Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Engineering
Department of Geoscience and Petroleum

Mads Bakken

Use of KPI as a strategic tool in the implementation of new digital solutions

An assessment of the development and utilization of indicators in the implementation of a digital solution with a large and complex user group.

Master's thesis in Engineering and ICT
Supervisor: Vidar Hepsø
Co-supervisor: Ashkan Jahanbani Ghahfarokhi
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Abstract

It is a great focus on digitization in the Norwegian oil and gas industry, with a continuous push on the development and implementation of new digital solutions to increase the productivity and efficiency of operations. In the oil industry, this is called Integrated Operations (IO), and is largely about using data in real time to develop new ways of working. These digital solutions affect operators working in the field to a large extent.

As an oil service company, Aker Solutions is also going through a digital transformation, especially at its yards in Norway. Several digital solutions will be implemented here in the coming years. Among these is WeBuild, an application that has digitized work orders, drawings and progress reporting for operators. This thesis examines the use of WeBuild through user analysis and a field study to develop key performance indicators that can be used to improve the implementation of digital solutions for the company.

The analysis found that there is a great need for training in new digital tools. By using a capability platform consisting of the four dimensions of people, technology, process and organization, it was found that there has been too much focus on developing technology, so that the human dimension has been neglected and the skills to utilize new tools have not been developed. This has led to a situation where the application has low user numbers due to little competence related to the application.

Furthermore, it was also found that WeBuild has a low number of returning users. There are many users who try the application without becoming regular users. This is because there are several errors and shortcomings in the application, which means that the articulation work, the extra work that operators have to perform in order to be able to do their primary work, increases. Operators then choose to use the old, analogue system so that they can carry out their primary work in a seamless manner.

The four KPIs proposed in this thesis measure a wide range of the use and implementation of new digital solutions. They are centered around integrated operations and articulation work, and can be focused on different user groups to investigate whether certain groups need more measures.

Sammendrag

Det er et stort fokus på digitalisering i den norske olje- og gassindustrien, med et kontinuerlig trykk på utvikling og implementering av nye digitale løsninger for å øke produktiviteten og effektiviteten av operasjoner. Dette kalles i oljeindustrien for Integrerte operasjoner (IO), og handler mye om bruken av data i sanntid for å utvikle nye måter å jobbe på. Slike digitale løsninger påvirker i stor grad operatører som jobber i felt.

Som et oljeservice-selskap går Aker Solutions også gjennom en digital transformasjon, spesielt på verftene deres i Norge. Her skal flere digitale løsninger implementeres de neste årene. Blant disse er WeBuild, en applikasjon som har digitalisert arbeidshefter, tegninger og fremdriftrapportering for operatører. Denne oppgaven undersøker bruken av WeBuild gjennom brukeranalyser og en feltstudie for å utvikle nøkkeltallsindikatorer (KPI) som kan brukes for å bedre implementeringen av digitale løsninger for selskapet.

Analysen fant at det er et stort behov for opplæring av nye digitale verktøy. Gjennom å bruke en kapabilitetsplattform bestående av de fire dimensjonene menneske, teknologi, prosess og organisasjon ble det funnet at det har vært for mye fokus på å utvikle teknologi, slik at menneske-dimensjonen har blitt neglisjert og ikke fått utviklet egenskaper til å utnytte nye verktøy. Dette har ført til en situasjon hvor applikasjonen har lave brukertall grunnet lite kompetanse knyttet til applikasjonen.

Videre ble det også funnet at WeBuild har et lavt tilbakevendende brukertall. Det er mange brukere som prøver applikasjonen uten å bli fast bruker. Dette kommer av at det er flere feil og mangler i applikasjonen, som fører til at artikuleringsarbeidet, det ekstra arbeidet operatører må utføre for å kunne utføre primærarbeidet sitt, øker. Da velger operatører heller å bruke det gamle, analoge systemet slik at de kan utføre primærarbeidet sitt på en sømløs måte.

De fire KPI-ene som er foreslått i denne oppgaven måler et bredt spekter av bruken og implementeringen av nye digitale løsninger. De er sentrert rundt integrerte operasjoner og artikuleringsarbeid, og kan spisses inn på ulike brukergrupper for å undersøke om enkelte grupper trenger flere tiltak.

Preface

This paper is the result of the course TPG4920 - Petroleum Technology, Master Thesis at the Norwegian University of Science and Technology (NTNU), written by Mads Bakken during the spring of 2023. The thesis concludes the 5 year integrated master program within Engineering and ICT with a specialization in Petroleum technology and ICT.
The topic of this paper is the digital transformation of the oil & gas industry, focusing on the implementation of new digital solutions in construction yards. The thesis is in collaboration with Aker Solutions and their yard at Stord, where they are currently implementing new digital solutions to digitize the work flows. It is a continuation of a specialization project written during the fall of 2022, which concerned the role of integrated operations in the implementation of new technology, entitled *How Organizations can use Integrated Operations to Improve the Implementation of New Digital Solutions.*

I would like thank my supervisor for this project Vidar Hepsø for all guidance and input through this project, and co-supervisor Ashkan Jahanbani Ghahfarokhi for all guidance through this project and during my time at NTNU. Further, I would like to thank Aker Solutions for the collaboration through this project. Specifically Trond Haga, Thomas Danielsen, Christopher Schwartz Kvarme and Erik Ånensen for having me at their offices at Stord, providing data and assisting with the field study. Lastly, I would like to thank my family for their support and help with proofreading.

Trondheim, June 2, 2023

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Mads Bakken

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Abbreviations

List of all abbreviations in alphabetic order:

- **AKSO** Aker Solutions
- **ICT** Information and communication technology
- **IO** Integrated Operations
- **IPL** Integrated Planning
- **KPI** Key Performance Indicators
- **MIPS** Aker Solutions' ERP-system
- **NTNU** Norwegian University of Science and Technology
- **O&G** Oil & Gas

Chapter 1

Introduction

Over the past two decades, the Norwegian energy sector has been undergoing a constant digital transformation (Hepsø and Parmiggiani 2022). The introduction of new information and communication technology (ICT) in the sector has led to this digitalization era, which is referred to as Integrated Operations (IO). IO describes the integration of people, process, governance and technology to create value through better decision-making and increased productivity. This integration was enabled due to new technology, and has revolutionized the work processes in the field. The use of real-time data has made it possible to develop new collaboration techniques, technology to monitor data and efficient information sharing methods.

Aker Solutions is a major Engineer-to-Order (ETO) organization in the Norwegian energy sector and is undergoing a digital transformation at their construction yards in Norway. Several new, digital solutions are being developed and implemented with varying applications. The primary goal is that the new solutions will improve the work processes for the operators and increase the productivity in the yards. The new ICT solutions will utilize real-time data, which enable the possibilities to reach these goals.

Implementing digital solutions is demanding in a large and complex user group. End-users and management have different interests and it is difficult to create applications that fit all users. The challenge to meet the needs and requirements of all end-users limit the implementation of large-scale applications. How management facilitates change will also influence the implementation of new technology. Because a digital transformation requires development in more than just technology. It also requires an understanding of the operational environment, how the operators are responding to change and how they perform extra work, known as articulation work, to cope with changing systems and failing resources.

To measure change and implementation development, key performance indicators (KPI) are often used. Creating KPIs that accurately measure usage and behavior is challenging, and will be explored in this thesis.

1.1 Project description

As part of the digital transformation, Aker Solutions (AKSO) wants to digitize the distribution of work orders, reporting and communication for their foremen and operators at their yards in Norway. This has been handled in a new application called WeBuild. The application has been tested in previous projects, but is being fully implemented in the current Johan Castberg assembly project at AKSO's biggest yard in Norway, Stord yard.

It is important to understand how the personnel are using the application for AKSO and the management at Stord. The organization wants to create several key performance indicators (KPIs) in order to measure the usage and user behavior. The KPIs will also be directed towards the value extraction of the application. However, accurate KPIs are challenging to create in an environment with a large user group with various interests and needs. Hence, the most important aspect is that the KPIs should provide accurate information to management about the usage and possible measures needed to improve the usage.

This project will design and develop key performance indicators for the use of WeBuild, and that can be used in the implementation of future digital solutions for the company. The aim is that these KPIs will provide AKSO with information to improve the implementation of these new applications. The KPIs will be developed based on field research at Stord yard, complemented with theory based on the concepts integrated operations and articulation work. The theory is a continuation of the specialization project written during the fall of 2022, focusing on integrated operations and articulation work in a digitization process.

1.2 Objective and Problem statement

The objective of this thesis is to develop key performance indicators that provide Aker Solutions with information to improve the implementation of their new digital solutions. The indicators will be developed based on an analysis of the usage of the WeBuild application, focusing on integrated operations and articulation work. Based on the objective, a problem statement can be defined:

How to develop key performance indicators that improve the implementation of new digital solutions in the energy industry?

Research Questions

The following research questions will be addressed to help answering the problem statement:

RQ1. How can capabilities be combined with the understanding of operators' articulation work in order to develop new work practices?

RQ2. How are the employees and the organization responding to this technological development?

RQ3. How are the operators' articulation work affecting the implementation process?

RQ4. What factors are limiting the implementation of WeBuild and what measures can be taken to improve this?

KPIs aimed at the usage of WeBuild will be developed by addressing these research questions. The KPIs will be generalized, in order to be used in future implementation of new applications.

1.3 Existing Work

Kamsvåg et al. (2022) executed a broad study on the implementation of WeBuild, using data from a survey responded by over 500 end-users. They investigated the factors influencing the active use of mobile applications and the perceived benefits of using an application in an ETO organization.

Firstly, they found that the users who had received training and those who had not found WeBuild equally intuitive. However, the trained users tend to be more active users than those without training. This is an indication that the user interface is easy to understand, and not the main factor responsible for the user numbers. AKSO is aware of the issues regarding training and acknowledges that training is critical for a successful implementation.

Secondly, the functionality seem to influence the active usage of WeBuild as well. While the majority of the participants in their research said they had the chance to influence the functionality in WeBuild, there are some parts where the operators prefer the old ways. For instance the work packages, where the paper format is preferable, as it is easy to browse pages and the drawings are bigger. The results show that a digital transformation take time, especially when transforming long-standing work practises.

Thirdly, they discuss the impact the IT infrastructure, which is essential for new applications to be implemented. They found that 50% of WeBuild users have delayed progress reporting because of sub-par internet access, and they claim that the poor internet service causes the application to work very slowly.

These three findings are the most critical factors influencing the active usage of WeBuild.

1.4 Structure of the Thesis

The structure of this thesis is as follows:

Chapter 1: Introduction
This chapter consists of the introduction to the thesis, along with problem description, objective and approach to the thesis.

Chapter 2: Theory
The theory chapter provides the theoretical background that laid the foundation for the thesis. It explains the relevant topics *Integrated Operations* (IO), *Articulation Work* and *Key Performance Indicators* (KPIs).

Chapter 3: Method
The method chapter provides an insight to the methodical approach used in this thesis. The method, a mixed method research approach using quantitative user data, field observations and interviews is described in general as well as how it was executed in this case.

Chapter 4: Results
The chapter starts with an empirical study of Aker Solutions and the WeBuild application. Then the chapter will present the results obtained using the method from Chapter 3. It will therefore consists of both quantitative and qualitative results, along with analysis of the data.

Chapter 5: Discussion
The discussion will center around the main findings from Chapter 4. Key performance indicators will be developed here by combining the main results with the relevant theory from Chapter 2.

Chapter 6: Conclusion
A summary is presented by looking at the key performance indicators developed in the discussion.

Chapter 2

Theory

This chapter will provide a theoretical background and introduction of basic concepts of importance in this thesis. It will start with an introduction to key concepts within *Integrated Operations* and *Articulation work*, which was the subject of the specialization project written by the student during the fall of 2022. It will end with an introduction to key performance indicators (KPI).

2.1 Integrated Operations

Integrated operations (IO) concerns how information and communication technology (ICT) have created new work methods and processes within the Oil & Gas (O&G) industry. It is a digital transformation that utilizes new digital tools to make the ways of working more efficient and productive by removing the borders between disciplines, geography and companies (Henderson et al. 2012). This transition distributes the work, creating new, efficient ways of collaborating across distance and disciplines. There are several ways to define Integrated operations, for instance this from Lilleng and Sagatun (2010): "the integration of people, processes, and technology to make and execute better decisions quicker. IO is enabled by the use of real time data, collaborative technologies, and multidiscipline work flows (ways of working) in work processes". Folstad (2021) illustrates this definition in Figure 2.1.

The use of real-time data is an essential aspect of this definition, and IO in general. ICT solutions utilizing real-time data are often the enablers for this digital transformation, as they facilitate for the development of new work processes.

IO was initially introduced to enhance the collaboration within and across O&G companies where the personnel were distributed across geography and between onshore and offshore (Skarholt, Hansson, et al. 2012). Consequently, there are terms and functions that are not relevant for Aker Solutions in this context, as it is an engineer-to-order manufacturer (ETO) in the O&G industry, and not solely an O&G company (Kamsvåg et al. 2022). However, the primary goal of IO is to increase value through developing

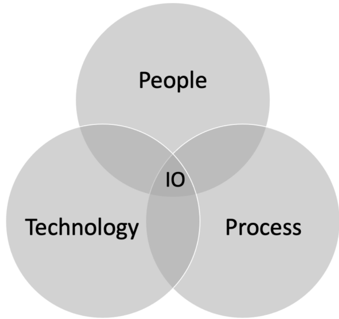

Figure 2.1: Illustration of the integration of people, process and technology (Folstad 2021)

new ways of working and new collaboration techniques enabled by new technology. IO creates value through better decision-making and optimization of work processes made possible by new technology utilizing data in real-time (Henderson et al. 2012). This definition is also relevant for an ETO company in the O&G industry, where the value is often measured on quality of the finished product delivered to customers, and time-of-delivery. New technology utilizing real-time data that develops new work flows leading to better decision-making and higher productivity and efficiency will improve both the quality and time-of-delivery. Figure 2.2 illustrates this process.

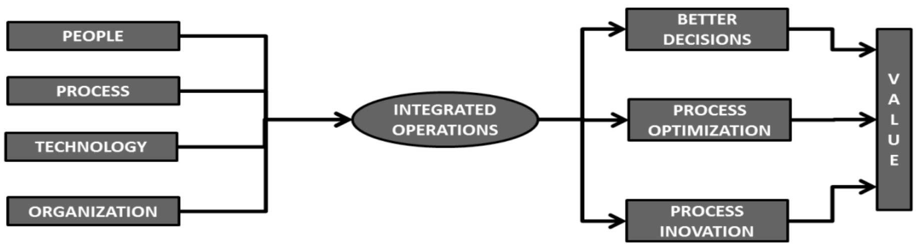

Figure 2.2: How Integrated Operation creates value (Lima et al. 2015)

2.1.1 The capability platform

To understand the concept of IO, an idea called the capability platform approach is described and discussed by Henderson et al. (2012). The capability platform approach is an integrated approach that aims to improve the understanding of the four dimensions *People*, *Process*, *Technology* and *Governance* and how issues related to these dimensions can be addressed. Capabilities can be defined as the "combined capacity and ability to plan in accordance with our business objectives through a designed combination of human skills, work processes, organizational change and technology" (Larsen et al. 2012, p.2). Specifically, a thorough combination and continuous iterative process of the dimensions is what enables the capabilities to create value. The process of developing capabilities is a performance improvement methodology, where all dimensions are required for the capabilities to create value (Larsen et al. 2012).

Henderson et al. (2012) describe the four dimensions people, process, technology and governance and how capabilities is made up of the interplay between these dimensions, see Figure 2.3. By connecting the capability platform concept to IO, the authors illustrate how IO can be recognized as an information ecology. Nardi and O'Day (1999) define an information ecology as a "system of people, technologies and practises in a certain local environment". The different actors, here the four dimensions as illustrated in Figure 2.3, work together and depend on each other for their individual development, and the growth and creation of new capabilities. The interplay and continuous interactions between the dimensions are what drives the continuous development of each dimension and the capabilities in the ecology (Henderson et al. 2012).

The technology dimension is seen as the foundation for capability development, as it is often the enabler for change (Henderson et al. 2012). New technology is what enabled the digital transformation within the O&G industry known as IO, which made it possible to create new capabilities to enhance efficiency and value. For instance, new digital solutions enable new collaboration techniques and work processes, which lead to organizational development and better and faster decision making.

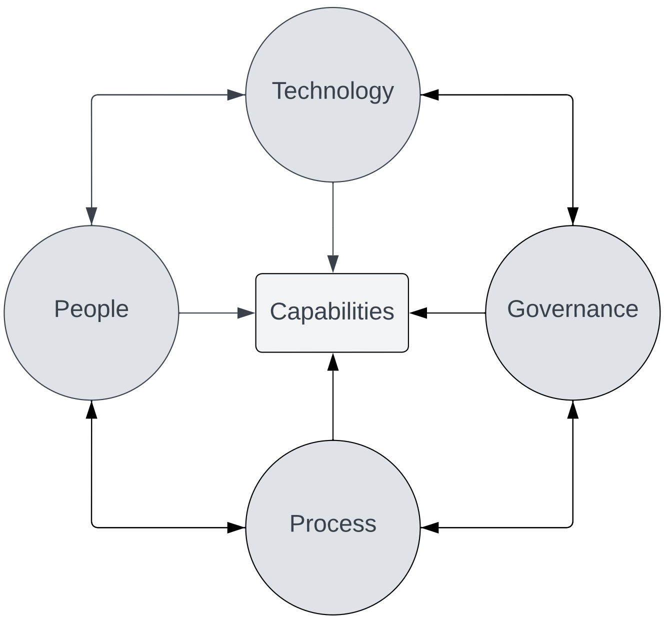

Figure 2.3: The dimensions making up a capability in an information ecology (Bakken 2022)

Although technology is the enabler and core dimension in capability development, each one is equally important for the value growth for an organization. How the dimensions take advantage of each others development is how organizations create value through IO, again comparing it to an information ecology. Instead of emphasizing the importance of technology compared to the other dimensions, organizations need to look at them equally, like Henderson et al. (2012) describe it: "Technology in a capability platform is an enabling device for people, process and governance. Alone, technology seldom drives value. But when combined in a creative manner with these other dimensions, technology can enable radical transformation" (p. 5). Transformative change require more than just technology, people need to change their behavior and practises as well. To see the effects of new technology, it its crucial to understand facts that affect usage (Kamsvåg et al. 2022).

This can be exemplified by looking at an organization that want to implement a new digital solution their employees are to use. However, the employees do not know how to utilize the application. Therefore, they will not use it and the organization will not see improvements of any capabilities and no increase in value. This is because all the focus was on the technology dimension, and no focus was on developing the people dimension of learning new skills and increasing competence with the new technology. Consequently, the process dimension will not change either. This example shows the importance of looking at the dimensions equally, as technology rarely creates value without a development of all dimensions.

2.1.2 ICT in Integrated Operations

Information and Communication technology (ICT) is the technology that has enabled the digitalization of the O&G industry. Digitalization is defined as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business" (Gartner n.d.(a)). Further, organizations within Oil & Gas developing IO strategies also emphasize digital solutions utilizing real-time data (Henderson et al. 2012). Real-time data allows for better and faster decision-making with companies that are broadly distributed across disciplines and geography. In fact, real-time data is a core enabler of IO, as seen in the definition of Lilleng and Sagatun (2010)

Real-time data, or live data, have created work methods that were not possible before. The possibility to access live information from anywhere made it easier to collaborate and communicate from anywhere. This made work processes much more efficient and productive. Real-time transfer of data enabled new collaboration techniques, developing the collaboration capabilities (Henderson et al. 2012). For instance, live video conferences and more accurate data sharing technology made collaboration across distance easier and more efficient (Skarholt, Hansson, et al. 2012). It also increased the safety of the employees. Because firstly, less employees need to be present on an oil platform due to real-time data that makes the information sharing more accurate (Skarholt, Næsje, et al. 2009b). More accurate data and automation of the oil platform results in less employees needed to operate on-site.

Secondly, a specific goal of IO is that the administrative work is moved from offshore to onshore due to new technology making information sharing easier, increasing productivity and collaboration (Skarholt, Hansson, et al. 2012; Madsen et al. 2012). This decrease in administrative work for team leaders is freeing up more time to spend out on site with their team. According to Skarholt, Hansson, et al. (2012), team leaders being more present in the field will also increase the operational safety, since team leaders are more cautious of safe operations.

2.1.3 Teamwork and Leadership in Integrated Operations

According to Skarholt, Næsje, et al. (2009b), IO is an organizational development as well as a technological one. For leaders and management, the issue is to develop new methods of working for the operators. Because how team leaders operate will often influence the operations of the operators. Further, according to Skarholt, Hansson, et al. (2012), IO is also a development within leadership teams, as they are the most affected. This is due to the improved communication and coordination between leaders, more hands-on leadership as described in the last section, and operations with shared leadership.

Teamwork and leadership are essential aspects of every organization. How teams work together and how they are lead can make a huge difference for the operations of the organization. New digital solutions enable huge changes to the teamwork domain, where new collaboration methods using real-time data are critical for these changes. It makes collaboration and decision-making easier across distance, and facilitates for an increased *Shared situational awareness.*

The use of shared leadership has become an essential aspect of the modern organizational world, with a continuously changing organizational environment (Shuffler et al. 2010). Shared leadership is also critical in operations where new digital solutions are being implemented. If a super-user within a team act as a leader due to their high competence with the new solutions, they can support and teach the rest of the team, enhancing the people-dimension of capability development.

Shuffler et al. (2010) differentiates between two types of leaders: a formal leader, such as a foreman in this setting, and an informal leader, acting more as an advisor with high competence. Informal leaders are then acting with a shared leadership. This is necessary in an information ecology like IO is, where there often are geographical boundaries separating team members or settings where the team leader rarely is present on the field with the rest of the team.

Teams utilize personnel with different skills, judgements and experiences to solve complex problems together efficiently (Taylor 2012). In IO, the emphasis is on the team distribution, where teams often include members from different disciplines, companies and across geography. This is to ensure increased efficiency, as this tend to increase when members of the team can utilize their expertise simultaneously to solve complex problems, instead of having what is called sequential collaboration. Since the focus of this project is the co-located environment at Stord, looking at virtual teamwork is outside the scope. Instead the focus will be to look at how local teamwork are affected by new digital solutions.

