CHALMERS
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Collection, Distribution, and Assimilation of Lessons Learned

A case study analysing the management of lessons learned in the oil and gas industry

Master's thesis in Quality and Operations Management

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Abstract

Knowledge management (KM) is often recognised as a key source of competitive advantage, as it promotes innovation, efficient resource management, and continuous improvement. Yet, although firms are investing more into their KM capabilities, many firms find it difficult to achieve the full extent of these benefits. As firms are increasingly organising their work into projects, the lessons learned (LL) process, which is defined as the firms ability to gather and retain knowledge during and between projects, is becoming an increasingly important part of KM. This report investigates the practical application of the LL-process, through a case study at a global oil and gas energy solutions provider, with the aim of showing how the firm's LL-process looks in the current state, and identifying potential opportunities and barriers for improvement. The LL-process is divided into the collection, distribution, and assimilation of LL, and for each step of the process, how the firm works with strategic KM and its people, processes, and technology is analysed. Through a combination of qualitative and quantitative research methods it was found that although the firm has a lot of well-documented processes for its operations, no predefined process exist which outlines all stages of the LL-process. Although there were clear structures in place for the collection of LL, there existed a lack of clarity regarding how to work with the distribution and assimilation of LL. Opportunities for improvement were in turn identified, regarding strategically aligning the firm's people, processes, and technology, and managing non-strategic operational inefficiencies. These inefficiencies included, limited motivation among employees to work with LL, a lack of a unified definition of LL causing information overload, and the technology not being built to facilitate the varying types, and large amount, of information it is being supplied. Finally, a handful of cultural and contextual barriers which exerts additional challenges on the improvement work were identified, as employees strategic preferences are not aligned with what theoretically best suits the firm's operations, there exist multiple different local cultures which the firm must adapt to, the nature of the industry promotes risk-aversion, and the firm is facing increasing environmental pressure.

Keywords: Lessons learned, Knowledge management, Collection, Distribution, Assimilation, Personalisation, Codification, People, Processes, Technology

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Marcus Edh, Gothenburg, June 2024
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List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

AI	Artificial Intelligence
CI	Continuous Improvement
IT	Information Technology
KM	Knowledge Management
KMS	Knowledge Management System
LL	Lessons Learned
PPT	People, Processes, and Technology
SPS	Subsea Production System

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1

Introduction

Although knowledge management (KM) is widely recognised among researchers as a key source of competitive advantage in today's economy, a majority of firms still struggle to achieve the full extent of the benefits associated with effective KM (Torres et al., 2024; McKendrick, 2023). KM refers to the process of continually managing knowledge, of all types, to meet firm's existing and emerging needs (Quintas et al., 1997). The importance of knowledge has been recognised by researchers for a long time, as firms' ability to effectively manage and utilise knowledge has been shown to have a direct correlation with efficient resource management and innovativeness (Quintas et al., 1997; Omotayo, 2015; Darroch, 2005). The importance of effective KM has also been increasingly recognised by firms as according to a survey conducted by APQC (2023), with managers and executives from a wide range of industries, 73% of firms expect to increase their investment into KM for 2024. Although research has shown clear benefits associated with effective KM and firms are investing more into the field, McKendrick (2023) argues that KM still shows great untapped potential for creating business value in most industries. Only 18% of KM professionals, including project managers and c-suite executives, express a high level of satisfaction towards their current KM solutions, and in most firms knowledge is continued to be siloed in different parts of the organisation (McKendrick, 2023). Ultimately, there exist a need for further research into the practical application of KM to ensure that its full potential is utilised, emphasising the role it plays in helping firms stay competitive and drive innovation.

At the same time as there is a need for effective KM, the world is also moving towards project-based economy as firms are increasingly organising their work into projects (Lao, 2021). Project work allows firms to be increasingly agile, which is of importance in today's fast moving economy (Lao, 2021; Thompson, 2023). The value of project-oriented economic activity is expected to increase by two thirds worldwide by the year 2027, and the need for effective KM in relation to project-based activities is hence of significant importance (Nieto-Rodriguez, 2021). The lessons learned (LL) process, is a sub-process within KM, and refers to firms' ability to gather and retain knowledge during and between projects (Dülgerler & Negri, 2016). The PMI (2013) define LL as "knowledge gained during a project which shows how project events were addressed or should be addressed in the future with the purpose of improving future performance" (p. 544). This definition was used as a baseline to define LL in this study, but we extended it to consider all types of improvements, as a result of project work. This may include everything from learnings that could improve the firm's products to its project execution processes.

