions that will help overcome the organizational problems in project management for virtual teams. As stated during the interviews, it is not the tools itself that solve the barriers, it is the underlying processes and organizational cultures. To be able to gain useful results from the implementation of a tool, these organizational problems need to be solved as well.

By following the function priority lists, as shown in Table 4.8 and Table 4.9, it is not sure that the whole corresponding problem will be solved just because one of the

functions is included, it can solve a part of the problem. According to the priority, it is more useful to solve the top prioritized problem. The functions that solve the top prioritized problems can also partially solve multiple other problems with lower priority.

5

Discussion

In this chapter, a final discussion about the project will be presented. Each part of the project will be discussed. Starting with the Theory Research, followed by the Methods & Tools Used in the Project, then the results from each phase of the project will be discussed. Finally, the chapter will round off by discussing the Ethical Aspects.

5.1 Theory Research

The four selected areas within the theory research were suitable. The areas, on the other hand were a bit wide which resulted in a lot of research material which made it difficult to limit and to find material suited for the research at first. The areas encompass each other and are well connected. The found articles often covered more than one of the areas which created possibilities to find a common view from the articles.

The Covid-19 situation has contributed to an increased level of digital work. People nowadays work from home. When the theory research was performed, there was not that much research regarding how the new way of working affects people psychologically and how it may affect projects. The theory showed that there was no longer an option to digitize, rather a requirement. It is of high importance to understand the reason behind the digitalization, not only for the organization itself but to create trust among the employees. Without knowing why and what value that the change may create increases the risk of resistance. With increased trust, defined goals, roles, and responsibilities enhance the level of motivation which in turn may reinforce better appearance. The same goes for knowledge management, first define why, create trust, set areas of responsibilities and a standardized way of working. With that in mind, sharing and re-use of knowledge help to take advantage of the companies' full potential and information, which in turn would help to use old knowledge within new areas and as well create more innovative solutions more effectively.

Barriers within project management and virtual project management seem to be quite similar but are being more experienced in a digital environment. The project group had to triangulate to identify the barriers, because of the lack of unclear definitions.

In globally distributed companies, cultural depictions were described as a major barrier, especially in a digital context where human expressions are difficult to define and understand. It is important to create a cultural community where social factors are of high priority. Different cultural norms and rules as well create barriers. People behind a screen do not act the same way as in a face-to-face meeting.

5.2 Methods & Tools Used in the Project

The four selected areas within the theory research were suitable. The areas, on the other hand, were a bit wide which resulted in a lot of research material which made it difficult to limit and to find material suited for the research at first. The areas encompass each other and are well connected. The found articles often covered more than one of the areas which created possibilities to find a common view from the articles.

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The second phase consists of an examination of what digital tools existed in the current market. The method used when searching for tools was based on the requirement specification and its functions that in turn was based on data from the interviews and the observations. Many of the existing tools seemed to be mainly

adopted in the construction industry and none of the found tools could solve all functions. It was difficult to assess the tools' functions based solely on the companies website and videos. The idea was that the four winning tools should have been tested and verified within the Case Project, but since the project did not consist of any deliveries, time frame, or milestones, it was not possible to manage. One question to ask is "whether the barriers would have looked different if the project was more established, with defined goals?". If the case had been more defined, the time distribution between the different phases would probably have been re-evaluated and more time would have been spent on the evaluation and testing of software.The methods used when comparing the four different tools consisted of demo meeting, demo test, and interview. To give a fairer assessment, each software should be tested in the same way.

In Phase 3, the identified barriers from Phase 1 were further analyzed to make sure that the barriers acted as the main barrier. It turned out that most of the barriers are based on underlying problems, which might have emerged at an earlier stage if observations could have been performed on-site. The results could also have been compared with other projects. With an increased level of direct contact between the project group and project managers/participants, knowledge could easier have been shared. The final priority list of barriers and functions was based on the main causes which were divided with help of the Activity Theory. The Activity Theory has followed along with the entire project, which made it easier for the project group to create the final priority lists.

5.3 Identification of Barriers in the Case Project

To investigate the existing barriers within virtual project management in the Case Project the three methods: observations, interviews, and the survey was used. One of the identified barriers during the observations was the different time zones, which made it difficult to schedule meetings. The lack of time could also depend on the number of projects each person was involved in. During the interviews, it was mentioned that many of the directors and coordinators were included in up to 25 projects each, which leads to difficulties with the allocation of time and knowing what information was given and available to whom.

Another observation that was made was that the different directors of the different pillars had different views on the current situation. Pillar managers that did not require any additional information from other pillars in their daily work were pretty happy with the work and tools. While pillar managers that required cross-functional information and data from other pillars or plants were less satisfied with the existing way of working and sharing data. This is in line with the results from the interviews, where it was clear that the interpretation of the current ways of working depended on the person's current level of need for cross-functional information sharing. This is not something unique, it is easy to get tunnel vision and only see the situation from the personal perspective and not from a bigger picture.

The participants that experienced the existing ways of working as good also seemed skeptical about the digital transformation, and rather preferred the old ways of working. This is a human reaction regarding the change, which is normal. If the individual does not see the personal benefits of the change it will create resistance against it. It can also depend on fear against the unknown since people prefer to deliver high results. By implementing a new digital tool, it requires new ways of learning and creation of experience before a work habit is created that people feel safe and comfortable with.

During both the observations and interviews it was clear that there was a lack of transparency in the current way of working. The observations showed that problems that are solved often reoccur, which also was stated from the survey. That it takes a long time to receive required information could be a problem affected by the lack of transparency, hierarchical detours in the flow, and that information is collected in different locations. No commonplace to collect data was identified as a barrier both from the observations and the interviews. During the interviews, it was clear that many options of work processes in the projects and tools existed and shifted from project to project. The most mentioned barrier was "adding a new tool, but still keeping the old ones". This creates multiple options for managing the work, which in turn creates a variation in the result, as data will be collected in different places. It will also be more time-consuming to find the required information, which in turn will result in a waste of time on none value-adding work and loss of efficiency. It also further fuels the lack of transparency, which leads to difficulties to analyse performance and comparing data between different projects and plants, as well create a lack of knowledge sharing and learning from best practices.

After the interviews and observations, it was clear that the project lacked a common goal, scope, and structure. The case project neither had a time plan with start and end dates, nor any allocated resources in form of decided participants. Hence it was clear that the case project was more of a pre-study with the purpose to investigate future possibilities for improvements regarding root cause analysis in the Case Company. Due to this, it was not rare that the team members felt that they did not know the goal and scope, and felt that there was no common work structure in the project. This might have affected the level of motivation and engagement. Nevertheless, the results from the investigation of the Case Project can be trustworthy, since the observation was made in a context similar to other projects within the organization and the same tools are being used in other projects. The question from the interviews included general questions, and not only case project-specific questions. Questions regarding data and how it is shared between the pillars and plants was one of the questions, followed by what tools that were used were included in the interviews. Therefore can the listed barrier cover a more general approach regarding virtual project management, and how the work was done currently to find possible areas for improvements.

The gathered data regarding virtual project management resulted in a barrier list

with 16 barriers. These barriers come from the interviews and the number of times they were mentioned. The barrier "Lack of common goals, scope, and structure" may be a barrier specific for the Case Project, since the project, later on, was defined more as a pre-study, rather than a classic project. This because it lacked all of the elements in the definition of a project. In addition, it was said in the literature research that having clearly defined goals, scope and structure was of even greater importance when working in virtual teams. From the observations, it was seen that most of the projects managed the communication through either emails or online meetings. Sharing of files was done mainly in Microsoft Teams and Sharepoint. Most of the employees stated that they still trying to learn the existing tools and that they, therefore, do not use the full potential in the tools.