Skarholt, Næsje, et al. (2009a) studied the operations at the Kristin asset at the Norwegian continental shelf and how the operators are affected by the ongoing IO development. They found that by giving operators more responsibility in terms of prioritizing, planning and reporting, the self-synchronization and empowerment among operators increased. This was enabled by new ICT solutions using real-time data, which resulted in the development of capabilities. Subsequently, the work environment became safer and more efficient, with a focus on collective knowledge and transparency around the work due to more responsibility for the operators (Skarholt, Næsje, et al. 2009a).

Shared situational awareness

The term *Shared situational awareness* describes how personnel collaborate and communicate within and across teams to ensure safe and productive decision-making (Skarholt, Hansson, et al. 2012). When working toward a shared goal or a project, elements such as collaboration, coordination, information sharing and overlap between team members are essential for ensuring successful problem solving (Skarholt, Hansson, et al. 2012; Skarholt, Næsje, et al. 2009b). Shared situational awareness relates primarily to how operators being aware of the surrounding, operating environment will improve their own work and decision-making. By operators being aware of the surrounding environment, including their team members, the shared awareness will increase which will make problem solving more efficient.

Shared situational awareness of the operations is critical if teams want to improve the collective problem-solving and synchronization among them. Because as Taylor (2012) describe it, activities can be asynchronous without a shared awareness, which can lead to inefficiency and lower productivity. It can significantly influence how teams solve problems, coordinate and make decisions.

The shared situational awareness depends on the situational context. For the scope of this project, the awareness between between team leaders and operators and operators who are-located will be the focus. This type of awareness is easier to create and maintain, than that of virtual teams (Skarholt, Næsje, et al. 2009b).

It is easier to obtain a shared situational awareness within co-located teams than in virtual teams. With daily meetings in person, the information sharing and trust among operators and team leaders are high, creating a shared awareness within the team (Skarholt, Hansson, et al. 2012). There should also be a level of shared situational awareness between team leaders and their team. This will benefit both the operators and the team leader. Team leaders with a situational awareness of the operational context of their operators will be better prepared for problem-solving. This awareness is developed through more hands-on management, which is one of the goals of IO (Skarholt, Hansson, et al. 2012).

Although the shared situational awareness is easier to obtain in operations where teams are co-located, the awareness tend to be low in co-located, analog environments. This is because the communication is mostly face-to-face, which affect the work flows and processes. Without sources of up-to-date information sharing and communication technology, operators and team leaders lack the shared awareness needed to take advantage of efficient problem-solving. However, these environments have the potential to increase the awareness by implementing IO. New ICT solutions using real-time data will increase the shared situational awareness by giving both operators and team leaders the possibility to obtain an overview of the operations, for themselves, their team and the full project operations (Skarholt, Hansson, et al. 2012).

2.2 Integrated Planning

The planning domain has a tradition of being divided among disciplines, or silos, in an organization, resulting in a lengthy and disjointed planning process. When each discipline has their own systems, methods and goals, the interactions between the disciplines may be fragmented and unclear (Parekh and Hassoun 2016). The industry have addressed this issue by introducing a concept known as *integrated planning*. This method employs ICT solutions to bring about a cross-functional and iterative process which results in the organization improving the communication and collaboration across the silos.

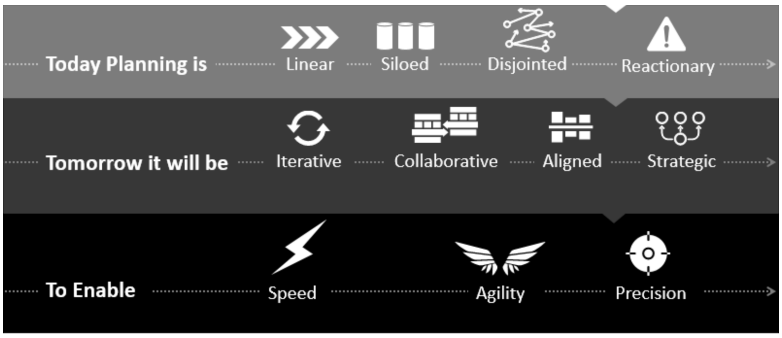

Figure 2.4: Integrated planning (Parekh and Hassoun 2016)

Figure 2.4 illustrates the differences between a traditional planning process and a proposed integrated planning model. The figure displays the benefits from taking advantage of ICT solutions to transform an organization, increasing the speed and precision of the planning process. Organizations will go from being disjointed between silos, taking rushed and reactionary decisions due to a linear model and hardly any communication, to becoming an agile organization that is iterative, collaborative and taking strategic decisions based on a well-planned process. These changes will increase the speed as the processes and silos are more aligned with each other, reducing down time and increasing efficiency (Parekh and Hassoun 2016).

Integrated planning has also become a concept in the energy industry, where it is a result of transferring the concept of integrated operations to the planning domain (Ramstad et al. 2012). Because IO concerns the development of new collaboration techniques across disciplines and geography using ICT solutions, integrated planning utilize several of the same techniques. Because all disciplines in an organization typically have specific resource plans and activities with no communication with other disciplines, resulting in a situation like the one demonstrated in Figure 2.4 with inefficient resource management and results.

Organizations in the energy industry want to address these opportunities for improvement by implementing IO components to the planning domain. Doing this will facilitate for a new organizational function that can ease the way organizations lead across disciplines by obtaining a holistic operational planning perspective (Ramstad et al. 2012). The downtime between operations can be reduced and the general speed in the operational environment can be increased with the use of ICT solutions.

According to a study executed by Ramstad et al. (2012), a massive challenge in how planning is executed today is the lack of collaboration tools in organizations. Without the correct collaboration tools, the coordination between disciplines suffer, leading to a non-ideal prioritization order of activities. Further, the study explored that a reason for the sub-optimal planning is that disciplines often plan in incompatible planning tools. Incompatible planning tools make data sharing and aligning of plans challenging, as the transferring of data between incompatible planning tools can be difficult. Subsequently, all the operations in the study called for a common information sharing and planning platform that utilize real-time data in order to improve the integrated planning processes (Ramstad et al. 2012).

Figure 2.5 displays a version of an integrated planning model based on the study performed by Ramstad et al. (2012). It consists of the three enablers ICT solutions, Roles and Processes, and Arenas for Coordination of Plans. These enablers are designed organizational factors relevant for an successful integrated planning implementation. However, they will not provide the necessary foundation for sustained change alone. For this,

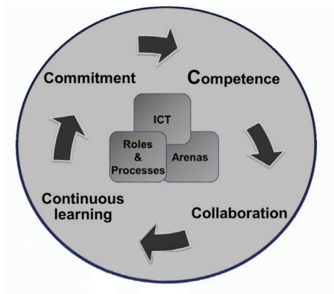

Figure 2.5: Enablers and capabilities in the IPL model (Ramstad et al. 2012)

there is a need for capabilities that cannot be regulated on an organizational level. The four capabilities in the example are Commitment, Competence, Continuous learning and Collaboration. These capabilities will help sustain the implementation, but they need to be cultivated through continuous focus from leadership and management (Ramstad et al. 2012).

Further, Figure 2.5 shows the interplay between the capabilities and enablers, how they depend on each other and the continuous iterations to ensure an implementation that can be sustained. On the one hand, the human capabilities depend on the enablers for their continuous development. Let us take an example using the collaboration capability, as developing new collaboration techniques is a central aspect of IO and IPL. New ICT solutions are necessary for this capability to be developed, as new solutions using technology such as real-time data enhance the possibilities for efficient collaboration. New techniques lead to new work processes which need new, defined roles which is another enabler. And continuous learning is essential to increase competence within the new solutions. This example also works the other way around, with enablers needing capabilities to develop and be taken advantage of. This further illustrates the connection between the integrated planning model and the capability platform discussed in Chapter 2.1.1, by displaying how the dimensions, capabilities and enablers are connected to create value (Bakken 2022).

2.3 Articulation work

There are different types of work that have to be conducted by employees to perform their everyday tasks. Hepsø (2006) discusses two distinct types in an information ecology in order to integrate the work processes and make robust work environments together with integrated collaboration capabilities. The two types are *Primary work* and *Articulation work*. Primary work denotes the actual tasks listed in a work order, and the goals related to the tasks or job description of each employee. Hence, the primary work are written, concrete work and usually part of a larger structure of a project and follows a work flow related to the information ecology of which the employees are a part of. Usually the employees have ICT systems that support them with the primary work, and such systems are called *Resources* (Hepsø 2006).

Hepsø (2006) defines articulation work as the social work that have to be performed by the employees in order to enable their primary work. It is the work performed in a reorganization and to maintain work processes when circumstances and conditions are changing. Employees have to perform this type of work when separate tasks of their task chain in the primary work need to be linked together (Pallesen and Jacobsen 2018). To be able to take advantage of new resources being implemented in an information ecology, it is essential to obtain a comprehensive understanding of how the employees, or actors in the information ecology, are adapting to change. A new resource can cause change in the work processes, work flows and the individual tasks and responsibility of each employee. How the actors in the ecology act to combine the primary work and articulation work is important to comprehend in order to create new work practices enabled by new resources (Hepsø 2006).

While primary work are the concrete tasks and goals given in work orders and job descriptions, articulation work describe the work that employees have to perform in situations where aspects of the work do not fit. This can be the system, a resource or different tasks in the work order that need to be linked. Schmidt (2011, p. 184) describes it as "work to make work work". In other words, all the surrounding work or tasks needed to execute the primary work. Because work orders and task descriptions in the primary work are seldom detailed enough to contain every possible occurring situation, hence employees often have to improvise by conducting extra work (Hepsø 2006).

Developing a system that can handle every circumstance and unexpected incident is challenging. To maintain the work flow, employees must perform tasks that are outside the scope of their regular job description. In a digital setting, it frequently depends on the available resources and how staff members respond to systemic flaws. Gasser (1986) discusses different types of articulation work required to handle deficiencies in the resources available to perform the primary work:

Fitting	Modifying the work process or the structure because of flaws or misfits in the system. This can be conversations between users of the resource and the governance in charge of the system. The next step in the fitting work might then be to implement improvements that eliminate the errors. Fitting as articulation work is essential for improvements of the integration of new resources.
Augmenting	Performing extra work to make up for the errors in the system, often adding additional tasks. Adding more task to a task chain often complicates the work processes, thus requiring more articulation work.
Working around	The third articulation strategy is working around, meaning that users work around misfits occurring in the system. It is often a strategy for solving urgent problems, avoiding the use of the system or using it in another way than what was intended.

Table 2.1: Three types of articulation work (Gasser 1986)

Gasser (1986) describe these types of articulation work as

> "the microlevel processes that integrate computing into work and sustain the operation of computing over the long term in organizations. These basic processes, which we term Fitting, Augmenting, and Working Around computing, serve to take up the slip between the static or slowly changing, fairly rigid work procedures associated with computing, and the fluid, rapidly evolving, contingent demands of daily work which computing supports" (Gasser 1986 p. 207).

These three articulation work strategies are particularly relevant with ICT solutions and the implementation of these. How personnel cope with new systems and misfits and errors related to new solutions is critical for the further implementation of these. Hepsø (2006) links articulation work to the integrated operations domain in order to understand integrated collaborative environments as information ecologies. The species in the information ecology must share the same resources to collaborate. This understanding is important in situations where species, or people, are adapting to new and changing work demands due to continuously new ICT solutions affecting the work flows and systems. Further, Hepsø (2006) stresses how IO often has a tendency to neglect articulation work by focusing more on the primary work. Because IO concerns new technology, often ICT solutions using real-time data. Nonetheless, articulation work is required to analyse and validate the data, because it is important to look beyond the data sharing models.

2.4 Key Performance Indicators

Performance indicators provide management with an instrument to compare targets with the actual results (Fortuin 1988). Productivity and quality improvement efforts need the progress to be monitored to see results. Indicators can provide organizations with instruments to control and monitor progress and results if utilized properly, by indicating the quality of products, activities and actions. These have to be developed and implemented from the organizations' objectives and goals and if the organization aims for improvement (Fortuin 1988). The indicators compare the estimated and actual performances in terms of efficiency, productivity, and quality of product, either over time or when measuring the impact of a change (Cox et al. 2003).

Key performance indicators should be the performance indicators most critical to the organizations' short and long-term success. KPIs can be defined as the measures that focus on the critical organizational performance for companies (Badawy et al. 2016). They are specific, quantitative measures designed to provide companies with concrete information about progress and effectiveness within the organization (Dolence and Norris 1994). KPIs provide information to establish the basis for implementing new strategies. Further, KPIs can also be utilized to see whether the strategies are working. This can improve the operational productivity and efficiency (Domínguez et al. 2019).

Key performance indicators can be useful for a company, however many companies tend to use incorrect indicators, thus monitoring the wrong measures, consequently not making the intended progress. Few organizations actually now what KPIs actually are and how to use them correctly (Badawy et al. 2016). Therefore, it is critical that organizations understand the value of developing KPIs that provide measurements of actual value.

There are two types of performance indicators when measuring the impact of a given change, namely *quantitative* and *qualitative* performance indicators (Cox et al. 2003). Quantitative performance indicators are the most used form of measuring progress and results by management. This is because they are values that can be measured physically and it is easy to see results as the numbers are quantifiable and easy to understand (Cox et al. 2003). Quantitative indicators can be measurements like cost reduction, sales growth, user numbers and percent completion. They are often gathered and calculated through numerical analysis and quantitative statistics (Cox et al. 2003).

Qualitative performance indicators are perceived as more difficult to measure, and are not considered reliable evaluation tools compared to the quantitative indicators. Cox et al. (2003, p. 144) define it as "those indicators that have the potential for measuring the behaviors of workers on the job site". In other words, they strive to measure the opinions and attitudes of the workers that cannot be measured in numerical statistics. Examples of qualitative performance indicators are user satisfaction levels, employee engagement, motivation and turnover. These are difficult to calculate through quantitative analysis and often require a more qualitative approach, which lead to the unreliable evaluations. A often used method for developing qualitative indicators is surveys (Hurree 2022). For instance, a survey measuring user satisfaction will ask subjective questions which yield opinions and results that are not possible to gather through quantitative KPI analysis.

Further, KPIs are differentiated between *leading* and *lagging* KPIs (Peng et al. 2011). The lagging indicators are KPIs that measure the result of earlier activities, looking backwards (Badawy et al. 2016). They provide data about past events, providing historical data of performance (Hinze et al. 2013). Lagging indicators are hard to change as the events have already happened, and they do often not provide enough information to change future events. On the other hand, leading indicators are metrics that look forward, predicting future performance (Naji et al. 2020). They are suggesting and measuring actions that are needed to achieve the goals of the organization, with roots of the lagging indicators (Peng et al. 2011). Leading indicators are proactive, acting to change the future outcome of actions, whereas lagging indicators are reactive and acting after the activities have happened (Hinze et al. 2013).

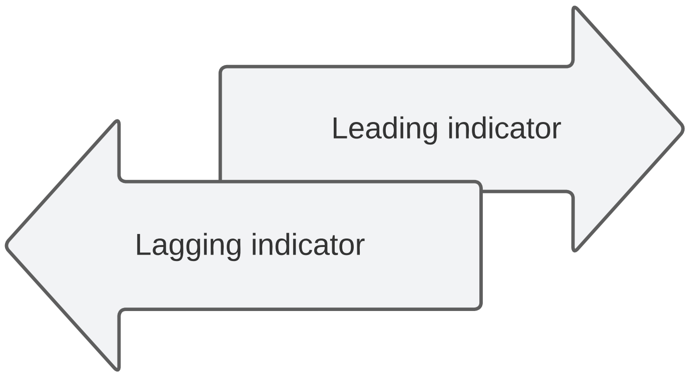

Figure 2.6: Lagging and leading indicators

This project will differentiate between two types of KPIs, here referred to as *Management KPIs* and *Usage KPIs*. Management KPIs are quantitative, as they are meant for management to look at return of investments and the economic value of new technology. While usage-KPIs concern the more controlling KPIs, looking into the usage and investigating the implementation and possible improvements. These are measured in a more qualitative way. Performance evaluation and productivity measurement and are two different functions of management. Since the scope of this project is to look at the implementation of digital solutions by analyzing the usage and user numbers, the relevant KPIs are usage-KPIs.

The SMART KPI framework

Developing good key performance indicators that measure usage in a good way can be challenging. Therefore, SMART KPIs were developed to help with this process. SMART Key performance indicators are a set of criteria developed to evaluate and select good KPIs (Podgórski 2015). It stands for Specific, Measurable, Achievable, Relevant and Time-bound KPIs (Elmo 2022). Podgórski (2015) analyzed and described each criterion thoroughly, see Table 2.2. By following these criteria, organizations will cover a set of specific features that will provide measurable KPIs.

Criterion	**Description**
Specific	The name of the indicator should accurately describe and explain the subject under research and easy to comprehend for the users.
Measurable	It should be technically possible to measure the value of the indicator based on a selected unit. Further, measurement data should be identifiable and available.
Achievable	The values of the indicators need to be achievable under the given conditions and time-bounded period. The resources, such as people and technology, must be sufficient.
Relevant	The criterion requires the indicator to be valid and representative. It should be relevant to the operations and the users.
Time-bound	The time period of which the indicator is to be achieved should be possible do determine.

Table 2.2: A summation of the SMART KPIs (Podgórski 2015)

Chapter 3

Methods

This chapter will describe how the problem statement and following research questions will be answered by describing the research method used. The chapter is divided in four segments: First, a brief introduction to the research context is presented, giving the reader an overview of the problem environment. Then, the research method is presented and explained, followed by a description of how the said method was implemented. Lastly, a segment discussing limitations and uncertainties of the method is provided.

The problem statement in this thesis, as presented in Chapter 1, is as follows:

How to develop key performance indicators that improve the implementation of new digital solutions in the energy industry?

3.1 Research context

The problem statement is generalized to make the results applicable to different areas and projects. But the scope must be narrowed down in order to conduct research. A possible scope and research context were provided by AKSO and is as follows. AKSO's biggest yard in Norway, Stord Yard, are implementing a total of 13 new applications over the coming years as part of their digital transformation, and are in need of establishing key performing indicators that can help assess the implementation of these applications and extract value.

The research context for this thesis is set to the application called WeBuild, an application that aims to digitize the distribution of work orders and reporting. The environment is three disciplines at the ongoing Johan Castberg project, where WeBuild is currently being implemented. The study contains data from December of 2022 to February 2023 as well as interviews and observations from March of 2023.

3.2 Research method

Research can be defined as a "well-arranged and systematic way of finding answers and explanations to various topics and questions that one might ask" (Oun and Bach 2014, p.252). There are three main approaches to conduct research. These are qualitative, quantitative and mixed methods research (Williams 2007). The mixed methods research is a combination of the qualitative and quantitative methods. The research method need to be chosen carefully in order to best conduct the research. For the purpose of this thesis, a mixed methods research approach was chosen. The reasons for this will be argued for in the following segment, where the mixed method research is presented.

3.2.1 Mixed methods research

The mixed methods research is the research approach that mixes or combines the qualitative and quantitative research methods in a single study (Johnson and Onwuegbuzie 2004). This involves the researcher collecting and analyzing data utilizing the strengths and non-overlapping weaknesses of both methods (Sadan 2014). The method will answer research questions that are too broad to be answered using only one method, or questions that need more comprehensive evidence (Sadan 2014).

There are different design methods for the mixed methods, based on several factors. Factors can be timing (when are the methods conducted related to each other) or how the methods should be mixed (Sadan 2014). An explanatory sequential was chosen for this project, see Figure 3.1 for the order of the different steps in this research design. This method uses the qualitative phase to obtain a better understanding of the results from the quantitative phase (Sadan 2014). As the quantitative data and results are needed first to conduct the secondary phase of qualitative research, it needs to be sequential. The steps will be explained in the following sub-sections.

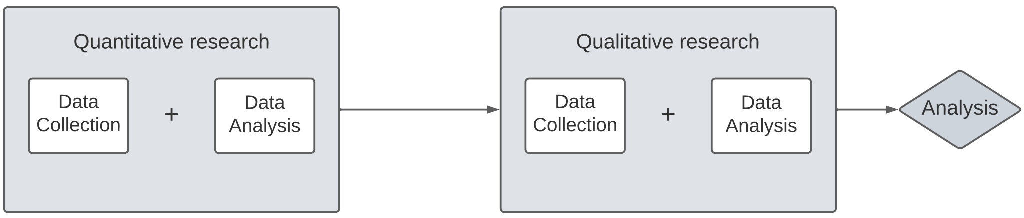

Figure 3.1: Overview of the steps in an explanatory sequential design of the mixed methods research.

3.2.1.1 Quantitative research method

Quantitative research is the research method that focuses on numerical data to explain something or answer a research question. Its main focus is to measure a social reality, and the research are exploring for quantities that can establish research and answer questions numerically (Sukamolson 2007). This can be an analysis of user data, answers from questionnaires or online polls. The benefits of quantitative research is that results are concrete and accurate numbers, making analysis easier and results more readable.

The quantitative research consists primarily of the two segments data collection and data analysis, see Figure 3.2. The data collection method can vary depending on the research question, and what numerical data is required to answer the questions. The method should be chosen accordingly. On the other hand, the data analysis does not vary as much, as the overall goal of the data analysis is to prove or disprove a research question. This is usually conducted by investigating the numerical data obtained in the data collection, looking for patterns and relationships between numbers to establish results.

In an explanatory sequential mixed methods design, the quantitative method is the first to be conducted. This is because the order of methods is to use the qualitative method to obtain a comprehensive understanding of the quantitative numbers. This is necessary when the quantitative data do not tell the full story, and a deeper analysis is required.