Being able to share LL is critical to scale best practices across firms, and foster a culture of continuous improvement (CI) (Dewar et al, 2019). According to Bessant & Francis (1999) having the capability to learn from experience and capture, codify, and share knowledge, are key characteristics of firms who have successfully deployed CI initiatives, to achieve a strategic advantage. Effectively managing the LL-process hence becomes imperative for firms to achieve the potential benefits associated with KM, as they are increasingly organising their work into projects.

As effective KM has a direct correlation with innovation and efficient resource management, one industry where the need for effective KM is of particular importance is the oil and gas industry. The industry is characterised by finite resources and is currently undergoing a major transition, driven by innovation, as the world is facing an urgent need to transform its energy systems. Global energy consumption continues to grow at a rate of 1-2% annually, and the demand for environmentally friendly energy solutions is increasing (Tsiukhai, 2021; Doepel et al., 2021). Firms active in the oil and gas industry are hence at the center of having to navigate this transition and the need for effective KM is key. For this study, a case study was therefore conducted at a global oil and gas energy solutions provider, focusing on subsea solutions. The case company will hereby be referred to as AB SubSea, which is a pseudonym to protect the anonymity of the firm and its employees. AB SubSea nearly exclusively, operates on a project basis, as it supplies engineered-to-order solutions for its clients, making the management of LL during and between projects imperative.

In this study the LL-process at AB SubSea is analysed by dividing the process into four main steps and developing a life-cycle of LL. These steps include the generation, collection, distribution, and assimilation of LL. This report primarily focuses on the latter three steps of the life-cycle however, as the generation of LL is assumed to exist on an individual level, and is hence outside the direct control of the firm itself (Grant, 1996). The developed life-cycle is based on a collection of frameworks found in literature that will be presented, together with a detailed description of each step, in chapter 2.2. The life-cycle lays the foundation of this report as the practical application of the LL-process at AB SubSea is analysed. For each step of the life-cycle, the firm's KM strategy and how it manages its people, processes, and technology is analysed to provide further insights into the practical application of the LL-process.

1.1 Purpose & Research Questions

The purpose of this report is to investigate and understand how lessons learned are managed and utilised throughout the organisation of a global oil and gas energy solutions provider, focusing on subsea solutions. The report aims to build on the existing body of knowledge management research by presenting a case study of how the management of lessons learned between projects is conducted, in its current state, at AB SubSea. The current state analysis is then followed by an investigation

of potential opportunities and barriers for improvement. To achieve the purpose of the report the following research questions will be answered.

RQ1: How are lessons learned between projects collected, distributed, and assimilated within the context of a global oil and gas energy solutions provider?

RQ2: What potential opportunities and barriers exist for improving the management of lessons learned within this context?

In the end this report gives an overview of how a global oil and gas energy solutions provider, focusing on subsea solutions, works to effectively manage lessons learned, acquired during and between projects, and how that knowledge is used to facilitate continuous improvement.

1.2 Company Background

AB SubSea is a leading global energy solutions provider, from Scandinavia, with over 10 000 employees, that offers an extensive product portfolio of subsea production systems (SPS). SPS are typically used for the production of oil and gas and differ from traditional oil platforms in that they consist of a series of wells at the seafloor, connected to a production platform at the surface (Speight, 2011). The SPS built by AB SubSea are primarily based on a set of standard modules and components, referred to as work packages, taking several years to construct and assemble. Most work packages are developed separately but follow a similar operative process of design, technical analysis, procurement, production, and testing. This study is limited to focusing on LL in association with the development and production of one such work package, mainly the umbilical system. The purpose of the umbilical system is to provide a safe and reliable route for various cables and tubes from the production platform, at the surface, to the subsea equipment, at the seafloor. The umbilical work package provides a unique opportunity for analysis as it follows a similar operative process to the rest of the company, yet, it in many ways operates as a stand-alone firm within the boundaries of AB SubSea. By focusing the scope on the development of umbilicals, a comprehensive analysis of how the firm manages LL can be conducted on a smaller scale, without having to analyse all of AB SubSea. Only the management of internally generated LL, that resides among the members of the umbilicals work package, are considered. The collection of LL from sources outside the boundaries of the umbilicals work package is outside the scope of this study.