The requirement specification list includes functions that could be included in a possible digital tool to overcome the identified barriers in the barrier list. Most of the functions are broad and each function can be solved in many different ways. The purpose is not to focus on how the tools solve the functions, rather that they can do it. For example, if a tool includes the function of a "Project Plan", that could be done in multiple ways, the important is that it is included in the possible tool. In a later stage when the tools are being evaluated deeper, the focus should shift to how the functions are solved to make it possible to rank the tools.

5.4 Analysis of Existing Digital Software

As mentioned from all of the interviews, it is required that a pre-study of the companies processes must be analyzed and examined before applying any digital tool. Adding a tool without analyzing the methodology and process will not solve any problems. It is not the tool itself that is of the highest importance, it is the process and methods behind it. The purpose of the implementation of the digital tool should be clear. Digital tools can be very useful and make the work more efficient, but it still requires that the core and the processes are established to increase the best possible experience.

None of the investigated and evaluated tools fulfills all the requirements in the requirement specification list. The requirements include either too many features or it is a lack of tools on the market to fulfill the desired needs to be able to reduce the existing barriers. Hence, a new tool needs to be developed or the organization needs to settle with a tool that fulfills most of the required functions. Even if a tool does not fulfill all the requirements it can still be beneficial to implement it.

Many of the evaluated tools are lacking in the ability to handle documents and decisions. Even if the tool had the possibility of handling documents it was perceived as difficult and inefficient when searching for desired information. It was said during the interviews that a search function in the documentation would have been useful to filter the documents. This would make it easier to re-use the gained knowledge and experiences within future projects where similar problems and challenges might occur. It was mentioned that easier documentation was required to avoid the hierar-

chical levels in the communication and work, to increase transparency, and manage the data in one common way.

Since it was not possible to evaluate the tools in similar ways, the quality of the evaluation can to some extent be biased. As the participants for the evaluation through the demo and the interviews were working for their tools company their answers was probably biased for their benefit. In similar ways could the evaluation through demo tests also been unfair for the tools, since they were only tested internally in the project group and not applied in a real project context. The aim from the beginning was to implement the tools and try them in the case project, and from that make observations and interviews regarding the experience of the tools.

5.5 Root Cause Analysis & Final Results

After identifying the barriers from the first phase, those were further examined in phase 3 to see if the found barriers were the main cause or were based on other problems.

It was discovered that most of the identified barriers from the interviews and observations were based on another problem. It is often the case that participants in projects experience a certain problem, which may not act as the root cause. Had the result possibly looked different if observations on site had been performed? It is important to solve the main cause to reduce the experienced barriers. Does this mean that by solving the main cause that several barriers will be reduced?

One question to ask is whether the barriers would have been the same if the Case Project had been more established. On the other hand, the barriers that arose during the theory research agreed with the identified barriers. Are the barriers independent of whether it is a project or not, and whether the project is managed virtually or not? Or are the barriers just being perceived as more tangible in digital projects?. A few barriers that arose during the interviews were not identified within the theory. These barriers were seen to be specific to the Case Project, for example, that a method was applied after the task had been performed. Henceforth, the barriers from the theory and the interviews can be found in Table 5.1 and Table 5.2.

Since the identified barriers from the interviews and the observations were not acted as the root causes of the problems. What if the barriers from the theory not either are the root causes, rather an event of rising problems from other problems. Barriers that arose during the theory research seem to cover most of the identified barriers from the Case Project, even though that the Case Project was not defined as a project. The barriers that were found in the theory were mentioned in another order compared to the barriers found in the Case Project, which is of common sense since a problem for one person, may not be perceived as a problem for another one.

Many of the identified barriers are based on changes and new ways of working. It is important to prepare the employees for change, which in turn may have decrease

many of the identified barriers. Digitize for the sake of digitalization does not generate better results, it rather creates additional barriers such as difficulty to build personal relationships working digital, lack of trust, lack of division of labor: task and responsibilities, lack of education and support. For an organization to be able to lead projects virtually, it is required that the company, first of all, understand why there is a need for change, what the aim and goals are and what increased value it may create, and then communicate the strategy among the employees. By involving the employees in the process barriers such ass resistance against change may be reduced.

Table 5.1: Identified barriers and brief description

	Barriers	Description
8	Adding new tools, but still keeping the old ones	By adding new tools and still maintaining old working methods creates a risk that employees will refuse to learn the new tools which in turn will create diversity in terms of leading projects. Since employees often participate in more then one project, a large amount of tools may create confusion and unnecessarily complex working processes.
6	Resistance against change	Employees often prefer the already existing working methods and tools and are not open for changes.
6	Results depends on the persons competence	Since working methods are not fully standardized, the result depends on who is performing the tasks. Different local variants of methods also depends on what resources the different cites has.
6	Lack of common goals, scope and structure	In case project, there were no common view over the project situation, which creates a risk for unmotivated participants.
5	Lack of system support	There is a lack of system support in the available methods and tools, no support function regarding usage and best practice.
4	Limited time resources	There is a lack of time resources due to many participants also are involved in other projects.
4	Difficult to build personal relations working digital	Virtual communication does not create the same opportunity for building relationships as during face to face meetings.
4	Still learning the existing tools	People in the project were not that interested in trying out new software tools due to the fact that the learning of a tool was still in circulation and people still exploiting the functions.
4	Need to pull data out of the different systems to analyse it	Data and information is gathered in different systems which creates difficulties when analyzing and comparing data.
4	Lack of communication between different functions	There is a lack of cross cultural communication between the different sites among the organization
4	No matching categorizes between sites	Which means that the plants are using different expressions for the same categories which creates difficulties when analyzing data.
3	Hierarchy - creates detour in the flow	Since the whole organization is built on a hierarchical structure, processes are becoming more time consuming due to detours in the flow. It also creates lack of transparency among the organization.
3	Not learn from best practice	Since the plants do not share their expertise and knowledge between each other, employees may working on already solved problems.
2	Unstructured and unorganized work	Organization and structuring of data takes place in different ways and is gathered in different places. Do not follow the working processes.
1	Apply method after solving the problem	By first solving the problem and then applying the method, similar problems will not always be solved in the same way. No standardized problem solving may lead to variation in the results.
1	Different national rules and regulations	Each country consist of different laws and regulations that affect the working methods

Table 5.2: Barriers found in theory and number of articles they where included in.

Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles	Barrier	Nr of Articles
difficult to build personal relations working digital	9	Problems in cross-cultural communication	5	Different problem solving approaches	4	Documnetation of work and access to the lates version	3	Lack of leadership capacities	2	Lack of proceses for archiving important written documentation	1	still learning the existing tools	1
lack of common goals, scope and structure	8	Collaborative learning and working	5	Challenging to keep control over progess as a leader	4	Asymmetry in processes	3	Lack of collaboration and coperation in the team	2	Monitoring team performance	1	Different national rules and regulations	1
lack of trust	8	adding new tools, but still keeping the old ones	5	Different time	4	Lack of face to face communication	3	Risk for miscommunication or misinterpreation	1	team members disengagement	1		
Various dimensions of culture	8	resistance against change	4	Limited time resources	3	resistance against change	2	Unnecessary documentation and emails	1	Lack of digital readiness	1		
Division of labour - divide tasks and responibility	8	Lack of education and support	4	not learn from best practice	3	Complex systems and project complexity	2	A common pitfall is for E-leaders to be available	1	Lack of education	1		
lack of communication between different functions	7	no matching categorizes between sites	4	Old project management methods are no longer effective	3	No social norms and standards	2	Lack of boundaries between home and work	1	unstructured and unorganized work	1		

5.6 Validation of Research

Validations are made to prove the result of the Master's Thesis. The results need to be validated both regarding the contribution to knowledge as well as contribution to practice. The contribution to knowledge is validated regarding the degree of compliance or not with the scientific research, and the degree of novelty of the research. The validation of contribution to practice corresponds to the generalization of the results (Isaksson, Eckert, Panarotto, & Malmqvist, 2020).