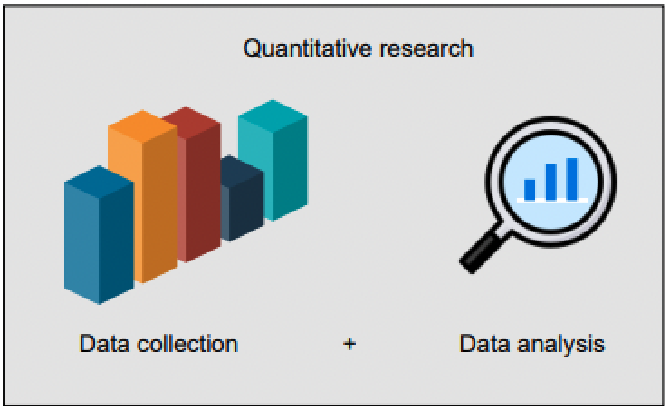

Figure 3.2: Quantitative research

3.2.1.2 Qualitative research method

While quantitative research focuses on numerical data, the qualitative method is empirical, where the researcher tries to understand the human behavior and why it behaves that way (Oun and Bach 2014). Qualitative analysis can provide a deeper insight into a problem by examine why and how persons act towards a topic. It is used when trying to explain and comprehend complex issues (Oun and Bach 2014). As in quantitative research, the qualitative research method comprise two main segments, data collection and data analysis.

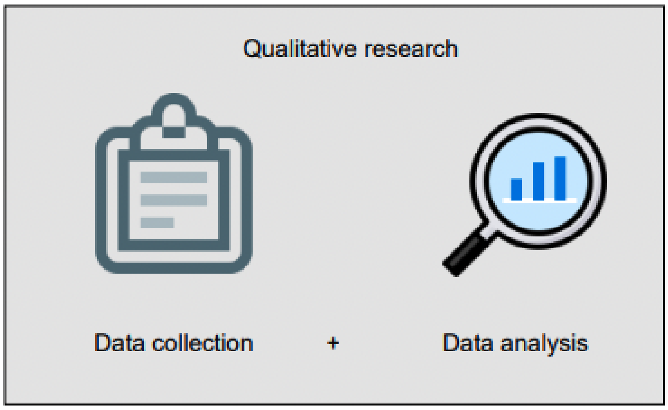

Figure 3.3: Qualitative research

There are several methods to conduct the data collection segment of a qualitative research - for instance individual interviews, focus groups, observations and self study (Oun and Bach 2014). The methods to be used need to be chosen carefully with the research question in mind to have a good foundation for the analysis. This project uses both observations and individual interviews to answer the given problem statement. Using two methods was deemed necessary in this mixed method research to obtain the empirical data needed to substantiate the numerical data.

Interviews

Interviews is perhaps the most common ways to perform qualitative research. There are three main ways to conduct interviews during a qualitative research, depending on the research question(Gill et al. 2008; Oun and Bach 2014):

1. **Structured interviews**: The researcher asks all the interviewees the same set of predetermined, short-answered questions. This method can resemble a questionnaire which is a common quantitative method. They are quick to execute, but does not allow for follow-up questions. It is not uncommon to start of interviews with some structured questions to lay a foundation for the rest of the interview.

2. **Semi-structured interviews**: A type of focused interviews, where the questions are open ended and broad. Allows for discussions within the pre-determined themes and provides more leeway to the researcher than a structured interview.

3. **Unstructured interviews**: In-depth interviews, where the interviews are more of a discussion where the researcher has prepared topics to be covered. Allows for

a free-flowing conversation with little boundaries.

In order to conduct the interviews, an interview guide has to be developed. The guide should present the problem statement and main topics to be covered. These topics should be based on the theory of the research questions. Further, as this is part of a mixed method research, it should also be based on the numerical data collected and analysed in the quantitative phase. The interview guide should also indicate what type of interview to be conducted. And if the interview switches between types, this should be noted. This is because the guide is meant to be a foundation for the researcher when executing the interviews.

Observations

Observations can be done in many different settings and is a common method for qualitative research (Oun and Bach 2014). The benefit of using observations as a method in addition to interviews is that by seeing the interviewees in a natural setting may give more accurate data than conducting an interview. This is because interviewees may provide inaccurate answers in an interview, whereas this is not possible during observations. Further, it gives the possibility to see the bigger picture of the context, giving the researcher a more comprehensive understanding (Oun and Bach 2014). It is an useful approach to collect data at the same time as the event is happening, without interfering with the event. In some cases, like when observing behavior, it is the only way to obtain accurate data (Queirós et al. 2017).

3.3 Method Implementation

This section provides the details of the methods for this thesis, and how they were conducted. The mixed methods research approach was chosen, see Figure 3.1. This is because neither the quantitative nor the qualitative method alone could provide detailed enough information to achieve the necessary comprehension in order to answer the problem statement.

The method was implemented in the chronological order given in an explanatory sequential design of the mixed method, meaning that the quantitative research segment was executed first, followed by the qualitative method. Figure 3.4 illustrates the order of which the different steps were executed.

All data in this project were anonymous, after an agreement with Aker Solutions. This means that all quantitative data were anonymized before they were provided to the research. The qualitative analysis were also conducted anonymously, by having in-person interviews and observations without collecting any personal data. Conducting anonymous interviews had several benefits. Because employees may provide inaccurate answers

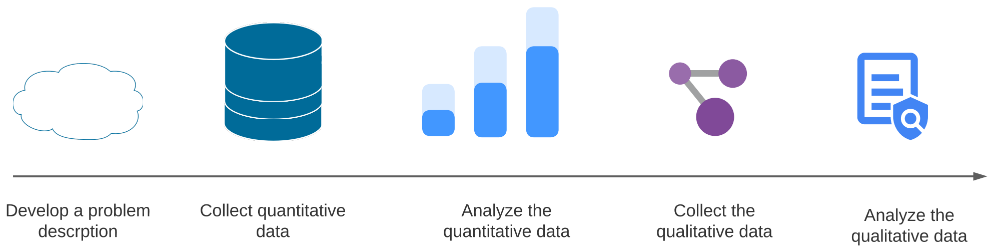

Figure 3.4: Summary of the approach

and not all personal opinions if their opinions were identified and known. This may be especially true in this instance as this project is in collaboration with the employer of the interviewees. So having the comfort of knowing that all answers and interviews were treated anonymously were beneficial for both the interviewer and interviewee. And it was not necessary to collect any personal data for this thesis.

The disciplines are also anonymized to prevent possible identifications from the data. The disciplines are given an ID to separate them instead, and will be called HD254, HD255 and HD57.

3.3.1 Develop a Problem Description

After an initial agreement between the student and AKSO about a collaboration, AKSO provided a suggestion to a problem to be researched. The fall of 2022 was used to write a specialization project, specializing in theory around the suggested problem and developing a problem description for this thesis. The problem statement was then narrowed down to more specific research questions based on the theory background from the specialization project.

It was decided, together with supervisors from AKSO, that a mixed method research approach was needed to fully comprehend the context and answer the problem statement.

3.3.2 Quantitative research

The first segment in an explanatory sequential mixed methods research is the quantitative research, see Figure 3.1. This segment consists of two phases, data collection and data analysis. The data for this segment were provided by Aker Solutions after an agreement on what data were necessary for a thorough data analysis.

Data collection

The first phase in the quantitative research method is to collect data. Quantitative data should be numerical, as the method aim to measure social reality numerically (Sukamolson 2007). The numerical data in this research is WeBuild user data, to look at user behavior.

To analyze the implementation of WeBuild and develop relevant usage-KPIs, it is necessary to look at different user data. Hence, the data to be collected in this phase are user data extracted from the WeBuild application. The data provided contained all usage of the application from December of 2022 through February 10 2023. For the relevance and scope of this project, it was narrowed down to only include permanent workers on the Castberg project. It was also decided together with AKSO that the focus group should be the three disciplines HD254, HD255 and HD257.

AKSO has implemented metrics that keep track of the screen-logging in WeBuild. In other words, the data available show how workers are utilizing the application by tracking the different screens they are using, anonymously. This information can provide insight into the actual usage of the application beyond only the number of users. Each user have an anonymous user ID so that it is possible to differentiate between disciplines and also individual workers. Before the data was provided to the student, ID's were anonymized by AKSO and given a neutral ID so it should still be possible to differentiate between personnel and disciplines. All data from the application are stored for 90 days in Microsoft Azure, the database where WeBuild is located. To use this data, AKSO anonymized it and transferred it to an ExCel file before providing it to the student.

Microsoft Excel was used for the processing and manipulation of data. Formatting the data as a table gave a range of possibilities to manipulate, sort and filter data to look for patterns and user behaviour. The data were initially stored in the four segments as seen in Table 3.1.

Screen	Showing what screens the user loaded
Timestamp	The date and time users accessed a screen
Organizational Unit	The discipline each user belongs to
Identity	An anonymized identity to separate users

Table 3.1: WeBuild User data provided by AKSO

Data analysis

We want to analyze quantitative data to look for patterns and user behavior that can answer or explain our problem (Sukamolson 2007). Before starting the analysis, all unnecessary noise had to be filtered out. Unnecessary noise was all data that were not in the scope. This included all operators belonging to another discipline than HD254, HD255 or HD257. With this filtered out and the correct data stored in a table, the analysis could begin. A few, primary patterns to investigate were predetermined based on the research questions. This included patterns like *What screens are the most and least used?* and *How are the weekly user numbers developing for each discipline?*

In order to analyze the data and look for patterns and behavior, several ExCel sheets were created, each with a different focus. Helper columns in the main table were also created to help with the filtering, so the analysis were as broad and precise as possible.

There are multiple useful functions when operating with tables. The three most used functions in this analysis are the *Filter*, *Unique* and *Sort* functions. For instance, Equation 3.1 shows the equation used to list all individual operators within the chosen disciplines who have used the application at least once during the time period. The table contains all screen recordings in the period, so filtering on different unique identities returns all unique users in the period. The helper column [HD254, HD255, HD257] equals 1 if the operator belongs to either one of the three disciplines, and 0 otherwise.

$$= UNIQUE(FILTER(Table1[Identity:];Table1[[HD254, HD255, HD257]] = 1)) \tag{3.1}$$

It is possible to distinguish both individual workers and the different disciplines. This enables the possibility to track how different workers utilize the application, and if there are patterns within each discipline that can be explained in the later qualitative segment. The implemented metrics that keep track of the different screens make it possible to track how workers are utilizing the application. This analysis is important because only looking at user numbers yield inaccurate results, we have to look beyond these numbers to see what and how the operators are using it, and how active and permanent the users are.

Since this is an explanatory sequential mixed method, this analysis had to be executed before conducting the qualitative research. Key results from the analysis were used as a basis for the interview guide for digitization personnel.

3.3.3 Qualitative research

The second segment in the explanatory sequential mixed method is the qualitative research method. This segment also consists of two individual phases, the data collection and data analysis.

3.3.3.1 Data collection

Two methods were used to conduct the qualitative data collection, observations and interviews. This was carried out during a four-day trip to Stord yard. The first two days were used for observations, and the last two days for interviews. The operators to be interviewed were asked to participate during the first day of observations.

Observations

Observations were carried out to obtain a better understanding of the research context and environment for the project. Two days were used to shadow a WeBuild coordinator at Castberg, listening and taking notes. A part of the coordinator's job is to be out in the field and assisting operators with the WeBuild usage and being the connection between the end users and developers of the applications.

During the initial conversations, the coordinator gave an extensive introduction to the WeBuild application, while also discussing the benefits and disadvantages with it. These conversations were had before observing out in the field, giving some background knowledge before possible questions were asked.

Observing the coordinator made it possible to listen in on conversations between the coordinator and operators at Castberg. The conversations mainly consisted of the coordinator pushing on and reminding operators and foremen to use WeBuild, and the operators and foremen describing possible errors and concerns the coordinator should bring to the developers or implementation personnel. These observations of daily conversations also provided the opportunity to speak with both positive users and negative non-users, forming a more complete image of the operations.

When observing (or shadowing) in the field, it is important to be in the background so that the conversations are normal without the feeling of being observed. The operators spoken to were however made aware that they were being observed and that notes may have been taking. This is a disadvantage of the observations as a method, as it can yield inaccurate results due to operators knowing they are being observed (Oun and Bach 2014). This did not seem to affect the results in this research however, as staying in the background and letting the coordinator lead conversations normally lead to operators speaking freely.

Interviews

The qualitative research were planned together with AKSO at an earlier trip to Stord. Here it was decided to interview two main groups - digitization personnel, working with the implementation of various digital solutions at the yard, and operators, the end users of the new solutions. The operators were permanent employees, working for one of the three disciplines HD254, HD255 or HD257. It was beneficial if they were split between active users, on-and-off (sceptical) users and non-users. Operators were asked to participate in the interviews during the observations, as the coordinator had the best overview of the operators' usage.

An interview guide had to be developed before travelling to Stord. The guide were divided into two parts, one for operators and one for digitalization and implementation personnel.
The interview guide for the operators consisted of three parts, and were mostly based on theory from the specialization project written by the student in the fall of 2022, supplemented with some quantitative data. The theory questions were based on the capability platform approach and articulation work, as described in Chapter 2.1.1 and 2.3, respectively. Although there were three sub-groups within the operators, the interview guide were the same. As a general rule, the establishing usage part of the interview were structured, while the main part were semi-structured, see Chapter 3.2.1.2. The guide were divided as follows:

1. **Introduction**: The introduction consisted of a short introduction of the student and the project, before the interviewee introduced themselves with what position and field they were working in. They were also informed of the anonymity of the interviews and thesis, to remove any eventual obstacles that prevented them for speaking freely.

2. **Establishing usage**: The first part of the interview was structured, aimed to establish the interviewee's utilization of WeBuild before discussing further topics in the main part. This was to establish a foundation for the rest of the interview. Most of the questions were the same for all interviewees, however some questions depended on the interviewee's utilization of WeBuild.

3. **Main part**: The main part of the interview were semi-structured, where the aim was to discuss topics related to the implementation and improvements based on interviewee's personal experiences. The main part consisted of three segments:

   (a) **Capability platform:** Questions regarding the capability platform and how AKSO have used this in the implementation. This included development of capabilities and the dimensions.

(b) **Articulation work:** Understanding how operators are executing their articulation work is essential when implementing new digital solutions. Questions related to this and how operators deal with errors were discussed

(c) **User Experiences:** Questions using the interviewee's experiences were asked to understand what AKSO can do to improve the implementation. This included improvement suggestions and changes AKSO should make based on their experiences.

4. **Conclusion**: To conclude the interview, interviewees were asked if they anything else to say. If not, they were thanked for their participation and the interview was finished.

As for the interviews with the digitalization and implementation personnel, the focus was more heavily on the quantitative data analysis. Because they are not end-users, topics like articulation work are less relevant for them. Instead, asking for opinions and explanations to user numbers may give insight beyond the numerical data.

1. **Introduction**: The introduction consisted of a short introduction of the student and the project, before the interviewee introduced themselves with what position and field they were working in. They were also informed of the anonymity of the interviews and thesis, to remove any eventual obstacles that prevented them for speaking freely.

2. **Questions from quantitative data analysis**: In this part, the interviewee's were asked questions directly related to the data analysis, where they were asked to comment on and explain graphs and numbers.

3. **Implementation related questions**: This part was more semi-structured, with questions related to the implementation process of WeBuild and the organizational effects.

4. **Conclusion**: To conclude the interview, interviewees were asked if they anything else to say. If not, they were thanked for their participation and the interview was finished.

Conducting the Interviews

The interviewees were selected together with a WeBuild coordinator. The aim was to have a wide spectrum of participants when it came to WeBuild utilization, meaning that the interviewees were some active, positive users, some where on-and-off users and some where non-users. The coordinator had an overview of operators within each of the aforementioned categories, making the selection easier. As different disciplines have experienced different issues regarding WeBuild, the coordinator tried to find operators within the different disciplines as well. Operators were asked to participate in the interviews while conducting the observations. Eight operators agreed to participate in interviews, given that it was anonymous. The interviews took place during the last two days of the field research trip. An office space at the yard was provided by Aker, nearby the Castberg ship. It was an advantage that the interviewee and interviewer had met during the observations, removing some of the possible tension from the interview setting.

The interviews were conducted anonymously, in the interest of both the interviewer and interviewee. This was to ensure a free-flowing conversation where the operators could speak their mind. All interviews were in Norwegian, giving even more room for a free-flowing conversation.

One hour was set aside for the interviews. However, the length of the interviews varied, and the whole hour was rarely used. It depended on the interviewee and their experience with WeBuild, their personal opinions and how much they each had to say on the matter.

As described earlier, the plan was to have a mix of a structured and semi-structured interview approach. This was to ensure that all the interviewer got the answers needed, as well as the interviewee could speak their opinions. The start and end of the interviews were structured, to get a general feeling of the operator's experiences and opinions on WeBuild. And to establish a foundation for the later analysis. The semi-structured part were the main part, where different topics were discussed. A few questions were prepared in advance to have some points of reference and to keep the conversations steady. The reason for having this part semi-structured was to have a conversations where the interviewee were free to raise their opinions, whether it was concerns or benefits of the digitization process. It also made it possible to ask follow-up questions where it was needed.

3.3.3.2 Data analysis

It is essential to conduct the data analysis soon after the data collection when the observations and interviews were fresh in mind. The observation notes were written down the same evening as they were executed. This was a set goal in order to retain all experiences gathered while out in the field.

Four of the eight operators interviewed identified themselves as daily users. Two said that they used it on-and-off, and two were non-users who had tried WeBuild in the past, see Table 3.2. This variety of usage offered different insights, opinions and views to the application and the implementation strategies, though the operators mostly agreed on the improvements that are needed and why WeBuild is lacking users. The daily users said that they use it for mostly everything, from downloading work orders to report progress. Whereas the on-and-off users often have issues with parts of the application, preventing them for taking full advantage of it.

Interview object	**Using WeBuild?**
1	Daily
2	On and off
3	On and off
4	Daily
5	Not using
6	Daily
7	Daily
8	Not using

Table 3.2: WeBuild utilization by the interview objects

A deductive approach was used for the analysis of the interviews. The deductive approach is where codes and categories are selected beforehand based on the theory behind the research question (Gale et al. 2013). The interviews were mostly semi-structured, but there were main topics that needed to be covered. These topics being integrated operations and articulation work that have been covered in Chapter 2. The last main category was user experiences, as this category opened up for the interviewees to speak freely about their opinions of the application.

The sub-categories were also specified on beforehand, including codes was developed through theory, initial talks with AKSO and the quantitative analysis. The semi-structured interview approach made it possible to discuss the main categories and add questions regarding the sub-categories if fitting and necessary.

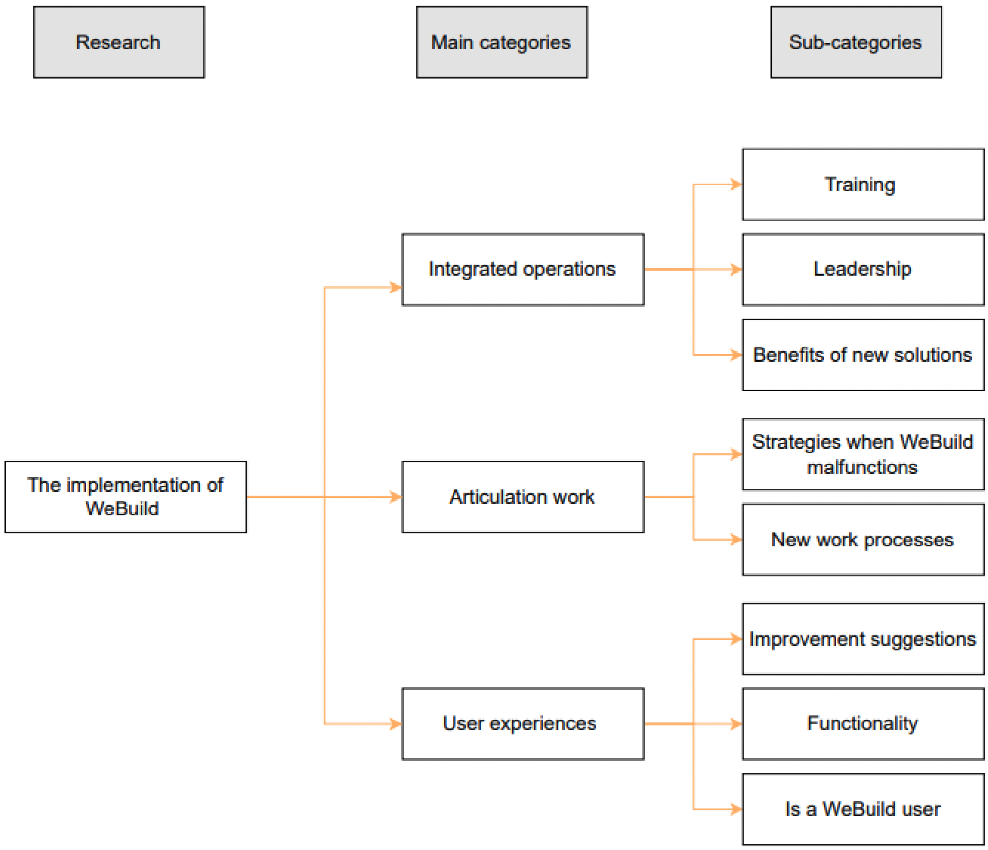

Figure 3.5: Categorization of the interviews

3.4 Limitations, Uncertainties and Evaluation of the Method

This section will first discuss the limitations and uncertainties of the chosen method, before evaluating its credibility and accuracy.

3.4.1 Limitations and Uncertainties

The data collected in the quantitative research phase are screen logs, as described in Chapter 3.3. This means that each screen loaded equals one data point. This method have limitations and disadvantages that can lead to insecurities. There are no functionality to access information on what an operator are using each screen for. This can decrease the accuracy of the method in cases where screens have more than one feature. There can be multiple queries between the application and MIPS on a screen, which are not detected using this method. This is why an explanatory mixed method research method was chosen, so the qualitative method can be used to understand what and why operators are using the different screens.

There are also uncertainties related to the number of permanent AKSO employees working at the Castberg project at any given time. Table 3.3 shows the employees at each discipline during the data collection period. Relocation to other projects or teams are not uncommon, and may harm the accuracy of quantitative analysis.