1.3 Thesis Outline

Following the introduction, the rest of the thesis is structured as follows. Section 2 gives an overview of the theoretical background which lays the foundation for the analytical framework used in this study. Section 3 presents the methods used and

provides an overview of the study context. Section 4 presents the results from the data collection and highlights how the firm actually works with their LL-process. In Section 5 the results are analysed, using the analytical framework presented in Section 2, and opportunities for improvement are identified. Section 6 discusses the analysed results and potential barriers for improvements, and finally Section 7 summarises the results and provides concluding remarks.

2

Theory

As mentioned in the Introduction, effective KM contains considerable potential for enhancing organisational performance. To achieve this potential however, it is important for firms to ensure that their strategic approaches and organisational components, in the form of their people, processes, and technology (PPT), are aligned with the firm's goals and objectives. In this theory chapter, we delve into the core concepts of KM, the LL life-cycle, KM strategies, and the PPT-framework. The PPT-framework is a framework designed for establishing successful business operations, by aligning the people, processes, and technology, within an organisation (Olmstead, 2024). While the PPT-framework emphasises the importance of aligning people, processes and technology in KM initiatives, it is simultaneously comprehensive and easy to understand. Ultimately, the PPT-framework, together with the LL life-cycle and the different KM strategies, lays the foundation for the analytical framework used when analysing the management of LL at AB SubSea.

2.1 Knowledge Management

Since the mid 1990s the amount of literature regarding KM has increased rapidly as the foundations of industrialised economies shifted from natural resources to intellectual assets (Omotayo, 2015). The broad applicability of KM has made it into a popular field of research as effective KM can be beneficial to firms and organisations active in nearly all industries and sectors. Although there exist a large and growing interest in the field of KM, there still exist contrasting opinions regarding for example what knowledge is and how it should be managed (Grant, 1996; García-Fernández, 2015). In this study the nature of knowledge will be defined based on the assumptions outlined by the knowledge-based theory of the firm (Grant, 1996). According to the knowledge-based theory of the firm, knowledge is a resource which exist among the individual members of the firm (Grant, 1996). The primary role of the firm hence becomes not to create knowledge, but to integrate the specialist knowledge that already exists among its members (Grant, 1996). KM in turn refers to the continuous integration of that knowledge, to meet firms' existing and emerging needs (Quintas et al., 1997).

Nonaka & Takeuchi (1995) also argues that there exist two different types of knowledge, tacit and explicit. The key difference between the two is that while tacit knowledge refers to "knowing how" to do something, explicit knowledge refers to

"knowing about" how to do something. In other words tacit knowledge refers to skills and knowledge that has been applied practically, whilst explicit knowledge refers to the awareness of facts and notions about how to do something but not practically applying it. Explicit knowledge is typically easier to share as it can be more easily expressed by the person who possesses the knowledge (Nonaka & Takeuchi, 1995). Tacit knowledge on the other hand is often more difficult to express in a verbal or written format, and many times the people that do possess the skill or knowledge are not aware of that they have it (Nonaka & Takeuchi, 1995).

To explain the relationship between tacit and explicit knowledge, Nonaka & Takeuchi (1995) developed the SECI-model. The SECI-model consists of four modes of knowledge conversion, which are socialisation, externalisation, combination, and internalisation. *Socialisation* refers to the transfer of tacit knowledge from one person to another. This often happens through people interacting with each other and share knowledge, often unintentionally, through observation and imitation. *Externalisation* refers to the conversion of tacit knowledge into explicit knowledge that is more easily shareable. The *combination* mode is both where explicit codified knowledge is sorted and filtered, and where new knowledge is generated through the combination of knowledge from multiple sources. Finally, *internalisation* refers to when explicit knowledge is internalised into tacit knowledge and put into practice by individuals.

One key distinction, and an important point made by Nonaka & Takeuchi (1995), is that although the SECI-model as a whole constitutes organisational knowledge creation, each of the four modes is experienced on an individual level. This corresponds with that of the knowledge-based theory of the firm presented earlier, as knowledge is created by the individual and the role of the firm is to integrate the knowledge which exist among the firm's individual members (Grant, 1996).