To validate the contribution to practice and to identify how generalizable the results are, it should be considered if the results are relevant to a particular company, an industry sector, or industry at large (Isaksson et al., 2020). Since the investigation was made at the Case Company in a particular Case Project, the result can be limited to only contribute with the practices for this specific Case Project. With the use of observations and interviews, which included questions regarding work in a more general manner in addition to the project-specific questions, it was clear that other projects had similar barriers when working digitally. The results are therefore valid for the particular Case Company.

Combining the results from the literature research and the investigations in the Case Project, the barriers are to a large extent aligned (see Table 2.2 and Table 4.2. Lack of common goal scope and structure and difficulties to build personal relations were barriers mentioned multiple times in both the literature and interviews. Other barriers as lack of trust, cultural differences, lack of cross-functional communication,

and adding new tools but still keeping the old ones are also barriers identified from both theory and the Case Project. The literature research was not limited to only include the automotive industry, which is the area the Case Project operates in, which can lead to that most of the resulting barriers are valid for the industry at large.

Considering the second research question, RQ2, for which an investigation and evaluation of existing digital software can be applied to overcome the barriers within virtual project management, the investigate software was used in multiple industries. Due to the wide range of investigated software to find out how new technology can overcome the barriers, the results can be valid for the industry at large.

The research area covers an identified a gap in the existing literature since there is limited research made in the area of project management, knowledge management, digitalization, and lean or agile in combination. Much research was made regarding each of the areas on their own or in other contexts, but together there is a lack of knowledge.

Based on the research, a question arose whether the identified barriers from the theory acts as the root causes of the problems within virtual project management. Barriers that were identified in the Case Project were aligned with the theory. The Root Cause Analysis, see Chapter 4.3 showed that most of the identified barriers did not act as the root cause in most of the cases. Has the theory regarding virtual project management identified the root causes or is a deeper investigation required?

5.7 Ethical Aspects

Many possibilities are created as a result of working digitally in virtual teams, but also new challenges are created. One of the good outputs from the digital project work is that people do not need to travel as much as before. Business meetings can be done with the aid of digital tools, hence limiting the need for long business travels around the globe. As well daily traveling to the office can be reduced, which in the long run is beneficial concerning environmental aspects.

One of the ethical considerations to take into account when implementing a digital tool and working digital is intellectual property. It is dependent on the social norms, and not only on the laws. It can be difficult to determine if an action is right or wrong in the digital environment. Sharing illegal files is easier and as a user, it can be difficult to know where the line goes between legal and illegal. Even if the action is not intentionally illegal, the outcome can act that way due to a lack of awareness by users.

Data security becomes extra important when working digitally. The data and files need to be managed, shared, and stored safely. Hence access must only be given to authorized persons. This can be a limitation when working in big projects with multiple participants and even individuals belonging to other organizations, as sup-

pliers or collaborative firms, included in the project. The virtual teams make these kinds of collaborative distributed projects possible, which is an effective way to use available knowledge and experience independent of physical location. At the same time, all members need to have access to the latest version of the data. Confidential data or sensitive information can easily leak out from the projects, especially when working in big projects with a huge amount of participants. It is therefore of high importance to follow organizational data security policies and rules, to prevent leakage of sensitive information that could be harmful to the competitiveness if it ends up in the wrong hands. Clear instructions on how to work in a safe and ethically correct way are required to align the workforce and include the policies and laws in the ways of working.

Another ethical aspect that becomes important when working in virtual teams is social networking. Due to the lack of face-to-face interactions, the creation of personal relations will be difficult to handle. Personal interaction is important to create a trustworthy environment where the employees feel safe, appreciated, and trusted. New ways to create the personal and social network are required to create the feeling of belonging and alignment of individual and organizational goals. The lack of body language and the ability to interpret how persons respond by reading their body language is eliminated when working digitally. These social relations were previously created through informal daily meetings in the office. New technology is required to close the gap in the creation of social networking when working digitally.

The digital work environment is connected to the analog work and the personalities behind the work. Actions made in the digital work reflect the personality which represents who the person is outside the digital world. Even if the actions made in the digital world are personal or anonymous, it is still the person that is responsible for the actions. It is therefore critical to implement norms and rules about how to act and behave when working digitally. On the other hand, it can also be the tool that affects the person to act in a way, as interfaces and functions in the tool can intrude personal integrity. In the end, it is always up to the user to control the personal behavior and include good judgment.

6

Conclusion & Recommendations

This chapter will examine the conclusions of the project. The fulfillment of the project's aim and research questions will be discussed. The chapter will round off with examining recommendations for further development of the project and recommended future research.

6.1 Conclusions

Conclusions are made regarding the methods and tools used during the project and for each of the three phases of the project.

Methods & Tools Used in the Project

The methods used were appropriate and well adapted to the project. Because of the Covid-19 situation, observations were performed virtually. Observations on site could have created a deeper understanding of the underlying problems and as well created evaluation possibilities comparing projects. The identified barriers from the interviews were not acted as the main causes of the problems but still agreed with the conducted theory research. What if the investigation of existing barriers within virtual project management only has been touched upon the surface and the root causes still haven't been identified.

The Case Project was not an actual project, which affected the project situation and it's result. Even though the identified barriers seem to be covered in the theory research the barriers may have arisen in an earlier state of mind. If the Case Project had been settled, testing of software could have been performed and verified more fairly. The identified data from observations, interviews, and surveys contribute to more valuable data since the organization first and foremost needs to solve the organizational barriers before a new tool can be added.

Identification of Barriers in the Case Project

One conclusion from the Case Project is that lack of time depends on the different time zones and that participants are included in multiple projects at the same time, which results in difficulties to allocate time and resources. In addition, it is also difficult to know what information is shared with whom.

It was clear that the interpretation of the current ways of working depended on the person's current level of need for cross-functional information sharing. The participants that experienced the existing ways of working as good also seemed skeptical about the digital transformation, and rather preferred the old ways of working. Another conclusion is that implementing a new digital tool requires new ways of learning, and new experiences need to be created before a work habit is created that people feel safe and comfortable with.

Much of the resulted barrier corresponds to the organization since most of the barriers have their core in the organizational culture and strategy. By following lean thinking, waste must be eliminated before any digital tool can be applied. Hence meaning that all the processes must be clear and should be standardized, which also applies the tools. This would make it possible to easier find the required data, and increase the re-usage of knowledge gained from previously solved problems. Leading to a more efficient way of working where resources are available.

Analysis of Existing Digital Software

Digital tools can be very useful and make the work more efficient, but it still requires that the core and the processes are established to increase the best possible experience. None of the investigated and evaluated tools fulfills all the requirements in the requirement specification list. A conclusion is that even if a tool does not fulfill all the requirements it can still be beneficial to implement if the processes and methods are established.