Discipline	**December**	**January**
HD254	15 (16 from week 50)	16 (28 from week 4)
HD255	29	21 (18 from week 3)
HD257	88	90 (from week 5)

Table 3.3: Permanent AKSO employees working at the Castberg project in the period December-January

3.4.2 Evaluation of the Method

The mixed method research approach was chosen to provide the most accurate results, as we needed a more comprehensive understanding than what either the quantitative or qualitative could provide individually. The explanatory sequential approach yielded a possibility to explain the numerical data, by interviewing experts and end users to investigate these. However, there are still disadvantages with the method that should be addressed:

- Sample rate: As the project is limited to 20 weeks, and the qualitative research was carried out over four days, the sample size was small. Eight operators were interviewed, and even though the aim was to have a wide user group, there may be some bias in the answers.

- Discrepancies: There may occur discrepancies between the quantitative and qualitative data. This has to do with the quantitative data collection method and the use of screen logs.

- Screen logs: The quantitative data may not be 100% accurate due to the way it is assembled. One data point refers to one screen loaded, which creates discrepancies when one screen has several functions. For instance, the progress reporting and retrieving work orders functions are on the same screen, which reduce the accuracy when analyzing the exact usage.

- Bias: Even though the interviewees were assured the interviews where anonymous, some bias can have occurred. This can be due to the fact that the project is in collaboration with Aker Solutions and the interviewees are employees there.

Chapter 4

Results and Analysis

This chapter presents the results and explanations of results obtained from the research, executed using the methods presented in Chapter 3. The results consist of the numerical data acquired together with AKSO along with answers and information from the observations and interviews from the field research.

The objective of this master's thesis is to develop key performance indicators that can help AKSO in their implementation of new digital solutions. Consequently, the results are included with this perspective in mind, and results that are not relevant are neglected. This includes both numerical data, and experiences from the field research.

When analysing application usage by looking at screen logs, there are a few things to consider. Firstly, more screen logs does not necessarily mean more usage. For instance, a user can have more screen logs while trying the application for the first time than an active user who knows how to use it. Therefore, instead of looking at the number of screen logs, the number of days used will be the base for the analysis. This gives a better overview over actual users over time.

The structure of this chapter is as follows:

1. Empirical study of Aker Solutions: The first section presents an empirical study of Aker Solutions, providing a background of the organization and the WeBuild application.
2. Analysis of WeBuild usage: The second section presents and analyses the user overview of the WeBuild application, obtained through numerical analysis and interviews. This section is split in four segments:
    - User overview
    - Active versus inactive users
    - WeBuild use cases
    - Differences

4.1 Empirical study of Aker Solutions

Aker Solutions (AKSO) is an international Engineer-to-Order (ETO) company, specializing in the delivery of integrated solutions, services and products to the global energy industry (Solutions 2023d). AKSO strives to be a leader in the energy transition, by enabling low-emission oil and gas production, develop renewable energy solutions and safe decommissioning of large constructions. As a marked leader, AKSO is powered by digital technology and is always looking for new, innovative digital solutions to keep projects safe, cost-efficient and of high quality. The company is currently undergoing a digital transformation throughout their yards in Norway. Their digitalization plan consists of 25 projects developed to increase efficiency, productivity and support the employees (Kamsvåg et al. 2022).

As a part of the digital transformation, AKSO is continuously developing new technology to digitize their work. This is also the case at their yards in Norway, where the organization is looking to improve the work processes by developing and implementing several new digital solutions in an effort to increase the productivity and efficiency of the day-to-day work. The applications will affect different aspects of the work processes. The variation in these application depends on different factors, such as user group, number of users, application complexity and the project environment. This makes the implementation processes of the application challenging, as the user groups are complex and varying.

AKSO has four construction yards in Norway, where Stord yard is the largest one. Here alone, thirteen new applications are being implemented over the next years in an effort to digitize the yard. This is a digitization process, meaning that they are transforming from an analog to a digital environment (Gartner n.d.[b]). This is especially the case for operators and foremen working out in the field. For instance, all distribution of hand books, material and drawings is handled analogously. The digitization transformation aims to streamline the work processes by digitizing these functions and materials.

AKSO has a common information space that help leaders and management to sustain the workflows. It is called MIPS (Method Integrated Project System), and is AKSO's ERP-system (Solutions 2023a). According to a digitalization engineer, MIPS is used in planning, engineering, construction and completion of projects.

Stord yard and the Castberg Project

Stord yard is AKSO's largest yard in Norway. The yard is a manufacturer for the O&G and renewable energy industry and specializes in assembling large platform topsides and onshore facilities modules (Solutions 2023c). Their biggest project as of 2023 is the construction of the subsea production system and the topside at Johan Castberg, which is a FPSO (Floating production storage and offloading) ship owned by Equinor (Solutions 2023b). There are roughly 2000 temporary operators working at the Castberg project along with around 200 permanent AKSO employees, according to an AKSO employee (Bakken 2022).

Among the applications that are currently being developed and implemented is WeBuild. WeBuild is an application that aims to digitize the general work flow at Stord, by digitizing work orders, work manuals, drawings and progress reporting. But before discussing WeBuild, we should look at the current work processes in order to understand the potential of the new applications.

Because before WeBuild, the operations at Stord were mostly analog and paper-driven. Work orders were given in hard paper copies to the operators. Operators observed stated that it results in long walking distances to and from work stations in situations where they forgot the work orders or drawings. However, the progress reporting is the most time-consuming aspect and where AKSO sees the most potential for increased productivity. Because now progress reporting is the foreman's responsibility. Operators are given work orders with specifications on the expected time needed to finish the objects in the work order. Once they have finished a task or an object, they often mark it in the work order. At the end of the day or week, the foreman comes out on the site and collects all finished tasks and orders or the operators report the progress to their foreman. With the progress gathered, the foreman walks back to the office and types all progress in MIPS, task by task. Foremen are often busy and seldom reports progress on a daily basis. This work process is inefficient and often results in days of delay, which have consequences for the overall planning, coordination and work flow. Having to report several days of progress simultaneously also increases the administrative work load, decreasing the time spent out in the field (Bakken 2022).

Foremen often have a low situational awareness of the operations in this analog approach, as the information in MIPS are not always live data. Foremen also have to use MIPS when distributing work orders and tasks, and to see whether the operators can execute their given tasks. Because MIPS will tell if other teams and disciplines are finished with their tasks related to the specific objects. And when this data is not live it can lead to unnecessary downtime. This quote from a digitalization engineer, obtained from a field trip to Stord executed during the specialization project, exemplifies this:

> Digitalization engineer: When a steel plate is welded, it has to go through an x-ray scan. This will be ordered after the team leader has reported that the welding is finished. Let us say that the welding is done on a Wednesday, but the team leader is busy and reports it Friday. Then the x-ray is ordered on Monday and executed on Tuesday. That is six days, which really should have been one day (Bakken 2022).

This quote displays the potential for increased efficiency and productivity by implementing new tools that utilize real-time data. By reporting progress instantly, the downtime can be reduced massively, streamlining most processes.

Looking at the project environment from an IO point of view, the Castberg construction project at Stord acts as the ecosystem. The species in the ecosystem must work together to continuously develop and create capabilities. When new technology like WeBuild enters the ecosystem, the other dimensions need development as well to develop the necessary capabilities. Further, MIPS and WeBuild act as common information spaces for all disciplines, and WeBuild as a new solution requires the organization and actors to develop new work flows and roles.

The primary work for the operators at Castberg are the tasks they are given in the work orders. These tasks include their personal tasks, but they are part of what Gasser (1986) defines as a *task chain*. It is a larger structure, often the whole production sequence for an object. Operators from different disciplines execute concurrent tasks in that task chain.

Articulation work in this ecosystem is all extra work that operators have to perform in order to make resources such as WeBuild and MIPS work. These are the ICT systems that support the employees in their day-to-day primary work. The articulation work is all the work that operators execute to make their primary work work, and what they do to cope with shifting environments and changing work flows. WeBuild will change the work flow by changing the responsibility of certain tasks, such as progress reporting. It will also consist of the work needed to cope with errors in the resources. Newly implemented applications can be error-prone, hence employees may have to perform more articulation work to make up for the errors in order to keep the task chain running.

4.1.1 WeBuild

WeBuild is a mobile application that aims to improve efficiency and flexibility, hereby improving the overall decision-making and reduce costs (Kamsvåg et al. 2022). The application digitizes the distribution of work orders, communication and progress reporting for operators and team leaders, utilizing real-time data. It is a mobile application for workers where they always have access to their work orders, live documentation and progress status. The ultimate goal is to have an application that improves the communication and shared awareness among workers, as well as empower the operators by giving them more responsibility of their work. Eventually less foremen will be needed per operator, foremen can spend less time on administrative tasks and a sense of change in the management structure will happen (Storholmen and Klemets 2020).

WeBuild was designed and developed with a multi-disciplinary research team, consisting of a project manager, UX designer, developers and super users (Storholmen and Klemets 2020). The super users were both foremen and operators from different disciplines, and are experts trained to teach other users. This was to ensure that the application was being adopted (Storholmen and Klemets 2020).

4.1.2 WeBuild Functionality

In WeBuild, every operator and foreman has their own user on their smart phone that is funded by AKSO (Kamsvåg et al. 2022). Foremen distribute work orders to their team members. Operators can see what work orders they are assigned to on the home page of the application. If they have a hard copy of the work order, they can search for the reference code or scan a bar code to access the work order in the application as well.

The work orders include all objects belonging to the work order. It is possible to see all documents related to the object in the object screen, such as material lists and drawings. The drawings can be downloaded and have zoom functions to make it easy to see all details. It is also possible to see which tools your team members currently access. The work order also comes with a time estimate, which is indicated in hours approximately needed. This is then divided such that every object and job related to the work order has hours specified. The progress reporting is done by reporting it on each object in the work order. Each object contains several "jobs", and when these are executed they are updated. By updating the progress bar on each object, the progress for the work order is also updated.

As WeBuild aims to improve efficiency by having live information available at all times, the application's most critical functions rely on real-time data. Among these are the progress reporting, which is perhaps the most essential functionality for efficiency improvement. Because with WeBuild, operators can report progress on an object instantly with their phone instead of going through their foreman. This ensures much more accurate data on progress and can optimize the work flows.

4.1.3 Implementation strategy and challenges

Training is a critical step of introducing new systems or services to an organization, and it was also part of the long-term plan with WeBuild. This did not receive funding in this case, making the implementation more challenging (Storholmen and Klemets 2020). Organizations often need to balance between the functionality needs and the human needs when working on a budget. In other words, the requirements and wishes of end-users need to be balanced financially against the need for training programs for the users (Kamsvåg et al. 2022).

Consequently, Storholmen and Klemets (2020) has emphasized the term *train the trainer*. The concept utilizes super-users, which have become essential in the implementation of WeBuild. They are responsible for training other end-users. AKSO has also developed training videos that demonstrates the application to support the super-users. They have recently hired a WeBuild coordinator, whose job is to be the connection between end-users and management and the development team.

4.2 Analysis of WeBuild usage

To establish a foundation for the rest of the chapter, this section will start by looking at general user numbers. These numbers were analysed in the quantitative research, supplemented with information gained during interviews and observations.

4.2.1 User overview

As explained in Chapter 3.1, the scope of this research is looking at permanent AKSO operators within the three disciplines HD254, HD255 and HD257 working at the Johan Castberg project. Table 4.1 displays the permanent operators within each discipline together with the number of operators who have used WeBuild at least once.

The table shows the number of operators who have loaded at least one screen. It is insufficient to only look at these from a quantitative perspective, as the information here is limited. And according to the coordinator, the numerical data and the actual qualitative analysis can vary greatly. Because using the application does not necessarily indicate an active user. It can be operators who have tried it once or twice, then decided to not use it. On the other hand, the numbers can also be underestimated. Because operators work in teams, and often performing their tasks in pairs. This only requires one operator to use WeBuild to report progress or look up material.

Discipline	**December**	**January**	**WeBuild Users**
HD254	15 (16 from week 50)	16 (28 from week 4)	18
HD255	29	21 (18 from week 3)	12
HD257	88	90 (from week 5)	12

Table 4.1: Permanent AKSO employees working at the Castberg project in the period December-January

The graph in Figure 4.1 shows that HD254 have the highest number of WeBuild users with 82%, whereas HD257 have the lowest with 13%. However, the qualitative analysis showed, through conversations with coordinators and operators, that HD257 is the discipline that uses WeBuild the most. They are the most active and positive users. The low user numbers can be explained with HD257 operators mostly working in pairs or larger groups. A HD257 operator said that he often reports progress for the whole team, whereas other disciplines work alone.

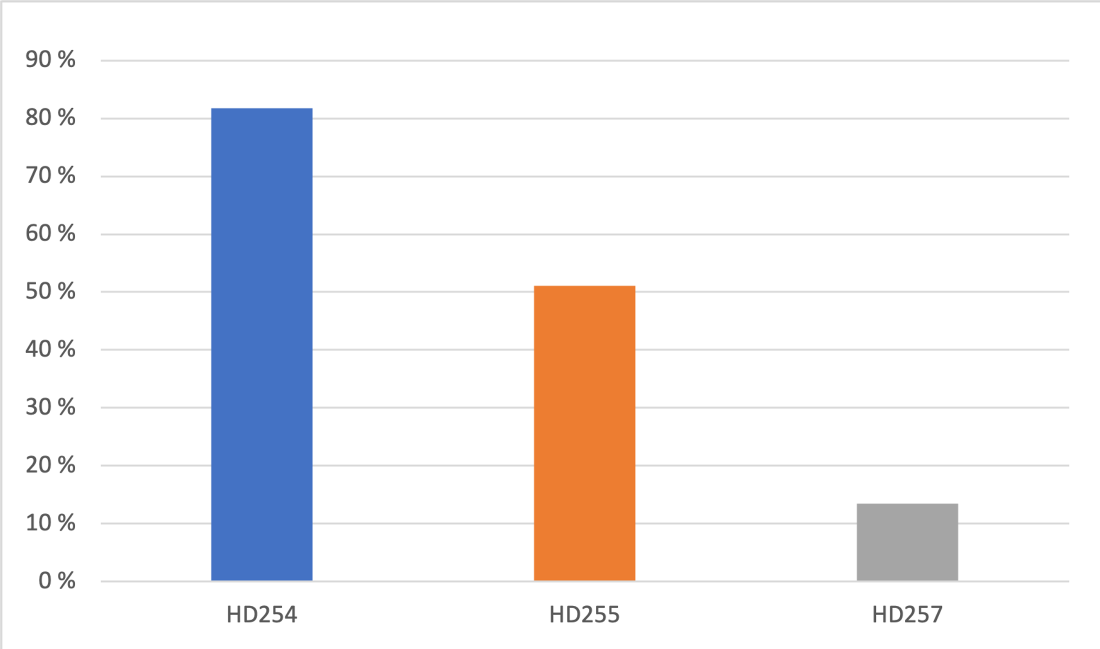

Figure 4.1: WeBuild users in each discipline, displayed in percentage of average operators

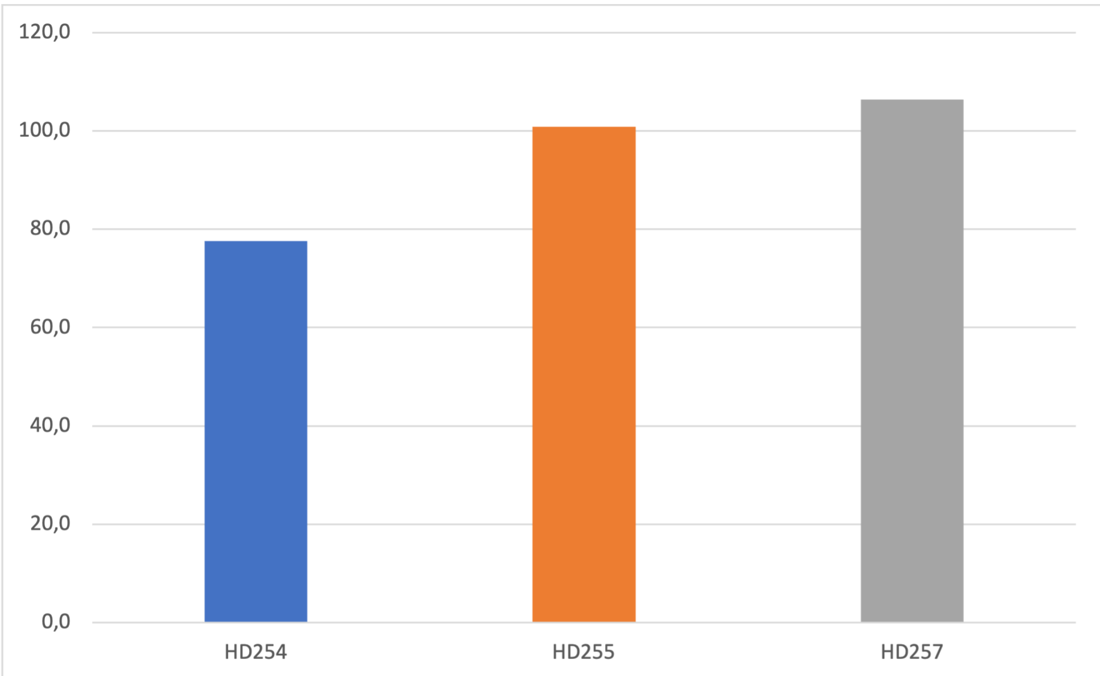

Figure 4.2: Screens loaded per user

Figure 4.2 illustrates what the observations uncovered - even though HD257 have the lowest user numbers, they are the most active users on average. This graph shows that more users do not necessarily mean more usage, and it is the usage that will generate value.

> Coordinator: There is a vast difference between the digitalization department working with numerical data and the people out in the field working with the end-users. The numerical data can tell something quite different than what the end users are saying. For instance are the numbers on progress per operator misleading as teams often report progress together.

Nevertheless, from Table 4.1 we can see that there are on average 133-136 permanent AKSO operators at Castberg, with 42 WeBuild users. This means that 31% of the operators have tried WeBuild, and roughly 2/3 of the operators working at Castberg in the data collection period have never tried the application.

Looking at the usage in a long-term perspective is also necessary to evaluate the performance of the application. Figure 4.3 illustrates Table 4.1 graphically, in percentage of the average number of operators over the time period. It shows the weekly users of WeBuild, measured in percentage of permanent employees each week. HD257 have the lowest percentage of WeBuild users, with an average of 5% weekly users. HD254 and HD255 however, averages more weekly users, though their numbers vary in some degree. HD254 averages at 41% weekly users, while HD255 have 22%. Week 52 can be neglected due to the holiday season. There are variations in the weekly use, however there does not seem to be any patterns of an improving development over the weeks. Although there are patterns indicating that the average user numbers decrease when number of employees increase, signaling that the organization is struggling with the recruitment of users among new or relocated employees.

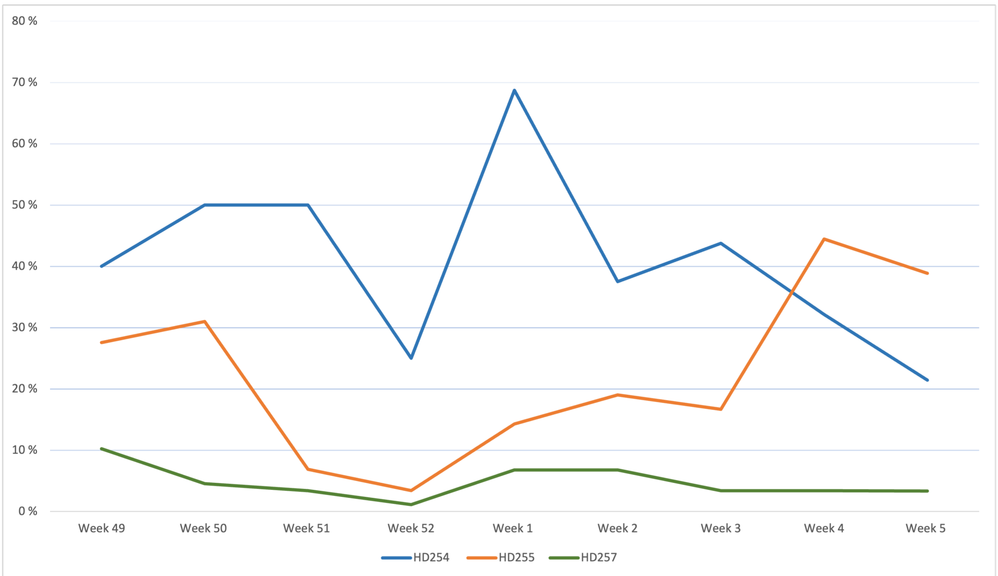

Figure 4.3: Weekly use of WeBuild, measured in percentage

The coordinator agreed that there were variations and also added that there was a notable decrease in usage when he was not present helping and pushing operators to use it. Some interviewees expressed a lack of pressure from the company to use it. Without an external pressure, using WeBuild is voluntary and will only be used by operators with a willingness to change. The WeBuild coordinator has, through his position as a connection between the end-users and developers, managed to increase the usage of WeBuild. The operators are told that they can call the coordinator when facing issues, which will then be solved or brought forward to the application developers or implementation staff. Further, there have been cases with operators and foremen who have been initially negative to WeBuild have changed their mind after being given a thorough introduction and tutorial. However, the tendency that operators are using it less when the coordinator is not at work, shows that operators still need to be motivated and pushed to use it.

Capability platform

In an effort to further explain these user numbers, we can look at the capability platform. Because an integral part of both the student's specialization project and the theory behind this master thesis is integrated operations, and how the dimensions of the capability platform work together to iterate and develop new capabilities. Consequently, a central part of the interview concerned integrated operations. With a focus on usage-KPIs, the two dimensions *People* and *Technology* and the collaboration between the two are the most important. When developing new technology and implementing it in a organization, it is essential that the organization facilitates for the employees to obtain new competence and learn the new tools. Therefore, all the operators were asked *How has the training been?* and *Have you been offered any courses on WeBuild?* The consensus was that there had been no training, nor any courses offered. The daily users said that they were mostly self-trained, and called the coordinator if they had questions or concerns.

> Operator: There has been no training or courses. There was an information meeting where they explained WeBuild, but not how to use it. All the operators who use it are self-taught. So there should be more training, especially for the older employees who are more sceptical. Training programs would definitely increase the user numbers.