2.2 Lessons Learned Life-Cycle

LL is a subsection of KM focusing on knowledge that is generated and utilised in a project setting, and the LL-process refers to the process from when an LL is first generated, to when it has being implemented and utilised (Rowe & Sikes, 2006). When observing the LL-process through the framework of the knowledge-based theory of the firm, the LL-process can be divided into two co-dependent processes. Firstly the creation of LL, which exists among the individual members of the firm, and secondly the integration of LL, which is conducted by the firm itself (Grant, 1996). When analysing the LL-processes as a whole it is intuitively appealing to visualise the activities of the LL-process as a life-cycle of LL. Despite this there exist little to no general consensus among researchers of how such a life-cycle should look (García-Fernández, 2015). Table 2.1 highlights a handful of frameworks developed by researchers, for the management of knowledge and LL.

Frameworks managing knowledge and LL
Create ⇒ Manage ⇒ Share ⇒ Utilise (Omotayo, 2015)
Identify ⇒ Document ⇒ Analyse ⇒ Store ⇒ Retrieve (Rowe & Sikes, 2006)
Knowledge Acquisition ⇒ Knowledge Dissemination ⇒ Knowledge Responsiveness (Darroch, 2003)
Create ⇒ Store ⇒ Use ⇒ Refine ⇒ Transfer (Edwards, 2001)

Table 2.1: Different life-cycles of LL developed by researchers

As can be seen in Table 2.1, the frameworks listed above include a varying number of elements and stages of the processes. This indicates a lack of consensus among researchers on how LL should be managed and what to prioritise when working with LL. Drawing inspiration from the previously established frameworks, we suggest condensing the LL life-cycle into four main steps. These include the generation of LL, which exist among the individuals, and the collection, distribution, and assimilation of LL which is conducted by the firm. Figure 2.1 presents a visual representation of proposed life-cycle of LL.

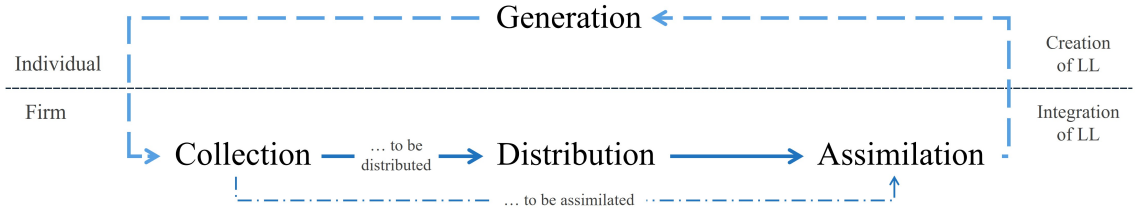


Figure 2.1: Visual representation of the life-cycle of lessons learned

For the purpose of this report, emphasis was primarily put towards the latter three stages of the life-cycle as the firm is only assumed to be in direct control of these steps. Below follows firstly a general description of the generation stage of the LL life-cycle, followed by an in-depth description of each of the other three stages. The different stages of the LL life-cycle, will later on become central for the analysis of how AB SubSea works with strategic KM and LL.

The **generation** phase of the LL life-cycle refers to the creation and acquisition of LL as described by Darroch (2003) and Edwards (2001). During this phase, new ideas are generated by individuals but they are yet to be shared with the collective of the firm. As individuals experience LL continuously throughout their work, the generation of LL follows a continuous process without a defined beginning or an end, even if the LL are not collected and utilised.

The **collection** stage of the LL life-cycle, refers to the gathering of explicit and tacit LL to make them shareable (Nonaka & Takeuchi, 1995). This marks the beginning of the LL integration process, conducted by the firm, as LL experienced by the

individuals are collected. Collecting internal LL for firms working on project basis can be challenging, as knowledge can take many forms. For example, it can take the form of tacit competencies and capabilities of employees, information about customers and suppliers, or systems for leveraging the company's innovative strength (North et al., 2018). Because of this the LL gathered within an organisation may vary in its applicability to the firm's operational processes. For firms working on a project basis, we propose that there exist two different types of LL collection. These are LL that are either collected to be assimilated, or LL that are collected to be distributed. LL that are *collected to be assimilated* refers to the collection of LL from other projects, and other parts of the organisation, to be used and assimilated locally. LL that are *collected to be distributed* is the opposite, and refers to LL that are collected locally, from a given project, with the intention of being shared and distributed to other projects and parts of the organisation. Both types of collection are needed for the life-cycle of LL to function as intended.