Root Cause Analysis & Final Results

As a conclusion, it could be seen that the identified barriers from the interviews were not the root cause of the problems, however, many of the identified barriers consisted of the same root causes and symptoms. It is important for the Case Company to address the root cause to avoid the onset of symptoms. The identified symptoms go hand in hand and can almost be caused by one another. Wrong prioritization of work may lead to that time is being spent on none value-adding tasks. No value-adding tasks may contribute to no value-adding results and those tasks take longer time than required to perform, which in turn creates poor conditions for the company to be able to act competitively. It is of high priority to dive into the area, to make sure that the company delivers the right product at the right time. Still, it requires adaption and change in the company's culture and way of leading projects virtually.

Reducing barriers from a short-term perspective is perceived as a complex process since the organizational structure needs to be investigated. However, by looking at the situation from a long-term perspective, changes would contribute to incredible improvements in leading projects, which could affect the company's existence and competitiveness. Virtual project management, can not be managed by old working processes. There is a need for an adaption and change of new technology.

6.2 Fulfillment of Project Aim & Research Questions

The Master's Thesis aimed to investigate the barriers within virtual project management at the Case Company in a specific Case Project and to explore the possibilities to use new technologies to overcome the identified barriers. To be able to solve the project's goals and purpose, the research was limited and concertized into two research questions:

- RQ1: What are the barriers for virtual project management in large global automotive organizations?

- RQ2: How can the barriers be addressed by using new technology?

To answer the first research question, RQ1, the Case Project was investigated through observations, interviews, and surveys. Identified barriers in the virtual Case Project were identified and analyzed to find the root causes. The investigation resulted in a priority list over the identified barriers within the Case Project, see Table 4.6 in Chapter 4.3.2. The investigation was done in the automotive industry. While the literature research covered virtual project management in a broader context, not limited to automotive. Even though, the resulting barriers from the case company correspond well with the identified barrier from the theory. A conclusion regarding this can be made that similar problems exist in most virtual projects, independent of industry. The priority list over the barriers is therefore the answer to RQ1, since it includes the barriers within virtual project management for a project operating in a large global automotive organization.

To address the second research question, RQ2, the analysis of existing tools for virtual project management was executed. A conclusion from the investigation, along with the results from the identified barriers is that it exists a wide range of possible digital management tools on the market. None of the investigated software fulfilled all the stated requirements that were listed to overcome the identified barriers. Nevertheless, even the lack of fulfillment of all the stated functions, this does not mean that the implementation of digital tools will not give any value. It is possible to apply the most suitable tool that fulfills most of the stated functions to overcome the barriers partially. To overcome some of the top prioritized barriers is better than doing nothing.

Even though, one of the main findings was that many of the barriers had their roots in cultural difficulties and how to act in a virtual environment. In this case, many of the barriers regard the processes and methods. The Case Company used old processes and methods and has with the increased digitalization tried to adapt by using new tools, which created miss-matches and variations in the work, along with a wide range of tools. One important conclusion is that the company needs to review and establish its core work and processes within the organization before a new digital tool will pay off and increase any value.

6.3 Recommendations

For further development, the project group proposes first and foremost to divide the following work into two parts. Part one mainly focuses on organizing and reducing waste within the organization and preparing for change, and part two mainly focuses on finding a digital tool and testing it in a real context. It is recommended to start with part one.

6.3.1 Organize and Reduce Waste

Part one largely consists of preparation of change within the organization and reviewing the existing barriers and possible solution options. The priority list should be used as a guide, starting from the top. Before using the priority list, see Table 6.1, make sure the following context have been examined:
  1. Create a common goal picture and understanding of why the company should digitize and further align the processes with the goal.
  2. Create a common goal picture within the area: knowledge management and create a common understanding of why sharing and re-use of data is of high relevance. Create standardized processes and formats and decide areas of responsibilities.
  3. Introduce change management and build trust by involving the employees.

Table 6.1: Priority list of functions to overcome the organizational problems.

Priority	Function	Problem
1	Standarize way of working	Lack of motivation and engagement
		to many options of work process
		Tool is to complex
2	Recognize and encurrage good performance	Lack of motivation and engagement
3	increase transparency among projects	lack of collaboration and sharing of knowledge cross-functional
3	prepare for change	Resistance against change
4	increase cross-functional collaborations and sharing of knowledge	doesn't use the full potential in the company
5	limit the amount of tools	Adding new tools, but still keeping the old ones
		To many systems/tools
		Unstandardized working methods
6	increase cross-functional collaborations and sharing of knowledge	lack of communication between different functions
		hierarchy - creates detour in the flow
7	create common definitons and standards	No matching categorizes between sites

6.3.2   Evaluate Tools

Part two focuses on finding a tool that in a more simply way can be aligned with the changing environment of how to manage virtual project management. The priority list, see Table 6.2 can be used as a guide through the project process. Before using the priority list of functions it is of high importance to review the following steps to provide the opportunity to find a tool that is aligned with the processes intend to overcome the barriers.

1. Create a well-executed benchmark and use the priority list as a guide
2. Test and evaluate the tools in a real context.

Table 6.2: Priority list of functions for a digital tool to overcome the problems.

Priority	Function	Problem
1	collect data in a common system	data collected in different locations
		Method gaps in existing systems
		hierarchy - creates detour in the flow
2	create intuitive and userfriendly interface	Lack of motivation and engagement
		incorrect use of tool
		Tool is to complex
3	show goals and directives for the project	Lack of motivation and engagement
		Lack of project strategy
4	involve organizational culture and values	Lack of motivation and engagement
5	create a common project view	lack in project management and communication
6	include limitied amount of functions	Tool is to complex
		No common work structure /no standard
		Unstandardized working methods
7.1	Personal profile vizualising progress and performance	Hide behind the screen
	Show task dependencies in a time plan	
7.2	easy to parry between project profiles	involved in many projects at the same time
	collect individual tasks in a common place	
	set labels on tasks	
	notifications about work updates regarding personal work tasks	

6.4   Future Research

For further research in the field, it is recommended to review the interaction between the human factor and digital systems/tools, as well as how digitalization will affect the daily work, culture, and psychological effects. It is said that digitalization creates good conditions for acting competitively, but what are the actual benefits in the form of financial consequences and how can this be guaranteed. Further research

should be done in the field of knowledge management with a focus on the re-use of knowledge and its effects, to investigate if companies can measure the increased value and if it even guarantees more valuable results.

The existing theory showed that similar barriers arose within project management and virtual project management. Most of the theory was performed within organizations that still had not aligned their processes and methods with the digital transformation. How will the barriers change with the digital transformation and the changed processes? Are the identified barriers from the theory the actual root causes within project management, or are the existing theory a bit misleading? The barriers identified from the interviews were consistent with the barriers found in the theory. When the root causes of the barriers were identified using the 5 Whys methods, the theory was not as consistent. Hence it should be considered if the theory within virtual project management only has been touched upon the surface and still needs further research. Does virtual project management require that organizational structures and methods need to be changed and further aligned with the digital transformation or can organizations use old ways of working and still lead and manage projects virtually? Had the barriers been affected? Had the existing barriers been the same, had new ones arisen, had they been easier to reduce? Or what would the consequences and effects be? These are questions and an area of research that needs further investigation.