The training operators receive regarding new digital tools seem to be insufficient. The coordinator could tell that the operators were only given an introduction to what WeBuild is. Consequently, most operators had to learn the application themselves. The coordinator sometimes joins in on different team meetings to have a short, more intimate tutorial of the application, which has given some results.

This obstacle, a fundamental lack of training, is preventing a lot of operators from using WeBuild. Operators are not using it as they often do not know how to use it. This is a result of a lack of training and information from the organization. When new technology

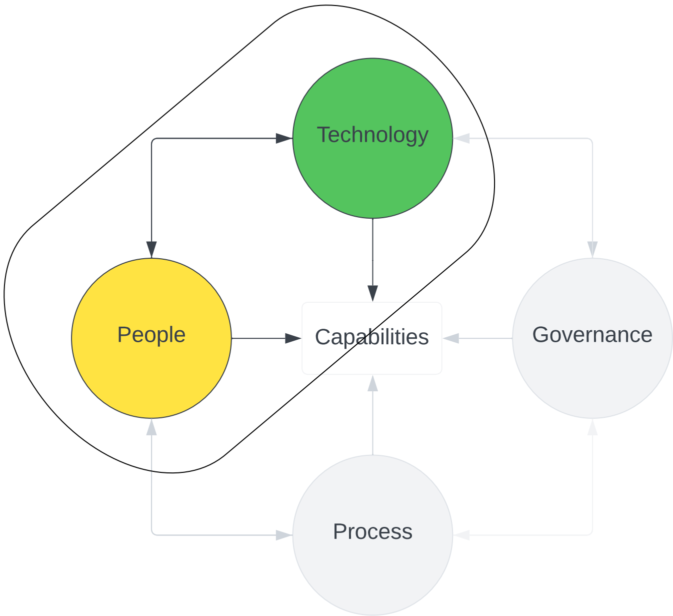

Figure 4.4: The people and technology dimensions of the capability platform

is developed, the other dimensions have to be developed as well, as Henderson et al. (2012) describe it: "Technology in a capability platform is an enabling device for people, process and governance. Alone, technology seldom drives value. But when combined in a creative manner with these other dimensions, technology can enable radical transformation" (p. 5). All the dimensions are equally important and need attention if AKSO wants the transformation they are seeking.

The people dimension can be developed through learning new skills and increase competence with new tools. This includes training and courses when new digital solutions are launched, to support operators in obtaining new knowledge that will gain both the operators themselves and the organization long term. Some operators and foremen spoken to during observation and interviews expressed a scepticism early on, but was convinced after a "personal" tutorial by a coordinator. These operators exemplifies how critical development of the people-dimension is when introducing new technology to an information ecology.

The only exterior pressure who is pushing for operators to use it are WeBuild coordinators. However, right now there is only one coordinator and over 100 permanent operators. All the active users spoken to were either new, young employees who started using it right away, employees who had used similar applications previously or employees with an eager to learn it or with a team member who were eager. The pressure for development is not coming from the organization directly. The organization has been passive in their approach to increase the user numbers.

The biggest difference between users and non-users seem to be their own personal willingness to change. With no organized training from the organization, most users are self-trained or are working with operators who have been self-trained and are highly skilled now. The prerequisite for a WeBuild user is a personal drive and will to learn it, or a colleague or team member that are leading the way. They do not feel pressured by the organization. Consequently, sceptical users will not have a reason to use it with no exterior pressure.

> Operator: Us operators would have gotten more out of WeBuild with better training. Many are held back by the fact that there are no courses, so they do not use it because they do not know how to use it. And there is no push from the company to use it, it sometimes seems like they do not care if we use it or not. If they had organized training it would be completely different.

The sceptical operators and foremen either do not believe they will benefit from application, or that they lack the skills to master it. They know that they have gotten along fine without WeBuild and see no reason to change that, especially without the push from the organization.

All the operators see possible benefits from WeBuild. They see the opportunities for saving time, both individually and collectively. The operators who experience a seamless system without errors are already taking advantage of this and seeing how it saves time. Additionally, it increases the shared situational awareness by being able to see more of the operational environment. However, the answers were varied when discussing the increased shared situational awareness. While some operators appreciated the increased awareness and overview of the operation, some called it "unnecessary", as they only cared about their personal work orders.

Leadership

One of AKSO's goals for WeBuild is that, when fully implemented, foremen will be more out in the field assisting their team as their administrative tasks decrease when progress reporting are performed by the operators. This hands-on leadership is also a goal in integrated operations (Skarholt, Hansson, et al. 2012). A more hands-on leader can increase the problem-solving and safety, as well as increasing the shared situational awareness for the leader.

The operators working in teams of high Webuild usage see their foreman more often that other teams. This is because operators have taken the responsibility for progress reporting, which results in foremen having more time to spend out in the field. This was a notable difference between teams where operators reported progress and teams where the foreman did. The latter had not noticed any differences from before WeBuild as the progress reporting did not work, hence the foreman had to report it. By having the possibility to download work orders on their phone, operators are also less dependable on foremen to acquire their work orders. However, it also requires foremen to be active on WeBuild. Foremen need to delegate work orders in WeBuild for operators to be able to report progress.

A social factor that can affect the implementation is the age of operators and foremen. Many of the permanent operators and foremen at Castberg are older. In fact, an operator said the average age is nearing 50 years old. And the operators and foremen who have been working with the same system for several years or decades are more reluctant to change than younger employees. The change must happen from the top down. Foremen who take the initiative to utilize WeBuild will influence their operators.

> Operator: We people are creatures of habit. We do not want to change if we do not have to. This is the case for both operators and foremen, but especially the older foremen who have used the same system for many years. These people do not want to change their work process, no matter how intuitive and easy the new system is.

It does seem more urgent that the older employees and foremen receive some sort of training. Younger operators are more used to applications and smartphones. And operators are dependent on their foremen for progress reporting. This is because the foremen have to assign work orders to operators, and operators can only report progress on work orders they are assigned to. And foremen tend to be fundamentally more sceptical to WeBuild. Why this is the case depend on several factors:

1. **Age:** The average age among foremen is higher than that of the operators. According to operators and other personnel, age and WeBuild usage correlates by the fact that younger personnel are more likely to use WeBuild than older personnel.

2. **Old systems:** Foremen who have used MIPS for many years have developed their own, efficient systems that work for them. They do not see the benefits WeBuild offer and prefers a system they are familiar with.

3. **Trust:** Some foremen do not trust operators to report progress themselves or do not want them to have more responsibility. There were also talks about foremen seeing the application as the start of eliminating foremen altogether.

It should be noted that is not the case for all foremen, and that there are foremen who use and are satisfied with WeBuild. But these factors indicate that training is necessary, especially since some foremen told that they were sceptical of the application until they were shown how simple it was by the coordinator.

> Operator: I have experience as a foreman and WeBuild user, I did not save any time. However, there are more benefits with WeBuild when working as a foreman than as a operator.

> Coordinator: Foremen essentially only need to do one thing in WeBuild, and that is the distribution of work orders. We are talking about to-three different actions.

These quotes illustrates how misinformation or lack of information has led to foremen not using WeBuild. They think it is more challenging to learn and use than their familiar system, because they are not aware of the simplicity of the application.

Integrated planning

While integrated planning was not a central topic of the interviews in this project as it is not directly relevant to the usage and implementation of new solutions, it was discussed in some way in most of the interviews.

WeBuild has the potential to be used as a common information space across the different disciplines. As an ICT solution, it can act as an enabler for change. Because the application uses real-time data for progress reporting, it makes it possible to align activities across disciplines more efficiently. A common information sharing space was also called for by the organizations studied by Ramstad et al. (2012). Because if operators can see in real-time if a job they need to perform is "accessible", meaning that someone has finished their work on that particular part, organizations can speed up their processes considerably.

> Operator: The overview of the whole operation is better, both for me and the foreman. The foreman gets an overview of the whole week. And the overview of when different parts or jobs are finished is better, so we can start working on those parts earlier. We can also see which discipline that are working on which parts.

This quote from an operator shows that a successful implementation of a common information sharing space can affect the operators as well. The problem here is still that the development of this enabler is insufficient without the development of the necessary capabilities. Without the continuous learning from the operators and the commitment from the foremen to learn new solutions there will be an under-development that ultimately leads to a continuation of sub-optimal planning processes.

However, integrated planning is not the main issue at the moment, neither for operators nor the organization. The results have showed that this concept is not integral for the implementation of new solutions, but rather the optimization of usage and work flows.

4.2.2 Active versus inactive users

This subsection will investigate the user numbers further by looking at individual user number trends and behaviors. But first we should attempt to define an active user. Figure 4.1 and Figure 4.2 show that we need more data to define users and usage, as the user numbers can be inaccurate. A WeBuild user does not necessarily mean an active WeBuild user. Figure 4.5 shows how many days each WeBuild user have loaded at least one screen in the application. The time period for the data collection was December 1 2022 to February 8 2023. Removing weekends and holidays leaves 49 working days.

A digitization engineer defined an active user as a "user who report progress repeatedly". Progress reporting is the primary goal with WeBuild and how the value of the application will be measured. However, this can be challenging to measure in an accurate manner, due to the dynamic ways teams work. An operator can be an "active" WeBuild user without reporting any progress by working in a team with a shared progress reporting routine.

The coordinator sometimes joins in on different team meetings to have a short, more intimate tutorial of the application, which seem to have given some results. However, there are about 20% of the users who have only utilized the application once. This can be explained with these tutorials given. Operators can have tried it during these tutorials, and then decided that they would rather continue with the old methods. But this count as an user and is decreasing the accuracy of the user numbers.

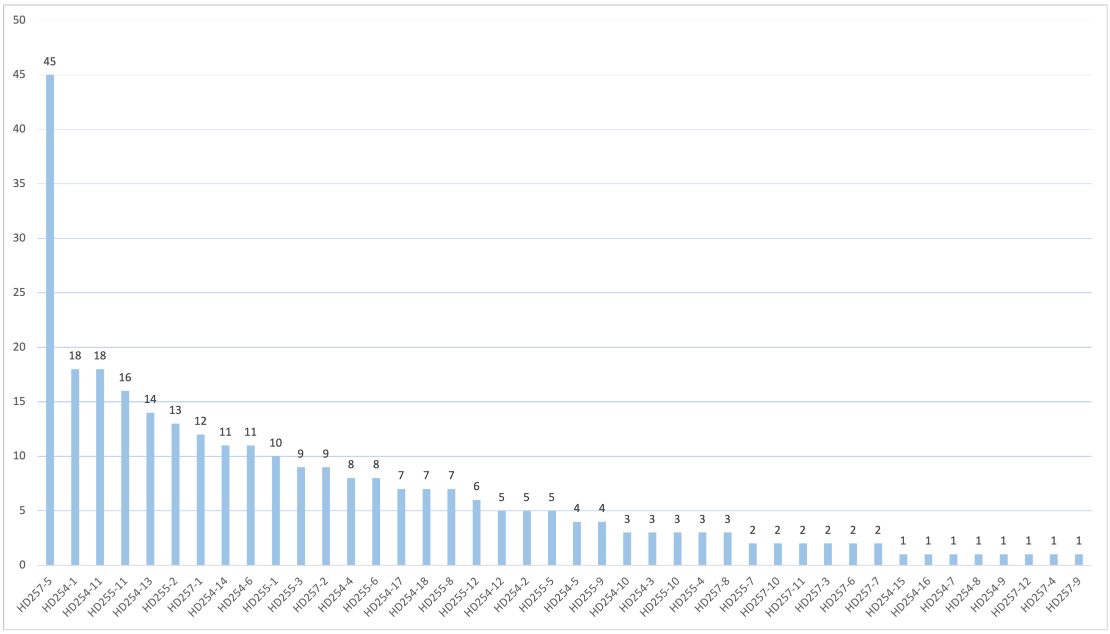

Figure 4.5: Number of days each operator have used WeBuild

The operators who have used the application only once, will not be counted as active users. Neither will operators with only two or three days, as three days only equal a 6% use. Together these variables account for 45% of the total WeBuild users, meaning that almost 50% of operators who have tried WeBuild have not stayed on as an active user. There can also be cases where operators have started using it, before being relocated to another project or overlaps between the periods of data collection. Therefore, every user from four days an upwards will be an active user in this thesis.

These numbers indicate that WeBuild has a low end user retention rate. A retention rate describes the percentage of end users who have continued to use the application after their first time (UserPilot 2022). The retention rate for WeBuild is currently on 54%, indicating that there are deficiencies that are preventing the users from integrating the application as a daily tool.

Characterizations of active users

With a definition of active users, we can look at how the behaviors of active users in contrast to less active users, by looking at articulation work trends. Articulation work is a central topic of this thesis, because the social work that operators perform to enable the primary work is important to understand when implementing new digital tools. Particularly in an environment undergoing a reorganization or a digital transformation where processes are changing. It is how operators connect different primary work tasks and how they handle errors in a system. To be able to take advantage of a resource like WeBuild, an understanding of how the operators adapt to new work processes, new ways to share information and new systems are needed. The manner in which operators handle errors and misfits in systems that are part of new work processes influences the user numbers.

To obtain a better comprehension of the WeBuild usage and its users, it was valuable to gain insight into what operators, especially the active WeBuild users, do when WeBuild does not work properly or is non-responsive. This type of articulation work can provide information on how the operators are adapting to the new system and work processes, further giving a better comprehension on how to take advantage of new resources. Operators were asked *What do you do when WeBuild does not work properly?* This question is directly related to Table 2.1, which shows the different types of articulation work created by Gasser (1986). How the operators react when a new system does not work will provide information about their attitude towards the change and how difficult the reorganization and transformation can be.

The answers varied according to their usage, which was expected. The daily users were more accepting towards WeBuild's shortcomings, indicating that they would rather wait for the application to load its screens and documents rather than put it aside, whereas other users were quick to grab the paper copy of the work order and continue with their old ways of working.

This shows that a major difference between the more eager users and the more sceptical operators seem to be the articulation work they execute when there are deficiencies in WeBuild as the resource. The eager users tend to have a *fitting* articulation approach - when misfits happen, they communicate with the coordinator. In these conversations, operators will explain the misfits, errors or other issues keeping them from utilizing the resource properly. The articulation work these operators execute are critical for the further development of WeBuild and other new solutions. Their contributions to improving the resource by reducing its misfits will also keep other users from experiencing these misfits, which can result in more users.

On the other hand, the more sceptical operators tend to have more of a *working around* approach. This is not necessarily a negative foundation to have. It gives the operators flexibility in their work flows, as they can utilize a combination of resources. When facing issues with WeBuild, some operators opted to go back to the analog work approach by using the paper work order. Hepsø (2006, p. 7) described this approach as an "ad hoc strategy to solve immediate and urgent problems". The immediate task will be solved by using the paper work order, however it does not solve the long-term issues of misfits in the resources. This strategy is necessary for the operators as their tasks are part of a task chain where other operators are executing tasks in the same task chain, meaning that tasks may be time critical.

The problems regarding usage arise when sceptical or on-the-fence operators try to use WeBuild and face misfits. When they work around the misfits, chances are that they do not return to WeBuild as they see the misfits as too disrupting to their primary work.

> Coordinator: I can guarantee that if an error occur operators will put WeBuild away, go get their paper work order and forget about doing anything with the error. It is stopping the improvements of the application when no one tells us about the errors happening. It is only the most eager users who report to us regularly and when errors occur, even though the errors generally affect everyone.

This quote by the coordinator is part of the explanation for the low active user retention rate. WeBuild users have experienced frequent errors with the application during the implementation process. If an operator experiences an error on the first try of WeBuild, it decreases the chances of that operator becoming an active user, as the way back to the old work process is short.

> Operator: I think there will take quite some time before the manual work orders disappear completely and we are all digital. People are too used to their own systems and processes.

Working around issues is also used by the active users. All the operators said that they still carry their paper work order around, either as an addition to the application or as a safety in case WeBuild is unresponsive. And even though the operators find WeBuild useful for drawings, the bigger dimensions of an A3 sheet gives a better overview. This approach is necessary for the time being, and also natural given that the workers are in a transition period to a digital era.

According to the coordinator, the issues some disciplines face regarding progress reporting can be solved by foremen. They have the possibility to change the way progress is being reported in WeBuild manually in MIPS. However, this involves extra articulation work in terms of augmenting, as they have to perform extra tasks to make up for errors.

All operators, regardless of usage, agreed on WeBuild being too slow. Whether it was downloading a drawing or reporting progress, it is slower than what one can expect. This slowness is also keeping operators from utilizing the application, as it takes anything from 10 seconds to a minute to report progress on an object. This slowness will be regarded as a misfit or an error in this setting. When asked about this misfit, the answers varied. The eager users expressed that they could do nothing but wait for it to finish loading, whereas the on-and-off operators said that after a while often opted for the work around strategy by going back to the analog approach.

> Operator: WeBuild is far too slow, for both downloading material and reporting progress. And you have to report object by object when reporting progress, and the application gets slower and slower for each object. I think more people would use it if it was faster, because they are giving up because of it.

Sceptical operators who experience a slow application or errors to key features when trying it have a higher possibility to work around it by returning to the old systems. An active user is characterized by the willingness to use WeBuild, performing extra work to make up for the errors and ultimately improving the application.

4.2.3 WeBuild Use Cases

This section will present the user data in terms of screen logs, looking at the most used functionality in WeBuild. This will be used to analyse what the operators are using the application for.

AKSO want to increase productivity and efficiency by digitizing the distribution of work orders, communication and progress reporting. For this to succeed, it is critical that 1) operators are utilizing WeBuild, and 2) they are taking advantage of the functionality that help increase productivity. AKSO primarily wants the operators to use WeBuild for two actions - report progress and retrieve their work orders. These two actions are the integral functions in WeBuild for their long-term goal of increasing efficiency.

Figure 4.6 shows the number of times each screen were loaded in the data collection period for the disciplines HD254, HD255 and HD257. There were a total of 5714 screens loaded in the time period, and 43 different screens. There were 13 screens that were loaded over 100 times, see Figure 4.7. On the other hand, there were 11 screens that were loaded less than 10 times.

The three most loaded screens stand out. They are *HomeViewModel*, *ObjectViewModel* and *WorkOrderViewModel*, see Figure 4.7. Besides the Home view, which is the landing page when opening the application, the most used screen is the *ObjectViewModel* which contains the details of each object.

- **HomeViewModel**: The screen accessed when opening the application. All information to manage Work Orders and collaboration with the team can be accessed here.

- **ObjectViewModel**: The screen for object details contains all information needed to work on an object, where operators can access Work Items, Documents, Attachments and notes. The object details screen contains all tasks required to complete an object. It is also possible to put objects on hold and report progress. This is done by navigating to the report button, where the user can report progress on each task individually. The overall progress for the object is then calculated and visualized.

- **WorkOrderViewModel**: The screen where all information related to a Work Order is found. It contains high level details, engineering notes, assigned operators, materials, orders and object list. The object list contains all objects related to a work order, and you access the *ObjectViewModel* by selecting an object from that list.

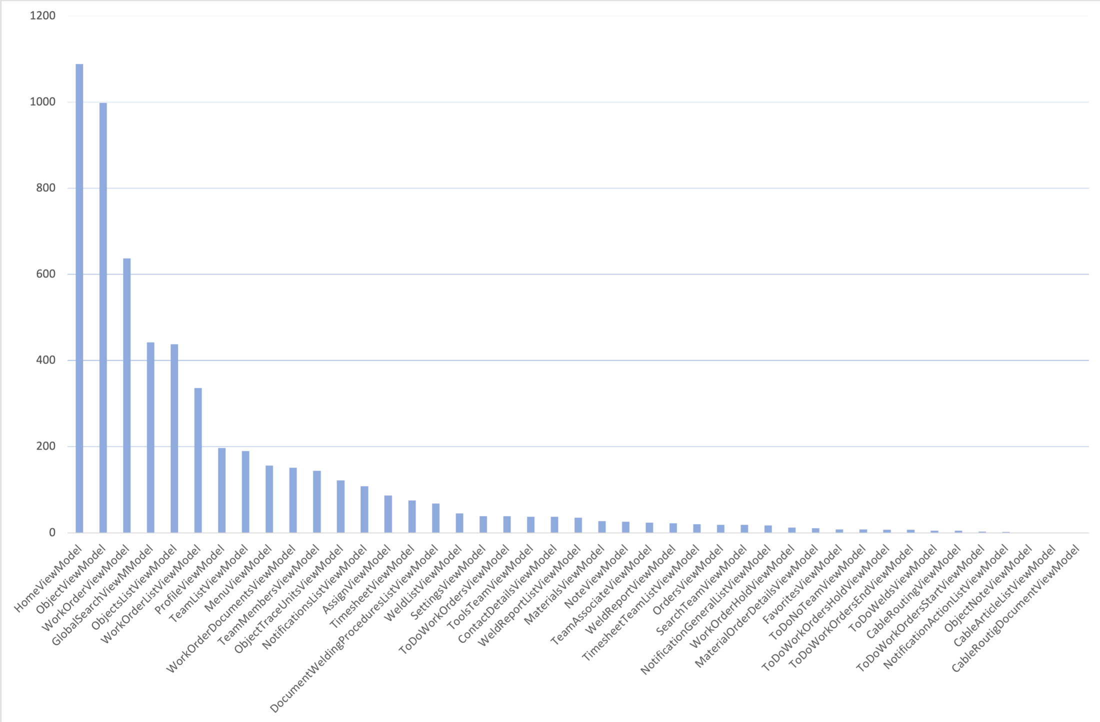

Figure 4.6: All loaded screens

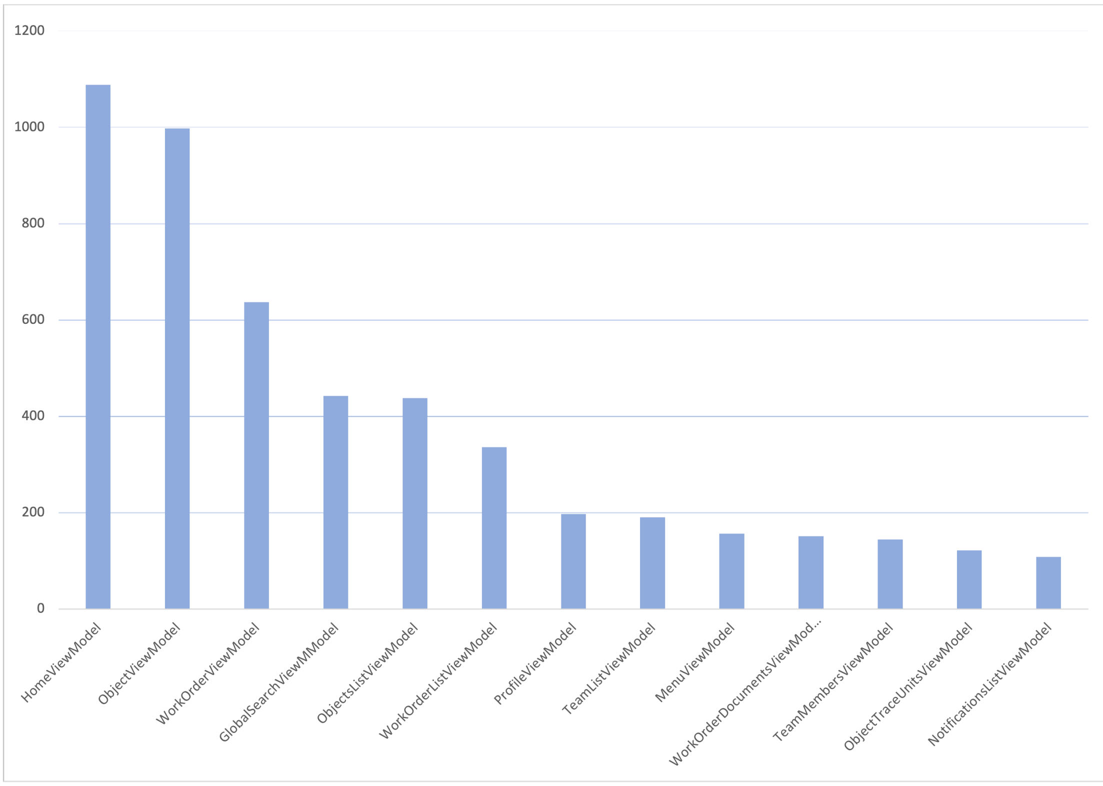

Figure 4.7: Screens that have been loaded over 100 times

Together these three screens account for 47% of the total screens loaded in WeBuild in the given time period. However, these screens contains multiple functions each requiring queries that are not detectable using the chosen data collection method. A qualitative research is necessary to obtain a more comprehensive understanding of why the operators are using these screens. For instance, the object details screen contains both documents like drawings and manuals, and functionality for reporting progress. These are two separate operations that are both crucial when measuring productivity increase. Digitizing the work order, drawings and manuals does not only help save paper, but will increase the productivity and efficiency when it is possible to download it directly. Digitizing the progress reporting by utilizing real time data will improve the shared situational awareness and efficiency by letting team members and foremen know when objects are done in real-time.