The **distribution** stage of the LL life-cycle refers to the actual sharing and transferring of newly collected LL and experiences (Darroch, 2003). This includes both the storage, combination, and the sharing of LL through verbal and non-verbal means of communication (Nonaka & Takeuchi, 1995; Edwards, 2001). One of the main goals of the distribution of LL is to improve and enable the sharing of knowledge across units within firms (Bouthillier & Shearer, 2002). As mentioned in the Introduction, McKendrick (2023) argues that most firms struggle with knowledge being siloed in different parts of the organisation. Hence, to break these knowledge silos, effective distribution of LL is key. If knowledge cannot be effectively shared within organisations, according to Spender (1996), the knowledge is likely to fade away over time.

The **assimilation** stage of the LL life-cycle process is closely connected to the discipline of change management, as LL are implemented to facilitate improvement and trigger change (Cameron & Green, 2019). Change management refers to the process of guiding organisations through the process of change (Abbas, 2023). Each time a new LL is assimilated it will lead to some degree of change, however small it may be, as the LL is put into practice. The assimilation stage includes everything from simply internalising awareness of issues, to the initiation of large-scale improvement projects. In many ways the assimilation stage mirrors that of the internalisation mode in the SECI-model, presented by Nonaka & Takeuchi (1995), as already distributed explicit knowledge is internalised and put into practice. Ultimately, once previous LL have been assimilated, it will then in turn lay the foundation for the generation of future LL, among individuals, and close the loop.

2.3 Strategies for Managing Knowledge

Strategically managing knowledge is often considered central for enhanced work productivity and innovation capacity in organisations (Venkitachalam & Willmott, 2017). Strategic knowledge management is concerned with "harnessing know-how that is comparatively non-replicable so as to influence environments as well as to re-

spond to them" (Venkitachalam & Willmott, 2015, p. 345). When deciding on a KM strategy, there exist two dimensions that need to be considered. Firstly whether to follow a codification or a personalisation strategy (Hansen et al., 1999), and secondly whether knowledge should be pushed or pulled throughout the organisation (Dixon, 2000). According to Dixon (2000) knowledge can either be pushed or pulled throughout an organisation, meaning that people can either be given knowledge by others (push), or they can be searching and retrieving knowledge from others themselves (pull). Both the push and the pull method for the distribution of knowledge can be used in combination with a codification and personalisation strategy. Below follows a deeper explanation of what codification and personalisation is, the challenges and opportunities associated with each strategy, and under which circumstances each strategy is most applicable. Additionally, what to consider when deciding upon a strategic mix, which refers to the mix of different strategies used within the firm, and how to best balance the different strategies will also be presented.

2.3.1 Codification

The codification strategy refers to when knowledge is codified and stored in databases, accessible to anyone in the firm, fostering people-to-documents communication (Li et al., 2013; Hansen et al., 1999). When organisations codify their knowledge, they package it into formats that facilitate knowledge transfer. The encoding of organisational knowledge can be accomplished in various ways, for instance, by utilising formulas, codes, or expert systems for expressing and storing the newly gained knowledge (Schulz & Jobe, 2001). By codifying knowledge and storing it in electric repositories, organisations can achieve scale in knowledge reuse, enabling growth and efficiency in leveraging organisational knowledge (Hansen et al., 1999). Other advantages of engaging in codification, is having a standardised way of sharing knowledge, and a centralised register for managing knowledge. Codified knowledge promotes standardisation in information sharing, ensuring consistency in the knowledge disseminated across the organisation. Simultaneously as knowledge is stored in electronic repositories, it becomes accessible to a wider range of employees within the firm, once again promoting knowledge transfer at scale (Hansen et al., 1999).

While codification can facilitate flows of organisational knowledge between subsidiaries, and facilitate the identification of new opportunities or emerging threats across markets and geographical regions, codification also has its challenges (Schulz & Jobe, 2001). Firstly, although codification opens up unique opportunities of achieving scale in knowledge reuse, people-to-document communication can be difficult to use when trying to convey very rich and subtle information (Hansen et al., 1999). Through a codification strategy the transfer of tacit information is not facilitated, nor does it promote one-on-one conversations to reach deeper insights from LL. Furthermore, creating and maintaining repositories of organisational knowledge is both costly and difficult (Schulz & Jobe, 2001). The databases with restricted sizes, storing all knowledge, needs to continuously be updated to ensure accuracy and usefulness of the knowledge. Additionally, the repositories need to be built to

allow for both efficient entering and retrieval of information. Among the common pitfalls of electronic knowledge repositories are information overload, from too much information being entered into the system that is unorganised and difficult to sort, and contribution overload experienced by employees as they need to spend time and effort to both enter and retrieve information (Bock et al., 2010). Codification hence requires heavier IT investments, in comparison to the personalisation strategy which is less reliant on technology (Hansen et al., 1999). Finally, codification can leave firms exposed to involuntary transfer of for example, strategic know-how and confidential product information, to competitors, as a result of data leakages which could harm firms and their operations (Schulz & Jobe, 2001).