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A

Interview Questions for the Case Project

- Can you please tell us a bit about yourself and your role?
- What do you believe are the goals for the root cause rocks project?
- How do you manage the communication and synchronization of work in projects? What tools are you using?
- What barriers have you experienced in leading projects?
- How has the way of leading projects changed due to the Covid-19 pandemic and the increased digitalization?
- How do you collaborate between the plants?
- How often do you communicate between the different plants?
- Within those tools you are using today, such as Office 365. Are you missing any functions?
- Do you use any specific digital tools for leading project and sampling data?
- Do you feel that all the plants are using the same tools and methods?
- How do you experience the collaboration between plants and projects?
- Do you share your experience and knowledge between each other?
- What opportunities do you see with a improved collaboration?
- Do you believe that a digital visual planning tool would help you in your daily work within projects?

B
Interview Questions used for the Benchmark Interviews with Users

- Would you like to start telling us about yourself and what you are working with?
- What is your relation to the ones that work with the digital tool?
- How included are you in the work connected to the tool?
- How did you work before adding this digital tool?
- What was the problems whit the previous way of working?
- What was the reason for the implementation of the new tool?
- Did you consider other optional tools before you decided to implement this one? If so, what was the reason to you select this tool?
- How did the employees reacted to the implementation of the tool?
- For how long time have you been using the tool?
- Has the attitude regarding the tool changes over time?
- Do you have any standardized ways of working within the tool?
- Are there any norms or rules regarding how the work should be performed?
- What ethical aspects needs to be considered when working digital?
- What positive effects comes with the usage of the tool?
- How has the tool affected the deliveries and project times? Why?
- Do you experience any negative aspects of the usage of the tool?
- How do you overcome these today?
- Has the way of communication changed? How?
- How do you experience that the way of leading projects has changed with the increased digitization?

C

Interview Questions used for the Benchmark Interviews with Tool Company

- Would you like to start telling us about yourself and what you are working with?
- What it the purpose of the tool? What should it generate to a project?
- What other tools are often used in combination with this tool?
- What does the implementation process look like?
- How does the implementation differ depending on the project and industry?
- Is there any guide or standardized way to work in the tool? Especially in the set-up of a project?
- Do you experience any major barriers with the project set-up?
- What do you think about the intuitiveness in the tool and the usability?
- What barrier have you experienced in the project management?
- Can the tool overcome these? Or how do you solve them?
- What are the positive aspect of using the tool, compare to old ways of working?
- Why is this tool better compare to other tools?

D

Statement categorized in themes as a result from the KJ-method

nr:	Organizational barriers	nr:	RCR goals	nr:	Project management barriers	nr:	Barriers in existing tools	nr:	Solutions	nr:	Processes	nr:	Thoughts	nr:	Digital
3	hierarchy - creates detour in the flow	1	develop the work process	1	the approach	1	Herca is completely useless	2	platform can analys data	1	learn by paper and pen, then add a system solution	1	you can do same things in Teams as you can in Visio, but not as user friendly	1	people act different online
3	forced to use new tools, such as office 365 and teams	5	don't know the goal	2	own way of working	1	VMMS not user friendly, requires education in order to navigate	1	common system - API keys	2	thorough pre-study	1	open for changes as long as it gives a value		
1	learned to question company structures	4	user friendliness in the systems and processes	2	need the right knowledge and experience in the right area	1	take to much time to conduct e.g. HERCA	2	project follow up system (Visio)	1	create clear directives	3	don't care what tool to use		
2	same core methods	2	investigate problems	1	waste of time on no value adding work	1	too many functions	1	tree structure in platform	1	PDCA	3	important to build relations and create common goals		
6	resistance against change	1	compile and visualise data from the reactive improvements work in a faster way	4	time resources	4	difficult to build personal relations working digital	3	platform - meetings, daily control, project plan, project follow up	1	WCM	1	biggest profit of digitalisation is the focus of the data collection and to create a basis of decisions		
2	a lot of meetings	1	how to create a common work structure	1	don't understand the main problem - not enough time at the plant	1	gap on the Kaizen side	2	share material on white board	1	cost deployment identify the problems	1	connect work to value chain		
4	still learning the existing tools	5	share data and knowledge	1	lack of system support leads to method slips	4	need to pull data out of the different systems to analyse it	1	tools should be user friendly, add value and be functional	1	same lean principles as the core	2	teams work - direct contact		
3	uses different tools in different plants	1	improve the processes	1	needs dedicated resources	1	no matching categorizes between sites	2	one tool would be the ideal	1	some standard work procedure, but some local variance	1	create a common work culture		
1	solve the problem without a method	1	understand if there are any problems	2	employees don't know the main goals	1	how to structure and organize the work	3	learn from best practice			1	digitalisation - something exciting and new		
1	apply method after solving the problem	1	create understanding of the processes	3	no concensus regarding working methods	1	many different tools - notifications everywhere	2	tool that replace meetings - continous work over time			1	daily communication		
1	waste of time on no value adding work	1	Don't know what to do in the project	3	involved in many project at the same time	1	old habits - need time and experience to learn a new work process	1	rooms in yolean			1	digital tools may not be the solution		
6	results depends on the person	1	find common issues and investigate values for gathering cross-functional and global	2	a lot of emails	1	no prospective view to see what to prioritize	2	share knowledge in a common platform			1	writing a policy will not help		
3	individuals interest drives the development			1	lack of support	1	not easy access to data	2	compare data in a common place						
3	many different tools			6	lack of common goals, scope and structure			2	create overview of the project - timelines, input, output						
1	difficult to analyse data			2	no common work structure in the tools			1	action plan						
2	manual data collection - lack of fact			2	no time frame			1	filter function						
2	collecting data in different systems			2	program or project			1	project management platform - task planner, create notes, select notification, user friendliness, user friendly, intiutive, create solidarity						
2	no connection between the systems			1	new way of working, supplier collaboration			1	everyone have acces to the data						
2	excel files everywhere			3	lack of sharing knowledge			1	transperency, visual, less meeting, rather common than individual, share knowledge, less emails						
2	lack of strategy			1	different time zones			1	work more cross-functional to use the competences and resources available in the organization						
2	much administrative work			2	lack of visualisation in projects			1	find a common system or a at least systems that can work with each other						
3	lack of collaboration in the network			3	different communication tools in different projects			1	communication leads to knowldege sharing and learnings						
1	hard to collaborate due to bad relations			2	tool depends on the project leader			1	easy to change view - long and short term perspective and in details						
4	lack of communication between different functions			1	documentation of project										
2	gap between production and the one taking decisions			1	scared of expressing thoughts in big groups										

3 data is not transperent			1 stakeholder management and resources to make something happen in a project										
3 not sharing knowledge			1 different pictures of the situation depending on role										
1 standardization vs adapt locally													
2 what data is important and how to analys it: bad input leads to wrong decisions													
8 adding new tools, but still keeping the old ones													
1 complex processes													
3 prestige in old working process													
1 complexity in big changes													
2 is there a need for change?													
1 afraid of the headoffice													
1 all plants have different plans													
1 a lot of problems in ME													
1 availability of resources													
1 national rules and regulations different													