> Digitalization engineer: We want operators to retrieve work orders and report progress. The goal is for all progress to be reported in WeBuild, as this is the primary time saver.

The primary objective of WeBuild is that all progress should be reported through WeBuild. This is where the most hours are saved, meaning increased value. And although no exact number on progress reporting is shown in this thesis, Figure 4.7 shows that ObjectViewModel, which is the screen where progress is reported, is the most used screen besides the home screen. Further, operators who use it on a daily basis said that they are reporting progress on WeBuild and that it is faster to report it there. The coordinator that was shadowed during the observations highlighted how much time that could be saved by reporting progress.

However, there are issues in WeBuild that are preventing operators in some disciplines from reporting progress. The issues are due to a standardization of how to report the progress. There are different ways to report - either by hours worked on an object or what percentage of the object is finished. Sometimes it is possible to report hours used, but not that the object is finished. It is the same process even though disciplines have different ways to report progress. Operators call it "annoying and frustrating", as they would like to report it themselves. These issues have led to some operators not reporting progress as it is not possible to do it in WeBuild. This issue varies among the disciplines and will be analysed further in the next section.

Functionality that is used more than the progress reporting is downloading drawings and other material. In fact, every user interviewed answered that they use WeBuild to look at drawings. Drawings and other material that can be downloaded are also found on the ObjectViewModel screen. Although the drawings are smaller than an A3-paper sheet, the zooming functionality allows for a greater detailed view, which is appreciated. This functionality is also a time saver on a personal level for the operators, as they decrease the time walking to and from stations to retrieve the paper sheets or printing new work orders.

These two elements, progress reporting and work order retrievals, are the two most, and almost only, used functions in WeBuild. The application offer more functionality, however this does not seem to be used by the operators. In some cases it is even making the application more confusing as these operators explained:

> Operator: I only need the work order, hours needed and to be able to report progress. There is a lot of excess information that I do not need, which only make the application more confusing. So the application should be more streamlined for the end users to fit our actual needs. I think in some instances it is also preventing operators from using it, as the application has so much information that it can seem too hard to learn it. So they just avoid using it instead.
>
> Operator: The overview is there if you want it, but it is often unnecessary. It is so much information, so that the application is more adapted to the foremen than operators.

It was showed in Figure 4.6 and 4.7 that almost 50% of the screens loaded were *HomeViewModel*, *ObjectViewModel* and *WorkOrderViewModel*. In other words, 50% of the usage were to retrieve work orders, look at objects or report progress, as the field research confirmed as well. Thus, the 40 remaining screens also account for 50%. This supports the operator's opinion that there are excess information and features which are not contributing to the increased usage. Operators are using the features that streamline their primary work and optimizing their tasks chain. The operator also emphasizes another important issue: Too many features in the application and no training can look like an unbalance between the development of the technology and people dimensions in the capability platform, where too much pressure were put on developing an application with all functionality necessary, neglecting the people perspective.

4.2.4 Difference between disciplines

The results so far have been general for the three disciplines in the scope. The following section will investigate each discipline further, to understand the usage and what the different disciplines are utilizing the application for. Useful information will be active users, number of days used per operators and what screens the disciplines are loading.

The field research indicated a partly huge difference between the three disciplines. A reason for this is the standardized way WeBuild is built. HD257 is the highest-using discipline. During the interviews it was made clear that it is the discipline that has experienced the least misfits and it covers all their needs. However, this is not the case for all disciplines. Both HD254 and HD255 operators experience issues related to progress reporting, preventing them for using WeBuild for that and in some cases stopping them from using it altogether. This has affected both the user numbers and the screens used for each discipline.

The amount of articulation work performed also seem to depend on the discipline. In addition to varying errors depending on the discipline, some disciplines usually work alone within the team, while others work in pairs. Some teams also have super-users and operators with high competence in WeBuild. These elements all affect the articulation work operators have to perform, ultimately affecting their stance on WeBuild as a useful resource.

HD254

HD254 has the highest number of WeBuild users according to the numerical data, see Figure 4.1 and Figure 4.3. With 18 HD254 operators, 64% have tried WeBuild at lest one day. Further, Figure 4.8 shows how many days each "active" WeBuild user utilized the application for. Five HD254 operators only logged into the application once, equalling 28% of the users. This gives a user retention rate of 61%.

Figures 4.9 shows the 13 top loaded screens for HD254 operators. The three most loaded screens are the same as the overall most loaded screens for the three disciplines, see Figure 4.7. HD254 experience issues concerning the progress reporting to the standardized set-up of the functionality. Further, HD254 operators often work alone, which can explain why they have the highest distinct user numbers.

> HD254 operator: Progress reporting rarely works for us, which is not ideal. Because there is more focus on progress at Castberg than other projects and prefabrication, since they want to see that the project is moving forwards. And it is always faster to report progress ourselves, it just does not always work properly.

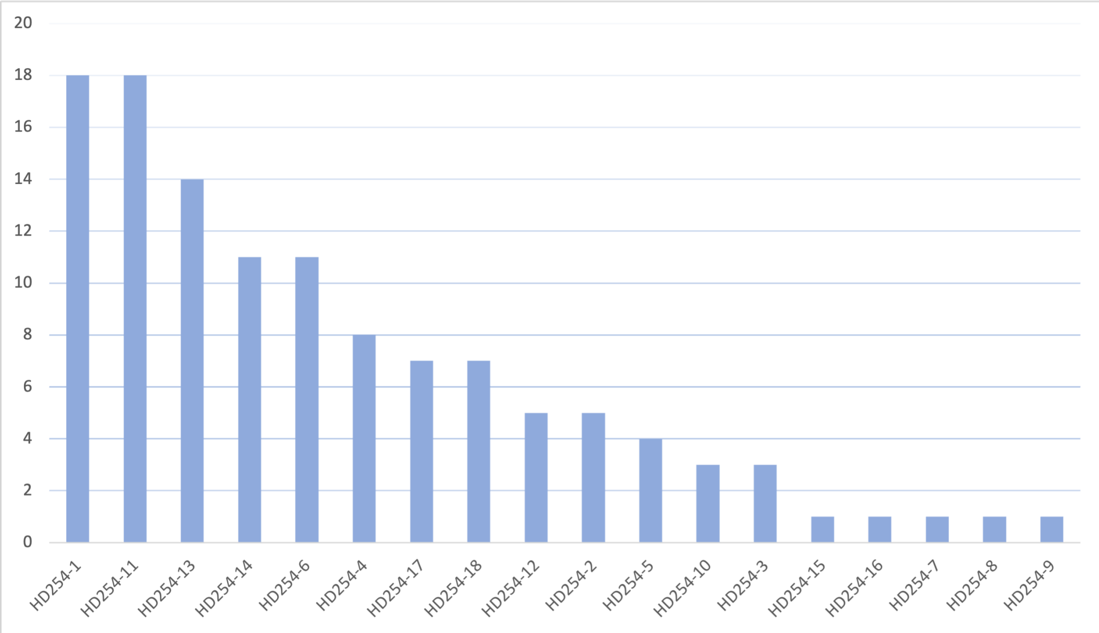

Figure 4.8: Number of days HD254 operators have used WeBuild

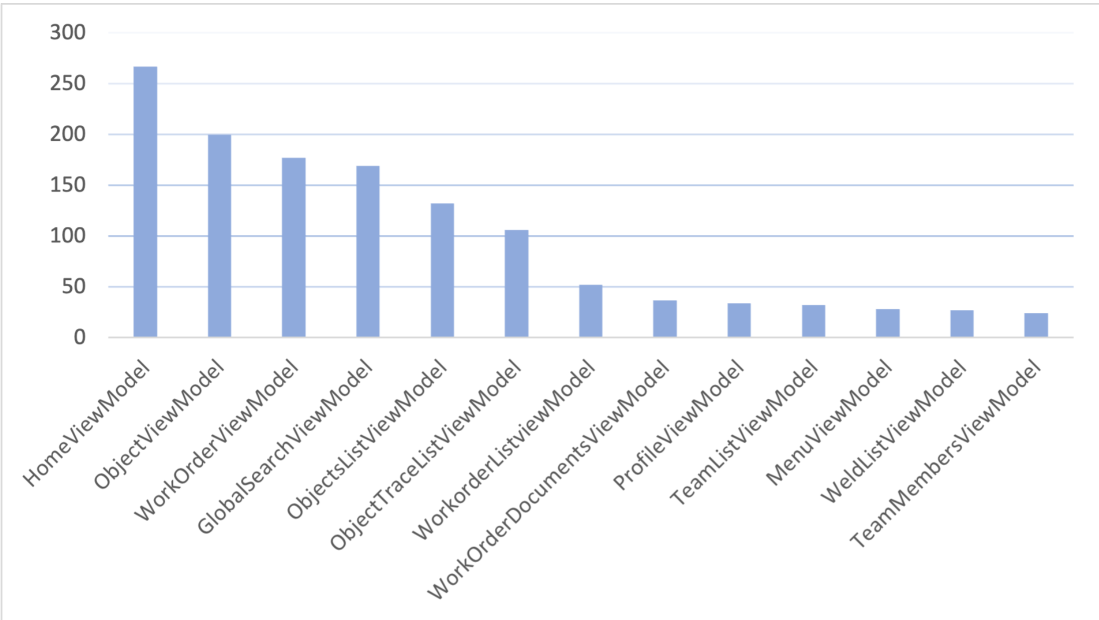

Figure 4.9: The most used screens used by HD254 operators

HD255

HD255 have just above 50% WeBuild users, see Figure 4.1. Further, the discipline has an user retention rate of 75%, which is the highest of the analysed disciplines. It is a stable user group with a relatively high retention rate.

The difference in user retention rate between HD255 and other disciplines can be explained in their work approach. Where some disciplines often work in pairs, HD255 personnel work alone. Resulting in situations where they cannot depend on other operators to look something up on WeBuild or report progress together.

Figure 4.11 shows the 13 most loaded screens by operators in the HD255 department. The interesting thing here is the relatively low use of *OjectViewModel*, the second most loaded screen overall. Instead, the operators are spending more time on the work order view.

The reasons for this were discovered during conversations with operators. The progress reporting functionality is not working for HD255 operators. As the progress reporting is standardized in WeBuild, it requires foremen to change it manually in MIPS. And foremen have turned out to be more sceptical to WeBuild than operators. The threshold for using WeBuild is higher when the foremen are sceptical, as it requires more work. Instead, they are continuing to report progress through their foreman. The HD255 operators are positive to the progress reporting, insisting that they would utilize it if it was functioning. Because they are using it for weld reporting, which is functioning. This misfit have slowed down the implementation of WeBuild, which is preventing benefits such as the foremen being more present out in the field.

The majority of the operators interviewed said they were using WeBuild for retrieving work orders, reflected in Figure 4.11. Having the possibility to always have the work order with you and be able to look up anything when needed is a great tool according to this operator:

> HD255 operator: I save a lot of time by being able to search for a work order instead of going inside and printing it out, so it is a great tool for time- and paper saving. I can also see the different tools my team and I possess. But I do not see the foreman more often, since progress is not working optimally. I would use it if it did, but overall it is already saving us some time since we can retrieve the work orders on our phone.

With work order retrieval already saving the operators time, the possible benefits are clear if the progress reporting issues are addressed. And since HD255 already have a high retention rate, fixing errors can ensure the operators are utilizing it more for their daily work.

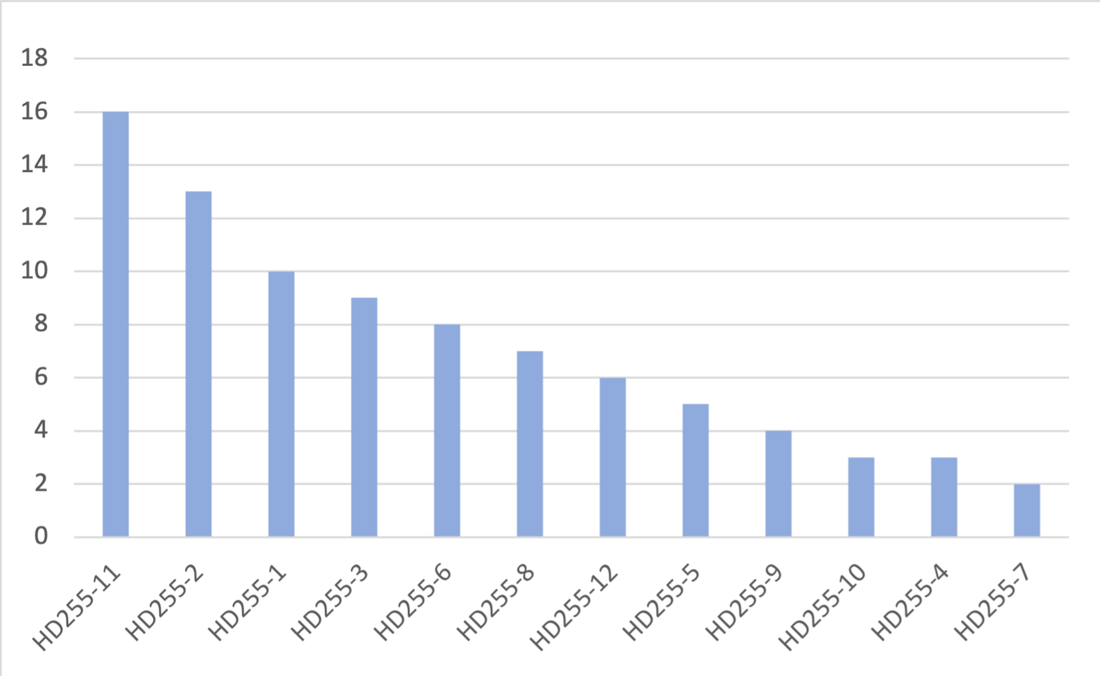

Figure 4.10: Number of days HD255 operators have used WeBuild

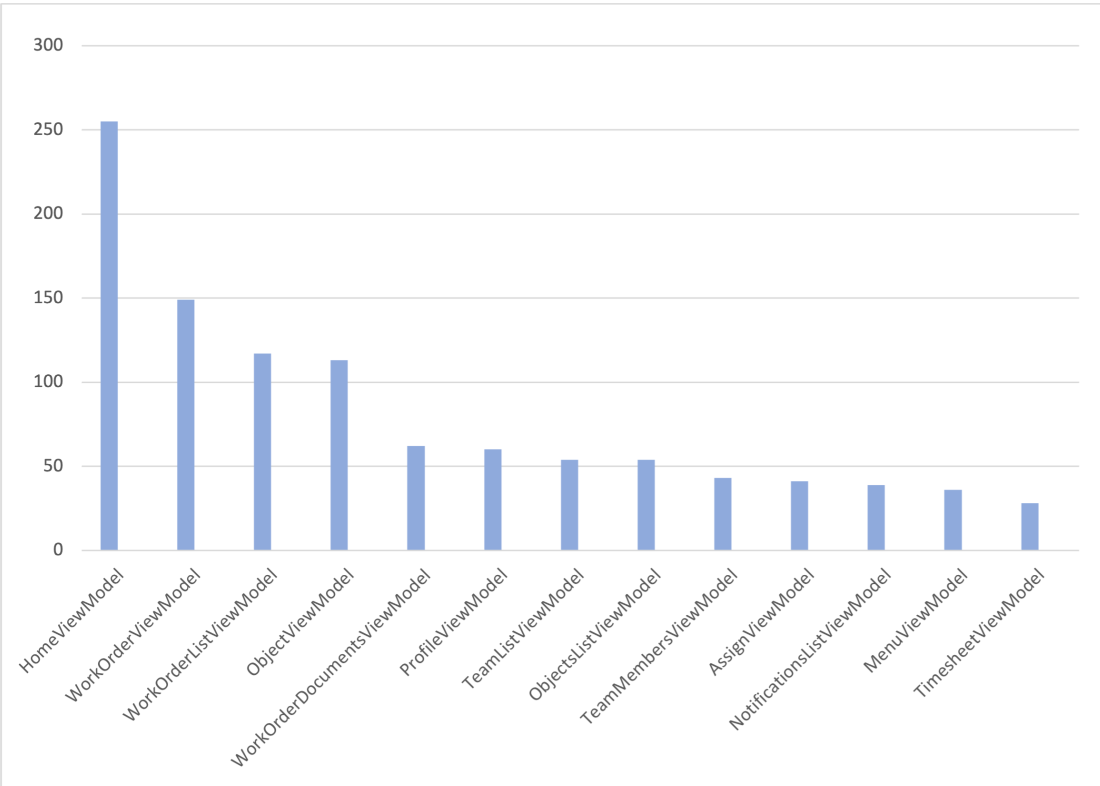

Figure 4.11: The most used screens used by HD255 operators

HD257

HD257 is the discipline with the highest usage. This was clear after conversations with operators and analysis of the numerical data. Although the discipline has the lowest percentage of users, they have the highest number of screens loaded per user, see Figure 4.2. This can be explained by how the HD257 operators work. They often work in smaller groups within their team, typically in pairs. When they finish their jobs, only one has to report progress. This is typically done by the most eager or experienced WeBuild user, acting as a leader in a shared leadership environment.

Figure 4.12 displays this case. With a user retention rate of only 25%, it looks like the user numbers are very low. But with the highest average number of loaded screens and a few very active users, this is a case of shared leadership where some operators are taking charge for the whole team. This shows that there may not be a need for every operator to use WeBuild. The WeBuild users can report progress for the sceptical operators as well, especially in disciplines where one or two operator can report progress for the whole team.

The HD257 operators, in contrast to the other disciplines, use WeBuild for more or less all their daily work. This is because they experience few misfits other than slowness when loading screens and reporting progress. Hence, the extra articulation work decrease and they can focus more on the primary work. They also have time to perform more primary work, as they always have access to the work order and drawings on their phone, reducing walking distances.

Figure 4.13 illustrates these points. *ObjectViewModel* has almost three times as many loaded screens as the next screens, which are *HomeViewModel* and *GlobalSearchViewModel*. This indicates that the critical functions in the application work. It also indicates a high level of competence among the operators. They are skilled in the use of the application, meaning that they do not waste time on unnecessary screens.

HD257 illustrates many of the benefits WeBuild can have if implemented properly. The skilled operators see benefits such as personal time saved, an improved shared situational awareness and more on-field time with their foreman. They have still been dependent on eager users who have taken charge to learn the application. This type of shared leadership have created an environment where they could develop skills by learning from each other.

> HD257 Operator: We are mostly self-taught, as one of the team members was a super-user. So we asked him when we had any questions or things did not work. It requires that someone takes charge and has a will to learn it, which is not the case in every team. It makes it much harder when you just get handed an application with no further introduction. You have to be

interested to learn it, or else it will be very challenging.

The quote describes the benefits of having super-users in a team when there has been no formal training sessions. But it also shows the disadvantages if there are no super-users present and no one to take charge of implementing the application in a team.