The codification KM approach is suitable for firms with a strategy based on reuse, that offers standardised products or services with little to no variance (Hansen et al., 1999). The processes for developing and selling mature products involve well-understood tasks and knowledge, which can be codified and stored in databases for easy access and reuse, indicating a reuse model would be beneficial for such business strategy (Hansen et al., 1999). Additionally, for firms that are also reliant on explicit knowledge that can be codified, such as simple software code and market data, the people-to-document approach can be suitable (Hansen et al., 1999).

2.3.2 Personalisation

In contrast to the codification strategy, the personalisation strategy revolves around fostering people-to-people connections (Li et al., 2013). When engaging in personalisation, the main focus is to foster and facilitate direct communication between individuals, and not to store knowledge in databases. The knowledge is instead transferred through one-on-one conversations and brainstorming sessions (Hansen et al., 1999). As employees communicate directly with each other, the person supplying the knowledge also get to see directly the impact of the knowledge and insights they may provide. When using a codification strategy, the person who provided the knowledge will often times not see the direct impact of their contribution, as the knowledge is distributed indirectly through the database. The personalisation strategy hence is more strongly connected to intrinsic incentives, in the form of gratification and enjoyment from helping others, compared to the codification strategy (Lee & Ahn, 2007). By combining the intrinsic incentives associated with personalisation, with the emphasis on direct people-to-people communication, the personalisation strategy has an advantage as it better promotes a culture of knowledge sharing and collaboration (Hansen et al., 1999). Additionally, in comparison to the codification methods, that are built to only efficiently transfer explicit knowledge, the personalisation strategy enables the possibility to transfer both explicit and tacit knowledge (Mukherjee, 2007). Tacit knowledge can be shared through personal experience, industry insights, and expertise, which may not be easily codified. Finally, there is no urgent need to invest heavily in large IT-systems for a company engaging in personalisation. Some degree of investment is required, but that is primarily to facilitate conversation and the sharing of tacit knowledge (Hansen et al., 1999).

Although personalisation can be used to convey rich information, it is limited by the number of people that can be reached, as whether users can obtain knowledge from its producer is contingent on the availability of that specific person (Chai et al., 2003; Lee & Van den Steen, 2010). This results in the personalisation approach being reliant on informal communication channels for knowledge sharing, which can lead to information silos and the risk of knowledge loss if key individuals leave the organisation. It also becomes challenging to document and retain tacit knowledge shared through personal interactions within the organisation, making the strategy even more vulnerable to loss of employees.

The personalisation KM strategy is most suitable for an organisation whose corporate strategy is based on providing their customer with customised products, and emphasising product innovation (Hansen et al., 1999). A company sells customised products and services if most of its work goes towards meeting particular customers' unique needs. Since those needs will vary dramatically, codified knowledge is of limited value. Therefore, companies that follow a customised product approach should consider the personalisation model (Hansen et al., 1999). Furthermore, if employees rely on tacit knowledge acquired through personal experience, operational know-how, and technological expertise to solve problems, the people-to-people approach of the personalisation strategy makes the most sense (Hansen et al., 1999).

2.3.3 Strategic Mix

A company's choice of strategy is far from arbitrary, as it depends on the way the company serves its clients, the economics of the business, and the people it hires. Emphasising the wrong strategy can quickly undermine a business, and hence firms may want to straddle and focus on both strategies simultaneously to avoid picking the wrong one (Hansen et al., 1999). Hansen et al. (1999) however found that firms that do manage knowledge effectively do not try to excel at both strategies at the same time. Instead firms that have been successful in their KM efforts, tend to pursue a strategic mix, where they predominantly focus on one strategy and use the second as a support function to the first. According to Hansen et al. (1999), the most efficient way of balancing personalisation and codification, is through a 80-20 split. This implies that 80% of a firm's knowledge sharing follows one strategy, and 20% the other. Firms that try to excel at both strategies simultaneously instead risk failing at both.