X

X

E
Barriers from Interviews Organized in Activity Theory

Activity Theory elements:	Definition:	Statemenst from Interviews				
Object	*Barriers for reaching the goals*	no time frame	lack of common goals, scope and structure	no common responsability	none value adding time and work	is there a need for change?
Subject	*Barriers in the project managers and participants in the project (teamet)*	involved in many project at the same time	resistance against new way of working	whip or carrot	need the right knowledge and experience in the right area	lack of support
Tools	*Barriers in tools and working methods*	a lot excel files	just adding a tool will not solve anything	no overall view	loosing material and notes with analog tools	to many tools and systems
		difficult to work many in the same tool at the same time	no system that can solve everything you need: leads to trade-off	the more functions leads to difficulties in the learning of the tool	forced to use new tools, such as office 365 and teams	a lot of meetings
Community	*Barriers in the environment where the project is carried out (organization)*	silos	no focus on cooperation	big variations in the way of working	different opinions about what data to visualize	more dynamic collaboration
		much administrative work	lack of collaboration in the network	gap between production and the one taking decisions	complex processes	prestige in old working process
Division of labor	*Barriers in taking responsibility, dividing work, taking charge*	tight margins: important with documentation to follow up	forced to work with new people	division of resources (e.g. time and people)	who is taking charge of strategic decisions	
Rules	*Barriers for the rules, guidelines, ethics, co culture and norms for the work*	no concensus regarding working methods	different experiences	co-located culture	ambiguous bounderies regarding project meetings	iterative process: not possible to set up a strict structure that all projects can follow

not as honest when working digital as analog	results depends on the person	individuals interest drives the development					
a lot of communication through emails	need to use different time plans at the same time	own way of working	lack of system support leads to method slips	lack of visualisation in projects	different tools in different projects	documentatio n of project	engage people
difficult to analys data	still learning the existing tools	manual data collection - lack of fact	no connection between the systems	data is not transperent	adding new tools, but still keeping the old ones	knowledge problems in the use of the tool	
lack of sharing knowledge	scared of expressing thoughts in big groups	generation shift	some loves new technologies and only sees the benefits	hierarchy - creates detour in the flow	same core methods	resistance against change	lack of strategy
complexity in big changes	afraid of the headoffice	all plants have different strategies					
no common work structure in the tools	different cultures	still learning the existing tools	standardization vs adapt locally	what data is important and how to analys it: bad input leads to wrong decisions			

F
Requirement Specification List

F. Requirement Specification List

Chalmers	Document type: Master thesis	Requirement specification				
	Project:					
Issuer: Jasmine & Ellinor		*Created: 2021-03-08*				
		Modified: 2021-03-26				
Criteria		*Goal value*	*R/W*	*Weight*	*Kano*	*Stakeholder*
1	**Object**					
1.1	Short time project plan	all systems in one tool would be ideal	R	5	Basic	Project user
1.2	Project plan	Project framework. Include goals and strategy for project	R	5	Basic	Overview user, Project user
1.3	Create overview of the project	Status check of project at the moment. Common view of project situation.	R	2	Deligther	Overview user, Project user
1.4	Synchronize work	Coordination of information and data	R	3	Performance	Overview user, Project user
1.5	Screen data	Data relevant for the project	R	3	Delighter	Overview user
1.6	Alignment of strategy	Make sure project are aligned with the strategy of the company	R	5	Basic	Overview user
1.7	Work related to process	Connect the tool to the work process. Creates common understanding	W	2	Delighter	Overview user, Project user
1.8	Individual status check	See how your work is going	R	5	Basic	Project user
2	**Tool**					
2.1	Easy to communicate	Q&A	R	5	Performance	Overview user, Project user
2.2	Continous updates of project	Continous updates regarding own work and tasks	R	5	Basic	Overview user, Project user
2.3a	Documentation of work	Track decisions, status of tasks, date, responsability, re-use knowledge	R	5	Delighter	Overview user
2.3b		Share & re-use knowledge	R	5	Performance	Project user
2.4	One tool	All systems in one tool would be ideal	W	4	Performance	Overview user, Project user
2.5	Handling data	Share and store data in a safe manner	R	5	Basic	Overview user, Project user
2.6	Parallel working in files	Work more effective and efficient	W	5	Basic	Overview user, Project user
2.7	Connected to other tools	Synchronize, reach data in a effective way. Save time	W	4	Performance	Overview user, Project user
2.8	Access to all data	Create transparancy through the project. Access data without personal contact.	W	4	Delighter	Overview user, Project user
2.9	Increase transperency	Decrease hiearchy levels and reduce silos between different levels	R	3	Performance	Oveview user, Project user
2.10	Analysis of data	To find useful information that support taken decisions and plan for upcoming events	R	2	Delighter	Overview user
2.11	Measure project data	Measure data to reach set goals	R	2	Delighter	Overview user, Project user
3	**Subject**					
3.1	Handling multiple projects	Easy to move and allocate from project to project	R	3	Performance	Overview user, Project user
3.2	Intiutive	Easy to learn and use without instructions	R	5	Performance	Overview user, Project user
3.3	Usability	Achieve goals effective, efficent and with satisfactory	R	4	Performance	Overview user, Project user
3.4	Motivate team	Engage your team	W	4	Delighter	Overview user
3.5	Support team	Support in coordination, planning and control	W	5	Basic	Overview user
3.6	Honesty	Work in a honest way	W	5	Basic	Overview user, Project user
3.7	Common work structure	Simular way of working in the teams and projects	W	5	Performance	Overview user, Project user
4	**Divison of labour**					
4.1	Resource allocation	Task planner, allocation of e.g time, people, money	R	5	Basic	
4.2	Meeting planning	Plan and schedule team meetings	W	5	Basic	Overview user, Project user
5	**Community**					
5.1	Flexible	Adaptable to different projects	R	4	Delighter	Overview user
5.2	Respectful work environment	Safe work environment, make people feel included, both emotionally and physically	R	5	Basic	Overview user, Project user
5.3	Visualize strategy	Create a common way of working, who is taking charge of different questions	W	4	Delighter	
6	**Rules**					
6.1	Create solidarity	Common work culture, responsibility, same goals	W	5	Performance	
6.2	Common structure	Create common way of using tool	W	4	Performance	
6.3	Cybersecurity	Follow company policys	R	5	Basic	
6.4	Code of conduct	Follow company policys	R	5	Basic	

G

Initial Benchmark

	Tool A	Tool B	Tool C	Tool D	Tool E	Tool F	Tool G	Tool H	Tool I	Tool J	Tool K	Tool L	Tool M	Tool N	Tool O
Project Management															
1.1 Handle daily control	x	x	x	x	x	x	x		x	x	x	x	x	x	x
1.2 Project plan	x	x	x	x	-	x	-		x	x	x	x	x	x	x
1.3 Create overview of the project	x	x	-	x	x	x	x		-	x	x	?	x	?	x
1.4 Synchronize work	x	x	x	x	x	x	x	x	x	x	x	x	?	x	?
1.6 Documentation of work	x	x	x	x	x	?	x	x	x	x	-	-	?	-	-
1.7 Evaluation of work	x	?	x	?	-	-	x		x	?	?	x	?	-	x
1.8 Easy to communicate	x	x	x	x	x	?	x		x	x	x	x	x	x	?
1.9 Resource allocation	x	x	x	x	-	x	x	x	x	x	x	x	x	x	x
Usage															
2.1 User friendly	x	x	x	?	?	?	x	?	?	?	x	-	?	x	-
2.2 Add value	x	x	x	x	?	x	-	x	?	x	x	-	x	x	x
2.3 Intuitive	x	x	-	x	x	-	x	?	-	?	x	?	?	?	-
2.4 Create solidarity	x	x	x	x	x	x	x	x	x	x	x	?	x	x	x
2.5 Visual	x	x	-	x	x	x	x	x	-	x	x	x	x	-	?
2.6 Continous updates of project	x	x	x	x	x	?	x	x	x	x	x	x	x	x	?
2.7 Individual status check	x	x	x	x	?	x	x	?	x	x	x	x	x	?	x
Handling of data								?							
3.1 Analysis of data	x	x	x	-	-	?	x	?	x	x	?	x	-	x	?
3.2 Share material	x	x	x	x	x	x	x	?	x	x	x	x	-	x	?
3.3 Access to all data	x	?	x	?	x	-	x	-	x	-	?	-	?	-	-
3.4 Easy to share knowledge	x	x	-	?	x	x	x	?	x	x	?	x	?	?	?
3.5 Screen data	x	x	x	-	x	-	x		x	-	-	x	-	-	-
3.6 Increase transparency	x	x	?	x	-?	x	-		?	x	x	x	x	-	x
3.7 Measure data	?	x	x	-	-	?	x		x	-	?	?	-	-	?
Process															
4.1 Work related to process	x	x	-	?	?	?	?		?	?	-	?	?	-	-
4.2 Clear directives	x	?	?	?	-	-	-	?	-	?	-	?	?	?	?
Other															
5.1 One tool	x (can connect to other tools)	x (can connect other tool to it to have all in one place)	x (has multiple apps possibel to connect)	-	-	-	-	-	-	-	?	-	-	-	-