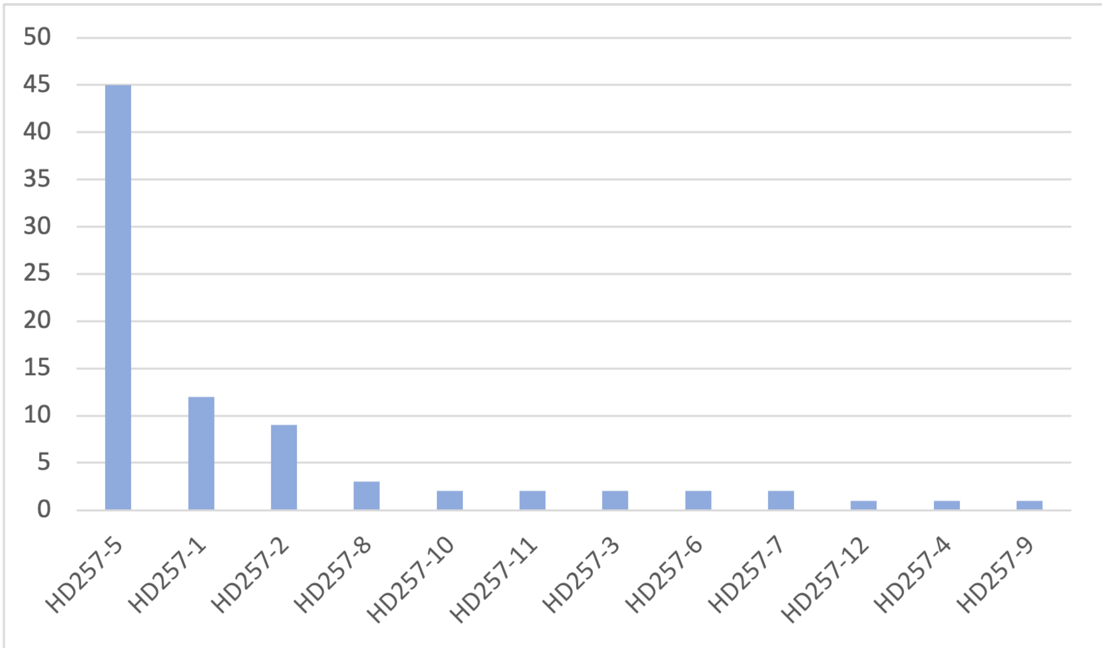

Figure 4.12: Number of days HD257 operators have used WeBuild

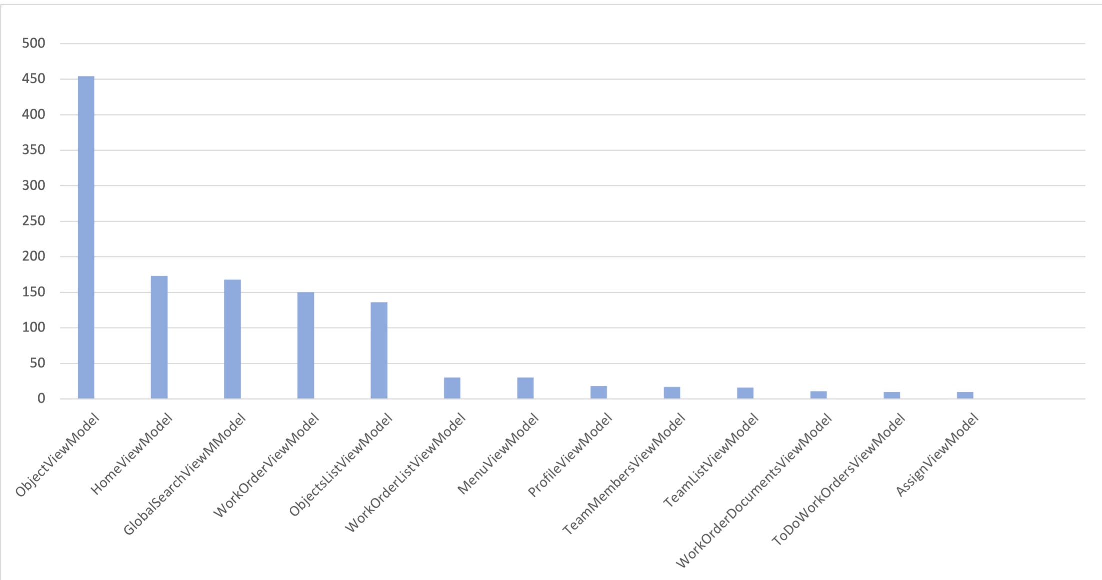

Figure 4.13: The most used screens used by HD257 operators

This chapter will end with a summation of the results presented in this chapter. The actual user numbers as presented here are less than desired at this stage of the implementation, and the personnel interviewed and observed pointed at several factors influencing this. First, no organized training of the new applications makes it more challenging to successfully implement new solutions, as the people-dimension in this information ecology becomes under-developed. Secondly, errors to critical functions such as progress reporting are frustrating for the operators, forcing them to use the old ways of working and spending more time on different types of articulation work. This includes the slowness of the application, a recurring topic of irritation for the operators. And lastly, getting the foremen to use it is essential for the further implementation, as they need to distribute the work orders in order for operators to report progress on it. They also influence their operators on how they should work. These findings all influence both the general user numbers and the user retention rate. The next chapter will discuss these findings more thoroughly and suggest measurements that can help the improvement of the implementation by addressing these.

Chapter 5

Discussion

This chapter is divided into four sections. The first section will provide more details concerning the reasons as to why key performance indicators are necessary here and what types of KPIs that are relevant. The two next sections will discuss the findings from Chapter 4 in light of the theory covered in Chapter 2, focusing on integrated operations and articulation work. Then relevant KPIs will developed and recommended. The last section will discuss further work, with an emphasis on developing the next generation of KPIs, focusing on optimizing the process.

5.1 Developing Key Performance Indicators

The development of new key performance indicators that measure actual value is demanding (Badawy et al. 2016). With a wide and complex user group, it is challenging to develop KPIs that fit every aspect. Because different age groups and disciplines all face separate issues related to WeBuild and the usage.

WeBuild is one of several new digital applications that Aker Solutions are launching as part of ther yards' digitization process. For management to gain knowledge about the actual usage of the applications, they need measurements to extract the true value. The scope will be related to usage-KPIs rather than productivity-KPIs, as usage-KPIs are more relevant at this stage of the implementation, see Figure 5.1. To be able to do this, Aker Solutions need to understand how the applications, in this case WeBuild, are utilized and why they are struggling with the implementation.

The usage-KPIs will tell more about what is working with the application, what is not working and how the implementation is going. This will also indicate whether the company should take action and implement measures. Although the scope of the thesis is WeBuild and the Johan Castberg project, the KPIs will be generalized so the organization can use them for the other new solutions that will be implemented.

Aker Solutions' motivation for developing these KPI's is the value that successful implementations of the new digital tools offer. An ETO (Engineer-To-Order) organization is often measured on the quality of product and time of delivery. And applications like WeBuild that utilize technology with real-time data often offer huge time savings. This is first and foremost a result of the live progress reporting functionality that can update the work progress live such that other teams or disciplines can start working right away instead of waiting several days. This downtime reduction can save up to several weeks if progress reporting is optimized. Further, by having everything needed on the phone, operators can save personal time by looking up live information on their phones instantly. Consequently having time to finish up more tasks.

The key performance indicators will follow the guidelines of the SMART framework, presented in Table 2.2. In an environment like that at Stord with rapid changes to teams and relocation of staff, being accurate with the data is challenging. A large and complex user group consisting of a large age variation width and different challenges for different disciplines create more challenges. Thus, creating standardized KPIs can be inaccurate as numerical data seldom provides a thorough image of the operations. Developing qualitative KPIs can be a solution in order to cope with these possible insecurities, as they provide more extensive feedback on end-users' opinions. Qualitative KPIs also offer the possibility to separate between different user group, which is necessary when handling a big and complex user group.

The KPIs will be designed as leading KPIs. In other words, they will be developed to assess and predict future events. They are KPIs that suggest measures to improve the implementation by assessing the lagging indicators of past performance. The leading indicators can also be qualitative in that they are not measured by numerical value, but rather values of prediction of future implementation success and measures to meet this success.

The time period or period of implementation varies with the KPIs. However, the KPIs are not directly related to the Castberg project. They are being created based on the analysis of the implementation of Castberg, and this analysis will be used in the future projects and digital solutions. Therefore, the time periods are based on the start time of a project.

AKSO need systems to ensure the measurement of the KPIs. The KPIs will be measured differently, but the systems should have a common ground. This will relate to the time periods for measuring and any consequences that follows. For instance, the KPIs should be measured for the first time a few months after implementation or after starting a new project. After this they should be measured on a regular basis, for example two or three times a year. If the KPIs yield insufficient results or show negative trends, additional measures may be necessary. Some measures will be discussed in the following sections.

On the other hand, if the KPIs are not measured on a regular basis, the organization will struggle to see improvements in the implementation. Because without the KPIs, it will be more challenging to determine exactly what measures are necessary and why the implementation and usage are struggling.

5.2 Integrated operations

Integrated operations and articulation work were used as a theory basis for this thesis, and were the foundation for the research and interviews. These topics will be the foundation for the development of the key performance indicators.

The capability platform is an essential part of this thesis, as it describes IO through capabilities by showing how different actors work together in an information ecology to develop new capabilities. The capability platform is made up by the four dimensions *Technology, People, Process* and *Governance*, see Figure 2.3. To develop capabilities and increase growth, each dimension is dependent on the other dimensions to develop as well - the dimensions are integrated and through iterations of development organizations can ensure growth. Another important aspect of IO is leadership, and how leadership teams react to change. How foremen operate and react to change influence their operators.

Figure 5.1 illustrates the implementation timeline of Webuild. We are here neglecting a step 0, developing the application, since this is outside the scope. So there are three steps, learn application, use application and optimize usage of the application.

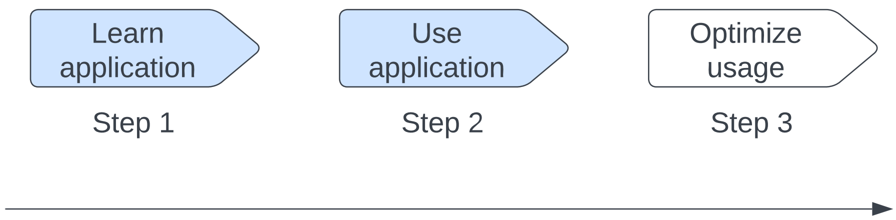

Figure 5.1: Implementation timeline 1

Each of the four dimensions is equally important for the development of capabilities, nevertheless the focus in this thesis is the technology and people dimensions. Technology is often the basis for development, because new technology require the other dimensions to develop as well to see change. During the implementation period, organizations go through different phases, see Figure 5.1. Operators will have to learn the application before using it. This has to be fulfilled before organizations can start optimizing the usage.

While step 1 and step 2 concern more of the people and technology dimensions, step 3 covers more of the process and governance dimensions with optimizing the usage to increase productivity. This will not be discussed here, as AKSO is now somewhere between step 1 and 2 with WeBuild, working to increase the user numbers.

Capability platform

It is, as often is the case in IO, a new ICT solution that has initiated this capability development. WeBuild uses real-time technology, which is a prerequisite for increasing productivity with new digital solutions in IO. To take advantage of this new solution, every dimension need development. Starting at step 1, end users need to learn the application first. The end users are operators and foremen, and the goal is that they will use it on a daily basis. New skills and competence are resources within the people-dimension that need development (Henderson et al. 2012). However, this need to be facilitated for by the organization. This can be in terms of courses or training with experienced personnel.

Because as described in the results, this is in demand by the end users. Every operator and foreman spoken to during interviews and observations said that there had been no organized training or courses held by the organization, and that every active user where either self-trained or had someone to teach them. This issue was identified as the biggest obstacle in the pursuit of increased user numbers. People will not use an application they do not know how to use.

While this is a people-development issue, it has to start with the governance. Investing in people by giving them training to increase and gain new competence will result in higher user numbers. However, AKSO lack the funding to invest in a comprehensive training program, as per a digitalization employee. When companies have limited resources, the financial balance between technology and funding for training is important (Kamsvåg et al. 2022). And this is a governance issue that is highly relevant for the people and technology, as governance have to balance the funding between the two. Without funding for training, they deprioritize the people-dimension and are relying on the new technology itself to generate value. But as seen in Chapter 2.1.1, this is an undesirable development, as all four dimensions should be present. Regardless, AKSO is aware of this issue and have taken other, low-budget measures to increase training by highlighting super-users and hiring coordinators.

One of the measures AKSO has implemented is hiring the WeBuild coordinator. The suggestion from the coordinator to develop a digital training course in WeBuild that can be mandatory for the operators is a more low-budget solution than having big, time-consuming meetings in person. It is critical that AKSO is aware of the lack of training.

Because this implementation process confirms what Henderson et al. (2012) said - technology cannot enable radical transformation alone, it can only initiate it. The other dimensions People, Process and Governance need to be developed as well. Personnel who lack the necessary skills and competence will not utilize new technology, hence the organization will not see increased value due to increased productivity. To create value by developing new technology, the governance need to balance between developing both the people and technology.

Leadership

With the lack of funding to develop training programs, AKSO has emphasized super-users. This strategy has given results, seen in how teams with super-users seem to have more active users and a more positive attitude towards the application. The super-users are assisting other users with the daily use of WeBuild and teaching the application to their team members.

The issue here is that not every team at Castberg has super-users. These teams tend to have a lower usage, as the threshold for learning it is higher when there is no one nearby to ask if there are questions, as this requires extra articulation work. In the initial phase of learning a new application, having a supervisor or super-user nearby to ask can be a dividing line as to continue to use it or not, as this keeps the articulation work load lower.

As discovered during the field observations, most active WeBuild users are either self-taught or learned from someone who is self-taught. This has resulted in a situation where WeBuild is mostly used team-by-team. In other words, if one team member starts using it, chances are more team members will start soon too. And the other way around where there are teams where no one is using it. This notable difference with super-users emphasises the demand for them.

With AKSO currently lacking the funding for comprehensive training programs, they have emphasised the concept "train the trainer" (Storholmen and Klemets 2020). The concept means that the super-users need to train the regular users in WeBuild. So teams with WeBuild users operate with some degree of shared leadership, where the super-users are passing on knowledge to their team members. Combining this strategy with a digital course can enhance the user numbers considerably. And given that there already are super-users in the field, it should be achievable. According to Storholmen and Klemets (2020), super-users were involved in the development of WeBuild, indicating that they were familiar with the system before it was launched.

For this strategy to work, the super-users need to be properly distributed. Meaning that there is at least one super-user on each team. This will ensure that the knowledge of the super-users are widely spread out so WeBuild reaches as many users as possible.

This will help both operators who have never tried WeBuild and the ones who tried and did not return, hence increasing both the generic user numbers and the user retention rate.

Integrated operations involves primarily leadership teams, as Skarholt, Hansson, et al. (2012) describe it. The foremen at AKSO are influenced by the introduction of the new solutions, and the WeBuild users see the benefits of it. Increased shared situational awareness and up-to-date live data available at all times are the two perhaps most important benefits. The increased shared situational awareness has primarily come from two segments - less administrative work and the features in WeBuild. The amount of administrative work decrease when operators have gotten the responsibility for reporting progress. With that time freed up, the goal is that foremen spend more time out in the field. This will increase the operational safety as foremen tend to be more aware of this, and the shared situational awareness within the operational environment. This make them better prepared with decision-making and problem solving in the field. The application also offers an improved situational awareness. The application makes it easy for foremen to obtain an overview due to all the functionality and information offered.

However, the errors regarding progress reporting need to be fixed in order to take advantage of these new benefits. The results found that the only teams that see their foreman more are the teams that use WeBuild actively to report progress. The foremen tend to be more sceptical to WeBuild, as it requires a change to a familiar system they have used for a long time. AKSO needs to facilitate for the foremen in order to see the full effects of the implementation.

5.3 Articulation work

WeBuild requires a reorganization of the work operators have to do, called articulation work. How they perform this work and how they combine this with the primary work is critical to understand when developing new work practices enabled by ICT solutions (Hepsø 2006). In the last chapter it was found that there are mainly two types of articulation work that operators perform when using WeBuild, *Fitting* and *Working around.* These are strategies the operators use to cope with the misfits of WeBuild, and are critical for the execution of the primary work and where there are misalignment between the primary work and the resource.

Fitting is mostly used by the permanent, active users. This activity involves operators negotiating and discussing the misfits with the developers or coordinators in order to solve or upgrade the misfits (Hepsø 2006). The active users are usually the more positive and eager, hence they will rather report and try to fix misfits rather than working around it. It was also discovered that operators struggle with many errors and misfits in WeBuild, with functions such as progress reporting not working for some disciplines.

When this happen, it is invaluable with users performing this fitting articulation work in order to improve the application. Eliminating errors will lead to less articulation work in the future, which decrease the obstacles for new users trying WeBuild.

Working around is the articulation work that is executed the most, as it is used by both the active users and on-and-off users. This ad-hoc strategy will solve the immediate primary work, as Hepsø (2006, p. 7) describes it: "It means intentionally using computing in ways for which it was not designed or avoiding its use and relying on an alternative means for accomplishing work". In these cases, avoiding its use and relying on other means is the relevant segment. The other means here being the manual work orders.

Because, as Kamsvåg et al. (2022) found in their analysis, digitization and a change of habits take time. Especially when changing work practises operators have been used to for decades. "In a transition phase from an analog to a digital procedure, it may be appropriate to allow for a coexistence between new and old tools/routines" (Kamsvåg et al. 2022, p. 107). In other words, allowing operators to work around obstacles faced using WeBuild can lead to a smoother transition to becoming independent from the analog work orders. However, operators should still report the obstacles they face and errors leading to taking this approach.

The resistance to report errors is preventing improvements of WeBuild, see Chapter 4.2.2. Hence, WeBuild depends on operators who perform this extra work in terms of fitting to reduce the articulation work for the sceptical users. This will increase the chance of new and sceptical users to seamlessly integrate new digital solutions into their work routines.

The reorganization of the operational environment in terms of new work processes and responsibilities has not affected the operators to any great extent. They did not report of any delays in their work processes, and expressed that they even save time with their new responsibilities of reporting progress. This has resulted in more time to execute primary work, which makes both the individual operators and the overall operation more productive.

5.4 Key performance indicator recommendations

The KPIs recommended are generalized, and will first be discussed in light of the results and discussion. The KPIs will then also be exemplified as SMART KPIs to visualize how the organization can utilize them.

5.4.1 KPI 1: Training attendance rate

The lack of courses and fundamental training in new digital tools for the operators and foremen seem to be the biggest obstacle that is preventing the majority of operators from using them. This, combined with AKSO not pushing on their employees to use the new tools have resulted in low user numbers. With the technology finished, there need to be more focus on the people-dimension to develop new capabilities.

AKSO is aware of this issue and have addressed this by hiring a WeBuild coordinator whose job is to be a connection between the end-users and management and developers, trying to increase the user numbers by being present in the field and assisting operators. Operators can ask the coordinator for help, report errors and get short tutorials. The coordinator reported an increase in usage by being present in the field and reminding operators to use it, see Figure 4.3. This initiative are making more people aware of the application and is a testament that AKSO is aware of the need for developing their employees as well.

The need for development requires more measures. All interviewees called for organized training and said that this would help increase the user numbers. Because having training sessions for operators and focusing on them is crucial to develop the people-dimension. This increases resources such as skills and competence within the new digital tools. However, the initiative for this need to come from the organization. Having training sessions and courses will require planning, resources and financing.

But as discussed, AKSO lacks the funding to implement comprehensive training programs. This means that they need to rely on more low-budget solutions such as digital tutorials and courses as proposed by the coordinator, see Chapter 4.1. A digital course, similar to the safety courses operators have to complete, that provide a simple tutorial in the application could make more operators aware of the benefits of utilizing it. Further, from a management point of view, it should be easy to track, thus easy to track both the KPI and who has completed the training.

Whether AKSO funds a comprehensive, in-person training program or develop a digital course, a KPI that measure training attendance and completion rate will be important when tracking the effect of training. The number should be the percentage of operators in the relevant scope that has completed the course. Tracking this on a regular basis will tell whether the courses are yielding the desired results. If they are not, AKSO may need to take further action. For instance, making the courses mandatory for the specified operators.

This KPI can be specified as a SMART KPI, see Table 5.1. This SMART KPI gives the organization a specific KPI to follow. The specifications can be adjusted if they are unreachable or deemed too challenging.

80% of the operators should have completed training in the application within the first two months	
Criterion	**Description**
Specific	The KPI proposed here is specific and should be easy to comprehend for all actors involved.
Measurable	Having digital courses is very possible to measure numerically of all employees who have completed it. It should also be available for the necessary personnel
Achievable	By setting the goal of the indicator at 80% makes it more achievable, because 100% can be challenging unless the courses are mandatory.
Relevant	As proven throughout the thesis, training programs are highly relevant for the further implementation of WeBuild and other digital solutions. Management is aware of this and the users are also calling for it.
Time-bound	This criterion is not specified here, as it depends on the organization and their plans. As WeBuild is being implemented in an ongoing project, it is hard to determine a time frame. But for future projects and applications, it should be a goal to have 80% completion of training programs within the first few months.

Table 5.1: SMART KPI 1

5.4.2 KPI 2: Number of foremen using the application

Integrated operations affect primarily leadership, and how they handle this development also affect operators (Skarholt, Hansson, et al. 2012). The implementation of WeBuild gives foremen a possibility to spend more time out in the field, which will increase the shared situational awareness among foremen, resulting in increased operational safety and productivity (Skarholt, Hansson, et al. 2012).

Operators are dependent on their foreman to use WeBuild, as they have to distribute the work orders for operators to report progress. Therefore, the change of work flow has to start with the foremen. But as we have seen, foremen are more stubborn and resistant to integrate these new applications into their work flows than their operators.

In addition to needing the foremen for the technical aspect of using WeBuild, operators also often listen to their foremen and their suggestions. So if they are not using it and advising against it, this influences their operators. Some foremen do not want the operators to be given more responsibility. This is either an issue of not wanting to change their ways of working or a lack of trust. The lack of trust is mainly related to tasks that were previously done by the foremen. The best example of this is the progress reporting, which many foremen do not trust their operators to execute themselves. However, trusting operators with tasks like progress reporting, planning and prioritizing tasks will yield positive results such as increased empowerment and productivity (Skarholt, Næsje, et al. 2009a).