H
Ratings used for the Score Matrix

Short time project plan	Rating
task, responsibility, dates, priority of tasks, status in progress, how much work is done, resource managements, show relations between tasks, notes to work, roadmap	5
most of the function	4
5/10 of the functions	3
3/10 of the functions	2
less then 3	1

Project plan	Rating
milestones, phases/sprints, main goal, budget, project owner, participants, scope of the project, resource estimation, risks, duration, connect project to work process, roadmap	5
over 8 functions	4
6/12 of the functions	3
3/12 of the functions	2
less then 3	1

Create overview of the project	Rating
overall view in one page	5
	4
need multiple views/pages	3
	2
no overall view	1

Synchronize work	Rating
Very good	5
Good	4
Moderate	3
Bad	2
Very bad	1

Screen data	Rating
screen and compare time and resources	5
	4
Screen time and resources	3
	2
don't screen any data	1

Access to all data	Rating
Possible to reach data without personal contact	5
	4
Possible to reach individual data	3
	2
Need personal contact to get the data	1

Increase transperency	Rating
Total project overview: see all tasks, connections, time	5
	4
Have a project overview	3
	2
Only acces to own tasks	1

Analysis of data	Rating
Possible to analyze and compare all data	5
Possible to analyze all data	4
Possible to analyze some data	3
Measured data can not be analyzed	2
There are no measured data	1

Screen data	Rating
screen and compare time and resources	5
	4
Screen time and resources	3
don't screen any data	1

Alignment of strategy	Rating
Project aligned with firms goals, objectives, activities and culture	5
Project aligned with firms goals and objectives	4
Project aligned with firms goals	3
Some functions for communication of strategy	2
Project not aligned with strategy	1

Individual status check	Rating
one view of own performance and tasks	5
filter function in overall view	4
divison of tasks, but no personal view	3
bucket-list or schedule	2
no divison of individual tasks	1

Easy to communicate	Rating
easy communication in tool	5
	4
comments on tasks	3
	2
no communication	1

Continous updates of project	Rating
Select what you want updates about in email and in tool	5
Update on email and in tool	4
Notifications only in tool	3
No personal notification	2
No notifications	1

Measure project data	Rating
Measure resource allocation both individual and project	5
Measure data on a daily basis	4
Measure overall project data	3
Only measure final results	2
No measure of data	1

Handling multiple projects	Rating
Personal project overview including all tasks and projects	5
	4
Personal project overview in each project	3
	2
Different views for different projects	1

Intiutive	Rating
Easy to learn and use without instructions	5
Guidelines needed	4
Short introduction needed	3
Need days of instruction	2
Not intuitive, hard to understand without instructions	1

Documentation of work	Rating
Easy to find information: filter function, free search function	5
Filter function in documentations	4
Documentation collected in one place	3
Saves old projects as achived	2
No documentation of work	1

Documentation of work: share and re	Rating
Filter function and search function in documentation folder	5
Filter function in documentation folder	4
collect uploaded files in a folder	3
upload files in specific tasks	2
not possible to share material	1

One tool	Rating
All work is managed through one tool	5
Connect and integrate with other tools	4
Connect to some tools as email	3
Different tools for same function	2
Not possible to connect tools	1

Handling data	Rating
Tags (security labels) + follow cyber security goals	5
	4
Follow company rules for cyber security	3
	2
No cyber security perspective	1

Parallel working in files	Rating
Easy to work in parallel	5
	4
Exist, but problems with synchronization	3
	2
Not possible to work in parallel.	1

Usability	Rating
Effective, efficent and easy to use	5
	4
Difficult to allocate and require a guide	3
	2
Not effective, efficient and easy to use	1

Support team	Rating
Tool direct communicate to project manager when problems occurs	5
manual help function	4
Personal meeting/chat support	3
Only support through project meetings or personal contact	2
Not any support function	1

Honesty	Rating
Task responsibilities personal	5
	4
Group/project team responsability	3
	2
No task responsability	1

Common work structure	Rating
Templates possible to customize and combine in one view	5
Possible to choose between different templates	4
One standardized template	3
Up to project manager	2
No standardized work structure	1

Resource allocation	Rating
Resource allocation individual and project	5
Resource allocation for project	4
Division of time and people	3
Division of time	2
No resource allocation	1

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I

5 Why Method

	Barrier	Why is it like this?	Why a problem	why	why	why	why	why	why	why	why	why	Cause	Symptom
8	adding new tools, but still keeping the old ones	Difficult to transfer the data from old systemt to the new.	To many options of work process.	data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required					data collected in different locations	takes more time than required
							different results depends on the user	results based on wrong root cause	wrong prioritizati on of work					wrong prioritizati on of work
			Don't learn the new tool.	uses old work processes	Data collected in different locations	Difficult to find data	none value adding work	takes more time than required					doesn't use the full potential in the company	lose competitiv eness
							different results depends on the user	results based on wrong root cause	wrong prioritizati on of work					
			complexity in big changes	locked in old systems										
			Does the new tool create any value?	employees comfortable with old habits	doesn't use the full potential in the company	loss of competitivenes s								
6	resistance against change	Comfortable with old work habits.	Take longer time to implement changes.	inefficent work	loss of competitivenes s								Data collected in different locations	takes more time than required
				miss-communication	lack of collaboration and sharing of knowledge cross-functional	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiven ess						wrong prioritizati on of work
			To many options of work process.	data collection to complex	Data collected in different locations	Difficult to find data	none value adding work	takes more time than required					lack of collaboration and sharing of knowledge cross-functional	loss of competitiv eness
							different results depends on the user	results based on wrong root cause	wrong prioritizati on of work					
6	results depends on the persons competence	Lack of education	to many options of work process	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work							to many options of work process	wrong prioritizati on of work
			incorrect use of tool	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work							incorrect use of tool	
			Lack of motivation and engagement	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work							Lack of motivation and engagement	
6	lack of common goals, scope and structure	lack in project management and communication	Work performed in different directions	don't uses the full potential, experience and knowledge	waste of resources	loss of competitivenes s							lack in project management and communication	loss of competitiv eness
				re-work	waste of resources	loss of competitivenes s								loss of competitiv eness
			lack of motivation and engagement	different results depending on the person who peform the	results based on wrong root cause	wrong prioritization of work								wrong prioritizati on of work
			is it even a project?											
5	lack of system support	To many methods	method gaps in existing systems	no concensus regarding working methods	inefficent work	project taskes longer time to complete							method gaps in existing systems	project taskes longer time to wrong prioritizati on of work
					different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work	lack of knowledge	Loss of competitiven ess					Loss of competitiv eness
					To many options of work process.	data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required		wrong prioritizati on of work		takes more time than required
									different results depends on the	results based on wrong root				
				No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work						
				do not put enough effort in each project	inefficent work	project taskes longer time to complete								project taskes longer time to complete
					different results depending on		wrong prioritization of work							wrong prioritizati on of work

4	Limited time resources	Division of work load	involved in many projects at the same time		the person who peform the work	results based on wrong root cause	lack of knowledge	Loss of competitiveness				involved in many projects at the same time	Loss of competitiveness
				difficult to prioritize work	inefficent work	project takes longer time to complete	Loss of competitiveness						
				lack of motivation and engagement	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work						
				lack of project management	difficult to plan and schedule meetings	people can not participate in work meetings	difficult to take decisions	inefficent work	project takes longer	Loss of competitiveness			
4	difficult to build personal relations working digital	No direct contact	Hide behind the screen	Not feeling comfortable in the team	lack of collaboration and sharing of knowledge cross-functional	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness				Hide behind the screen	loss of competitiveness
					lack of motivation and engagement	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work					wrong prioritization of work
				Lack of honesty	lack of trust	difficult to take decisions	inefficent work	project takes longer time to complete	Loss of competitiveness				
						lack of motivation and engagement	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work				
4	still learning the existing tools		lack of motivation and engagement	different results depending on the person who peform the work	results based on wrong root cause	wrong prioritization of work						lack of motivation and engagement	wrong prioritization of work
			Tool is to complex	Lack of learning/education	No standardized work	Lack of resources	Time consuming learning process	None value adding work	Takes more time than required			Tool is to complex	Takes more time than required
			Adding new tools, but still keeping the old ones	To many options of work process.	data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required			Adding new tools, but still keeping the old ones	takes more time than required
								different results depends on the user	results based on wrong root cause	wrong prioritization of work	wrong prioritization of work		wrong prioritization of work
				Don't learn the new tool.	uses old work processes	Data collected in different locations	Difficult to find data	none value adding work	takes more time than required				loss of competitiveness
								different results depends on the user	results based on wrong root cause	wrong prioritization of work	wrong prioritization of work		
				Does the new tool create any value?	employees comfortable with old habits	doesn't use the full potential in the company	loss of competitiveness						
				complexity in big changes	locked in old systems								
			Resistance against change	Take longer time to implement changes.	inefficent work	loss of competitiveness						Resistance against change	loss of competitiveness
				To many options of work process.	miss-communication	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness				takes more time than required
					data collection to complex	Data collected in different locations	Difficult to find data	none value adding work	takes more time than required				wrong prioritization of work
								different results depends on the user	results based on wrong root cause		wrong prioritization of work		
4	need to pull data out of the different systems to analyse it		To many systems/tools	data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required				To many systems/tools	Takes more time than required
							different results depends on the user	results based on wrong root cause	wrong prioritization of work				Wrong prioritization of work
				miss-communication	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness					Loss of competitiveness
				No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work					none value adding work
				Time consuming process	inefficent work	loss of competitiveness							

#	Problem	Cause	Why 1	Why 2	Why 3	Why 4	Why 5	Why 6			Problem (repeat)	Consequence
			Loss of data	Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work						
				difficult to transfer data	time consuming	none value adding work						
			Much administrative work	time consuming	none value adding work							
			notifications everywhere	loss of information	bad planning of work	late deadlines	loss of competitiveness					
4	lack of communication between different functions		miss-communication	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness				lack of communication between different functions	Loss of competitiveness
			Loss of data	Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work						Wrong prioritization of work
				difficult to transfer data	time consuming	none value adding work						None value adding
			No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work					
			Take longer time to implement changes.	inefficent work	loss of competitiveness							
			lack of understanding of different needs depending on position	inefficient resource allocation	wrong prioritization of work	Resources spent on wrong problem areas	None value adding results					
			lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness						
4	no matching categorizes between sites	No common work structure /no standard	some standard work procedure, but some local variance	difficult to collaborate coss-functional	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness			No common work structure /no standard	loss of competitiveness
					Take longer time to implement changes.	inefficent work	loss of competitiveness					None value adding results
					lack of understanding of different needs depending on position	inefficient resource allocation	wrong prioritization of work	Resources spent on wrong problem areas	None value adding results			wrong prioritization of work
				No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work				takes more time than required
				Loss of data	Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work					
					difficult to transfer data	time consuming	none value adding work					
				data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required				
							different results depends on the user	results based on wrong root cause	wrong prioritization of work			
3	hierarchy - creates detour in the flow	organizational structure	To many levels of communication	Time consuming process	inefficent work	loss of competitiveness					hierarchy - creates detour in the flow	loss of competitiveness
			Afraid of the headoffcie	scared of expressing thoughts	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness					wrong prioritization of work
			No transparency among the organization	No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work				none value adding work
			Loss of data	Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work						
				difficult to transfer data	time consuming	none value adding work						
3	not learn from best practice	organizational structure	spending time on solving problems that already are solved	inefficent work	loss of competitiveness						spending time on solving problems that already are solved	loss of competitiveness
				inefficient resource allocation	wrong prioritization of work	Resources spent on wrong problem areas	None value adding results					None value adding results
				lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness					
2	unstructured and unorganized work	Lack of project strategy	Lack of understandning	A lot of qusestion. Emails	lack of support	inefficent work	project takes longer time to complete	Loss of competitiveness			Lack of project strategy	Loss of competitiveness
			Detour in the project	lack of continous work	not reaching the goals	None value adding results						None value adding results
			No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work					wrong prioritization of work
			Difficult to prioritize work	inefficent work	project takes longer time to complete	Loss of competitiveness						
			Lack of	Difficult to find	takes more time than	none value adding work						

			documentation of work	Difficult to find data	different results depends on the user	results based on wrong root cause	wrong prioritization of work						
			Work performed in different directions	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness							
				re-work	waste of resources	loss of competitiveness							
1	apply method after solving the problem	Want to be effective and fast in the work	Unstrandardized working methods	different results depends on the user	results based on wrong root cause	wrong prioritization of work					Unstrandardized working methods	wrong prioritization of work
				Loss of data	Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work						none value adding
					difficult to transfer data	time consuming	none value adding work						loss of competitiveness
				re-work	waste of resources	loss of competitiveness							
1	Different national rules and regulations	Global organization	difficult to collaborate coss-functional	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness				No matching categorizes between sites	Loss of competitiveness
				Take longer time to implement changes.	inefficent work	loss of competitiveness						None value adding work
				lack of understanding of different needs depending on	inefficient resource allocation	wrong prioritization of work	Resources spent on wrong problem areas	None value adding results				Wrong prioritization of work
						difficult to collaborate coss-functional	lack of collaboration and sharing of knowledge	don't uses the full potential, experience and knowledge	waste of resources	loss of competitiveness		takes more time than required
							Take longer time to implement changes.	inefficent work	loss of competitiveness			
							lack of understanding of different needs depending on position	inefficient resource allocation	wrong prioritization of work	Resources spent on wrong problem areas	None value adding results	
					Difficult to create common standards	No matching categorizes between sites	some standard work procedure, but some local variance	No overview of the situation	difficult to understand the problems	no common view of the situation	results based on wrong data	wrong prioritization of work
									Decisions based on incorrect data	results based on wrong root cause	wrong prioritization of work	
								Loss of data	difficult to transfer data	time consuming	none value adding work	
								data collection to complex	data collected in different locations	difficult to find data	none value adding work	takes more time than required
											different results depends on the user	results based on wrong root cause	wrong prioritization of work