The other issue of a stubbornness to change the work flows can be a lack of knowledge as they are not aware of the positive outcomes a digitization process can have. This issue is mostly related to foremen who have been there for a long time. The coordinator said that there are some foremen have been here for nearly 20 years and have developed their own systems for reporting and work order distribution. They are reluctant to learn a new system, thus changing their work processes. Because this is not an issue for new foremen. Among the new foremen observed, there were less reluctance to new solutions. This is because they do not have any set routines or systems. And this does not seem to be an unique issue here, as Ramstad et al. (2012) found in their study that some leaders often have strong commitments to already designed work processes, and that this low level influenced the implementation of new work processes.

Some of the problems that occur with the standardization of the progress reporting can also be solved with competent foremen. Because they have the possibility to change the set-up of progress reporting for WeBuild in MIPS, such that it is aligned with how their discipline should report progress. Therefore, developing the foremen into competent WeBuild users could also solve some key technical deficiencies. The articulation work this includes, in terms of augmenting, will decrease as the foremen increase their competence in the application.

Based on the discoveries in this thesis, having foremen as active users of new applications seem to be a catalyst for the usage. This is why the proposed SMART KPI recommend a 100% usage among foremen. This is challenging given the circumstances described, but it is possible if the right measures are taken, such as training or courses for the foremen.

Increase the user number among foremen to 100%	
Criterion	**Description**
Specific	The KPI proposed here is specific and should be easy to comprehend for all actors involved.
Measurable	Measuring foremen who are active users is easier than operators, as each foreman need to use the application themselves. Therefore, through numerical and qualitative data it should be measurable.
Achievable	It has been discussed in this thesis that foremen are the most sceptical users of WeBuild, as changing a work process is a long process. However, with the right measures such as training and follow-ups, it should be possible.
Relevant	Getting the foremen on board is highly relevant for the implementation of new solutions, as they are both role models and in charge of their operators. Hence, increasing foremen user numbers is critical.
Time-bound	This criterion is not specified here, as it depends on the organization and their plans. Increasing the foremen user numbers is challenging, it can require a longer time frame. However, it should be a set goal within a given time, meanwhile it should be measured regularly to see if other measures are needed to increase the foremen user numbers.

Table 5.2: SMART KPI 2

5.4.3 KPI 3: User retention rate

The user retention rate indicates how many operators return as regular users after their first use. The number is relevant for the around 1/3 of permanent operators who have used or tried WeBuild and is a quantitative indicator. This number is more representative than just looking at WeBuild users, because as seen in Figure 4.5, there are roughly 20% of WeBuild users who have used it once, and 45% who have used it for a maximum of three days. This means that the user retention rate is low, as there are few operators who return to WeBuild after trying it. This number will need to increase in order to obtain a stable number of permanent WeBuild users, hence we need to understand how this can be obtained.

To understand the low user retention rate, we need to understand why operators are choosing not to use WeBuild after initially trying it. First is the issue of no organized training. This lack of development of the people dimension in the capability platform leads have resulted in operators lacking key resources such skills and competence of the new solutions. This will ultimately lead to the new applications not being used. Because people will not use tools they do not know how to use. The 45% of operators who have used it for a maximum of three days may not have developed the necessary skills to utilize WeBuild. AKSO have addressed this issue by hiring coordinators whose job is to assist operators with WeBuild, remind them to use it and to be the connection between developers and end-users.

The coordinator has also given short tutorials to teams during their meetings to encourage them to use it. This has given some results, but the majority of operators interviewed still expressed a total lack of training. Operators also discussed how it often is the first obstacle that are preventing the sceptical operators from taking advantage of new technology. The first obstacle can be that they are not finding the application intuitive and not knowing how to use it. If they are in an environment with no one to ask for help, they will probably not use it.

Secondly, the misfits or errors that may happen when initially trying the application. Whether this is trying it for themselves or together with the coordinator, if some critical functionality malfunctions, the chances are low that they will try it again. This case applies in particular to the more sceptical operators, as they would rather use the manual system they know works, than constantly having to work around misfits in a new system they are not as familiar with. They are also aware that their tasks are part of a task chain, or a "larger system of tasks" (Gasser 1986). It is easier and more efficient to maintain the task chain in a hectic work environment by following a known system, than to spend time learning a system with errors that requires more articulation work. With several malfunctions in the application, operators either have to combine the new and old systems through extended articulation work, or not use it at all.

An implementation manager said that they are being careful with pressuring operators to use it since there are too many errors in the application. For instance, let us look at the standardized progress reporting. AKSO's primary goal is that progress reporting and work order retrieval should go through WeBuild. These are the time-savers that will generate value for the organization in the long run. When the progress reporting does not work for a large portion of the operators, it is harming the general usage.

The organization need to address these issues to increase the user retention rate. The user retention rate is easy to calculate. Aihr (2022) use this formula:

$$\frac{(TotalNumberOfUsers - UsersWhoLeft)}{TotalNumberOfUsers} \tag{5.1}$$

If we say that the operators who have used it for a maximum of three days are non-returning users, the calculation for the period of December-February looks like this:

$$\frac{(42-19)}{42} * 100 = 54\% \tag{5.2}$$

Meaning that in the said period, the user retention rate was at 54%. So almost 50% of users are not returning after trying it. This indicator refers to operators who have tried the application, and does not address the total number of users. But if the measures addressed here are followed up on, both the new and returning user number have good chances of improving. A possible inaccuracy with this KPI is the data used. The insecurities of this method is covered in Chapter 3.4.1 and the definition of active and inactive users are covered in Chapter 4.1. These need to be clearly defined before activating this KPI, to keep the calculation equal over time.

A user retention rate also enables the possibility to differentiate based on disciplines when calculating it, to see if there are differences that need to be further addressed or measured. Such as disciplines with errors related to progress reporting that prevent operators from using the application, which has been described.

Table 5.4 illustrates how a user retention KPI can be defined as a SMART KPI to make it easier to measure. A 100% user retention rate is challenging, but it is essential for the implementation that every possible user returns after initially trying it. The rate should be measured on a regular basis.

Increase the user retention rate to 100%	
Criterion	**Description**
Specific	The KPI proposed here is specific and should be easy to comprehend for all actors involved.
Measurable	This KPI should be simple to calculate and measure, as presented in (5.1) and (5.2). The only thing to be aware of is the insecurities in the data. However, creating a method for obtaining accurate data should be possible when working with longer time periods.
Achievable	Reaching this KPI is achievable, but it has some requirements as discussed in this subsection. It also requires the KPI 1 presented in Chapter 5.4.1 to be reached. Right now it is at 54%.
Relevant	This KPI is descriptive for the implementation of new digital solutions, as it provides information about returning users to an application. It differs from normal user numbers in that it does not tell anything about all possible users, only the ones who have tried the application.
Time-bound	The user retention rate should first be measured after a few months of implementation or from starting a new project. Thereafter, it should be measured regularly. This gives the organization the possibility to track the KPI over time, seeing if more measures are necessary

Table 5.3: SMART KPI 3

5.4.4 KPI 4: User satisfaction rate

This indicator can be very useful in the setting WeBuild is currently in with continuously new updates and development of the application. If AKSO manage to measure the user satisfaction on a monthly basis for instance, they can track the improvements on a different level than just numerical. Because as the coordinator told, there is a vast difference between the numbers and the actual user environment. Numerical data will not tell anything about user behavior or their opinions, and it is hard to understand this from analyzing user numbers.

Operators and foremen regularly seek out the coordinator to inform about misfits, errors or if they have any questions. This type of fitting articulation work helps in continuously developing the application to fit the user group. A tool to see if fixing misfits or deploying a new update are giving results would be valuable. Thus, having a survey regularly will provide information beyond the user numbers and may explain these numbers.

It is essential to have an application that users find easy to use and is a helpful tool in their everyday work. Hence, keeping the users satisfied is critical to retain them on the application and attract new users. A study by Gatian (1994) found that user satisfaction affect the productivity and efficiency when using a system. Satisfied users tend to be more productive when it comes of data processing correctness and reporting.

A high user satisfaction depend on several factors, many of them will in this case resemble what Kamsvåg et al. (2022) found in their analysis and the results provided in Chapter 4. An application with fitting functionality that is also reliable are keywords to have a satisfied user group.

A tool to investigate the usage and satisfaction of the application can be user satisfaction surveys that measure this (Hurree 2022). The questions in a survey do not necessarily only have to concern the user satisfaction, but also other topics that affect it. This can be already mentioned topics, like training or errors in the application. Questions such as *How satisfied are you with the training you have received?* and *How easy do you find it to use WeBuild?* will provide information about the training of WeBuild at the same time as indirectly telling something about user satisfaction. Hence, the surveys should be more comprehensive than a single questions regarding user satisfaction in order to obtain a more complete overview.

User satisfaction as a KPI will provide a more thorough number to the application analysis. They can be a more descriptive addition to the numerical user data KPIs. Consequently, it gives more information of the results obtained after changes made from feedback. It is also an option for operators who are reluctant to ask for help or report misfits. By answering an anonymous survey, it provides every operators with a chance to report satisfaction and concerns in a discreet manner.

Having surveys on a regular basis also help management with differentiating the opinions between disciplines and age. Surveys can answer questions as to why disciplines have different user numbers and if different disciplines require different measures. It also offers the possibility to differentiate on age, to investigate if different age groups have different experiences. Hence, it is a very flexible tool to use as a KPI since it is easier to look at different patterns.

User satisfaction through surveys is a qualitative KPI, but it can be measured quantitatively. If the questions are multiple choice, the answers can be calculated and given a numerical value. The numerical values can be calculated based on different measures, ultimately providing indicators.

A qualitative KPI as this one is more challenging do define as a SMART KPI. It relies on how the satisfaction will be measured and the questions asked in the surveys. However, it should be possible to convert the qualitative data to numerical values in order to calculate a number. Nonetheless, it has been attempted here to define it as a SMART KPI, see Figure 5.4.

80% user satisfaction	
Criterion	**Description**
Specific	The title of the KPI is specific, however it requires effort to enable the measurements of it.
Measurable	This is a qualitative KPI and relies on surveys to be measured. Qualitative KPIs tend to be harder to measure as they require more work to obtain measurable values. But by creating systems for collecting and analysing data, such as regularly surveys, the organization can develop good ways to measure the KPI.
Achievable	The organization currently do not have any tools to measure user satisfaction, so it is hard to tell whether the specific number achievable. However, as AKSO wants all their employees to utilize the new tools they are integrating, 80% user satisfaction is a necessity to achieve that.
Relevant	User satisfaction is highly relevant for the implementation of new digital tools. Satisfied user are more likely to use the application and encourage others to use it. The way the KPI is measured also allows the KPI to be split on different genres like age and discipline, making it more dynamic and specific.
Time-bound	User satisfaction surveys should be executed on a regular basis, for instance monthly or semi-annually. This gives the organization the possibility to track the KPI over time, seeing if more measures are necessary.

Table 5.4: SMART KPI 4

5.5 Future work

Going forward, there are three steps needed in order to successfully implement and optimize the usage of the new digital solutions by using key performance indicators.

Firstly, AKSO must take the required measures discussed here in order to increase the user numbers. This includes training, in the form of a digital course, recruit foremen to use the application and address the functionality that is not working. This step is crucial if the organization wants to see results with the KPIs.

The second step is to implement the key performance indicators that measure the implementation and measures taken to address this. The KPIs suggested in this thesis include a broad variation of measurements. Creating a user satisfaction survey will also give the opportunity to look at smaller selection of user groups.

When AKSO has finished the implementation and have stabilized the user numbers, the organization can move on to step three of the implementation timeline, see Figure 5.2. Optimizing the usage requires more attention to the process and governance dimensions of the capability platform. The optimization process should include more analysis on articulation work trends and integrated planning to take full advantage of the new solutions.

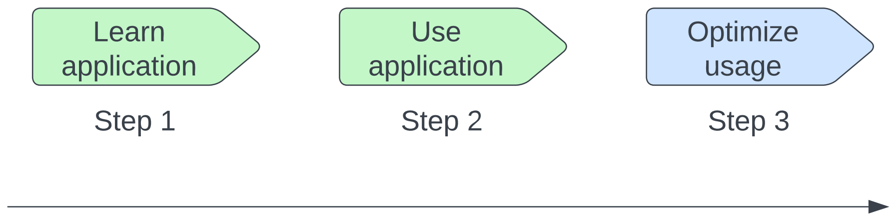

Figure 5.2: Implementation timeline 2

Chapter 6

Conclusions

This thesis has created four key performance indicators to be used in the implementation of new digital solutions in ETO organizations. This has been done on the basis of a theoretical study involving integrated operations and articulation work, together with a comprehensive mixed method research.

The capability platform describes how the four dimensions people, technology, governance and process must work together to develop capabilities to create value. And though technology often is the enabler for change, all four dimensions are equally important. This study has focused on the two dimensions people and technology, as is the main focus in an implementation process. It was found that a deprioritization of the people dimension has led to low user numbers. An unbalance between the technology and people has led to the organization not having funding to invest in their employees in terms of learning new digital solutions. A consequence has been that the employees are not using the new application. It was also shown that the leadership of foremen influences the operators, and low user numbers among foremen have resulted in low user numbers among operators as well.

How operators act in a changing, digital environment influences the implementation of new solutions that change work processes. This study has shown that an unreliable tool leading to extra articulation work for the end-users decreases the user retention rate. Because new users experiencing issues leading them to having to work around the errors will often not return as a regular user.

Going forwards, AKSO needs to focus on their employees, and facilitate for them to gain new competence and skills to increase the user numbers and implementation. The recommended KPIs can measure whether the actions taken are giving results, and if other measures are needed.

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Appendix

A - Interview guide for operators

Introduksjon

Fortell om prosjektet, hva jeg gjør her og hva jeg fill finne ut av. Kan for eksempel være:
Mitt navn er Mads, jeg går siste året på NTNU og skriver nå masteroppgaven min for Aker Solutions. Her skal jeg studere implementeringen av deres sine nye digitale løsninger, i dette tilfellet WeBuild. Derfor er det nyttig å snakke med dere som sluttbrukere, så jeg prøver å se på bruken av applikasjonen - hvor mye den brukes, hva den brukes til og hvordan bruken kan forbedres.

Be operatøren fortelle om stilling/disiplin, si ifra om at all informasjon er anonymt.

Del 1, strukturert del

Bruk dette for å etablere litt generell fakta. Samme spørsmål for alle operatører.

Etablere bruk for videre intervju

Før vi går videre med intervjuet er det viktig å vite i hvilken grad intervjuobjektet bruker WeBuild for å etablere hvilken vei intervjuet skal. Her vil vi også ha et mål om å få en generell innsikt å hva en aktiv bruker faktisk bruker WeBuild til for å se om det stemmer overens med brukerdataen.

1. Har du brukt WeBuild? Ja/Nei

2. Hva bruker du WeBuild til?

Dersom brukeren svarer «nei» på spørsmål om de har brukt WeBuild, vil det være andre spørsmål som er mer relevant å stille.

1. Har du prøvd WeBuild? (Hvis nei, hvorfor ikke?)

2. Hvorfor bruker du ikke WeBuild?

3. Hva må til for å ta i bruk WeBuild? / Hva stopper deg fra å bruke WeBuild?

Med dette som grunnlag har man en bakgrunn for å gå inn neste del.

Del 2, semi-strukturert del

Etter en innledningsfase hvor vi får etablert bruksnivå kan vi gå litt dypere inn i selve applikasjonen og bruken. Her vil det være relevant og se på temaer knyttet til integrerte operasjoner. Tilpass spørsmål etter bruker/ikke-bruker

Integrerte operasjoner

Hovedfokus for denne delen av implementasjonen vil være på teknologi- og menneske-dimensjonene. Snakk om temaer som menneske- og teknologidimensjonene og hvordan disse blir utviklet. Når en organisasjon utvikler og implementerer en ny digital løsning som WeBuild er det viktig at også menneske-aspektet av organisasjonen også utvikles Spørsmål kan omhandle dette:

1. Det er viktig at ansatte får utvikle kompetanse og nye egenskaper til å utnytte nye verktøy. Hvordan har dette vært med implementeringen av WeBuild? Opplæring osv

2. Digitale løsninger kan ofte være mer tilpasset ledelsen enn sluttbrukerne. Føles det som at WeBuild er laget for å gjøre arbeidshverdagen lettere for dere også?

3. Fordeler med WeBuid iht. IO, f.eks. ser formann mer eller økt shared awareness?

Artikulasjonsarbeid

Et annet viktig begrep ved implementasjonen av nye løsninger er Primærarbeid og Artikulasjonsarbeid. Primærarbeid selve arbeidsoppgavene og målene som følger med, mens artikulasjonsarbeid er alt arbeidet man gjør rundt primærarbeidet for å få dette til å fungere. Dette arbeidet er viktig å forstå for en vellykket implementering. Noen spørsmål rundt dette:

1. Artikulasjonsarbeidet er det arbeidet dere gjør for å få systemer som MIPS og WeBuild til å fungere. Hvordan brukere du WeBuild?

2. Innføringen av WeBuild fører jo til at dere som operatører må tilvenne dere et nytt verktøy for å utføre jobbene deres. Hvordan har det påvirket primærarbeidet, altså

arbeidsoppgavene dine?

3. WeBuild fører også til en reorganisering ved at for eksempel dere som operatører nå har muligheten til å rapportere fremdrift selv. Hvordan påvirker dette dere?

4. Hva gjør du når WeBuild ikke fungerer?

Brukeropplevelser

Her skal vi prøve å få frem erfaringer fra operatørene om hvordan implementeringen kan forbedres.

1. Hvilke tiltak kan AKSO gjøre for å bedre implementasjonen?

2. Basert på dine egne erfaringer med WeBuild, hva må til for å få flere andre operatører til å ta i bruk applikasjonen på daglig basis?

3. Er det noen funksjoner/ting som er mer lettvint å gjøre manuelt (uten WeBuild)? Kan være tegninger, bestillinger osv.

4. Er det slik at det er lettest å bruke en kombinasjon av manuelle operasjoner og WeBuild? Hvis noe fortsatt er lettere å gjøre manuelt.

Avrunding

Be om noen eventuelle siste kommentarer. Hvis ikke det er noen, takk for at de stilte opp.

B - Interview guide for digitalization department

Introduksjon

Fortell om prosjektet, hva jeg gjør her og hva jeg fill finne ut av. Kan for eksempel være:
Mitt navn er Mads, jeg går siste året på NTNU og skriver nå masteroppgaven min for Aker Solutions. Her skal jeg studere implementeringen av deres sine nye digitale løsninger, i dette tilfellet WeBuild. Derfor er det nyttig å snakke med dere som slut-tbrukere, så jeg prøver å se på bruken av applikasjonen - hvor mye den brukes, hva den brukes til og hvordan bruken kan forbedres.

Be intervjuobjektet fortelle om stilling, si ifra om at all informasjon er anonymt.

Spørsmål fra kvantitativ analyse

Prøv å oppklare data fra kvantitative analysen. Kan være aktuelt å vise grafer.

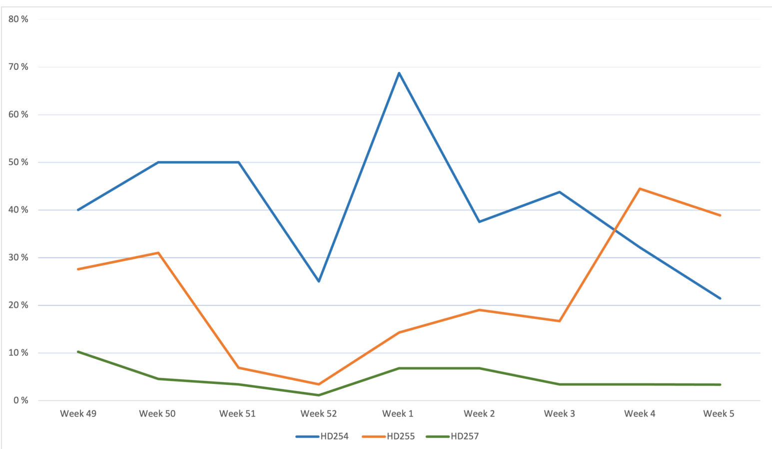

Figure .1: Weekly use of WeBuild, measured in percentage

1. Denne grafen viser for eksempel ukentlige brukere. Hva kan skyldes den store variasjonen fra uke til uke?

2. Tallene for disiplinene viser også at totalt 29% har vært innom WeBuild minst en gang. Det betyr at 2/3 av operatørene aldri har vært inne på WeBuild. Tanker rundt dette? Hvordan kan det ha seg?

3. I tillegg viser dataen jeg har analysert at 20%, 1/5 kun har brukt applikasjonen 1 gang/dag. mens nesten 45% har brukt den maks 3 dager. Tanker?

4. Homeview, ObjectDetail og WorkOrderview er de tre mest brukte skjermene. Mer detaljert?

Integrerte operasjoner

Hovedfokus for denne delen av implementasjonen vil være på teknologi- og menneskedimensjonene. Snakk om temaer som menneske- og teknologidimensjonene og hvordan disse blir utviklet. Når en organisasjon utvikler og implementerer en ny digital løsning som WeBuild er det viktig at også menneske-aspektet av organisasjonen også utvikles Spørsmål kan omhandle dette:

1. Det er viktig for ansatte at det tilrettelegges for utvikling av ny kompetanse når nye verktøy implementeres. Hvordan er opplæringen av WeBuild?

2. Hva har dere som organisasjon gjort for å tilrettelegge for implementasjonen?

3. Ellers ha en åpen diskusjon rundt implementeringen/IO/artikulasjonsarbeid

Generelt

1. Hovedmålet med WeBuild er jo å øke effektiviteten og produktiviteten. Hvilke screens/funksjoner er viktigst for å øke effektiviteten? Og produktiviteten?

2. Innføringen av WeBuild innebærer at operatørene må lære seg et nytt verktøy. Får operatørene noen fordeler ved at den overordnede arbeidsflyten til AKSO blir mer effektiv?

3. Ellers ha en åpen diskusjon rundt applikasjonen og implementeringen

Avrunding

Be om noen eventuelle siste kommentarer. Hvis ikke det er noen, takk for at de stilte opp.

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