Whilst Hansen et al. (1999) argues that firms should predominantly follow one strategy, Venkitachalam & Willmott (2017) argues that it is still important to find a balance between the two and avoid over-committing to either one strategy. By exclusively committing to codification or personalisation firms run the risk of running into the pitfalls of knowledge structuration or knowledge proliferation respectively (Venkitachalam & Willmott, 2017). Knowledge structuration, refers to when the overemphasis on structured codified knowledge hinders creativity, as employees' thoughts and ideas are restricted by the boundaries put in place by the firm's

codification methods. Although the highly structured form of information, which is easily digestible and applicable, may promote high work productivity it harms the firms' innovation capacity.

Knowledge proliferation on the other hand is the opposite to knowledge structuration, and is a potential pitfall of personalisation (Venkitachalam & Willmott, 2017). Knowledge proliferation refers to uncontrolled dissemination and sharing of knowledge between actors from all parts of the organisation (Venkitachalam & Willmott, 2017). This results in a lot of knowledge being generated, but as firms are overwhelmed with the amount of insights and suggestions from numerous different perspectives, they become unable to act upon the information. Although, through the sheer wealth of ideas being generated, the firm's innovation capacity may increase, knowledge proliferation also results in low work productivity. In the end, although it is important to predominantly commit to one strategy, it is just as important to not over-commit, but to use the other strategy as a support function to avoid falling into the pitfalls of knowledge structuration and knowledge profliferation (Hansen et al., 1999; Venkitachalam & Willmott, 2017).

2.4 Elements of Learning Organisations

The learning organisation is a phenomenon, within the discipline of KM, that considers an organisations ability to retain knowledge, to learn faster than competitors, and to establish a sustainable competitive advantage (Loermans, 2002). A learning organisation is an organisation that possesses continuous learning mechanisms to meet its ever changing needs (Khamis Ali, 2012). These mechanisms are important to help foster a culture of continuous learning, adaptation, and innovation within organisations. Such a culture in turn promotes continuous improvement of work processes, products and services, the structure and function of individual jobs, teamwork, and effective management practices (Bennett & O'Brien, 1994). The competitive learning organisation is a continuously adaptive enterprise which promotes focused learning on an individual, team, and organisational level, through satisfying changing customer needs, understanding the dynamics of competitive forces, and encouraging systems thinking (Jashapara, 1993). To improve the organisation's mechanisms and position vis-á-vis the market competition, the PPT-framework is used across several industries. The framework focuses on how firms manages its people, processes, and technology, and combines everything from leadership, to digital transformation, organisational talent, and management practices to ensure stronger and better business results (Cflow, 2024). The PPT-framework is multifaceted and can be used for, among other things, establishing successful business operations, redesigning business models, and building agile workforces that are flexible, adaptable, and responsive to the dynamics of the industry (Cflow, 2024; Olmstead, 2024). When implementing changes in an organisation using the PPT-framework, it requires a holistic approach rather than an individual siloed set of changes (Cflow, 2024). This holistic approach consider all three components of people, processes and technology, which will all be further described in this chapter.

2.4.1 People

The people component of the PPT-framework refers to the individuals in an organisation responsible for putting in individual work or completing a project (Olmstead, 2024). This includes employees that execute tasks, managers and leaders who set goals and make decisions, or stakeholders who bring companies toward their goals. Since the people are the fuel that brings a firm's vision to life, building a culture within the firm that embraces change is essential to ensure engagement of learning new things to establish a competitive advantage (Olmstead, 2024).

Learning can be defined as how people acquire knowledge through experience that leads to a lasting change in behaviour (Buchanan & Huczynski, 2010). The process of learning is not just an acquisition of knowledge, but also the application of it through doing something different in the world (Buchanan & Huczynski, 2010). Many of the change scenarios that people find themselves in requires that they learn something new, or that they adjust to new ways operating, or to unlearn something (Cameron & Green, 2019). For instance, in the case of a firm attempting to establish a better and more efficient LL-culture within the organisation. When completing changes at a workplace, people may experience that their own personality structure and stability becomes affected by the changes. An implementation of a more strongly embedded LL-culture eventually will cause changes in the employees' role , which is when resistance to the changes may be brought out (Creasey, 2024). When role changes are required, employees often lack desire to learn new technologies or systems, simultaneously as others are concerned about the time they have to adopt to changes, the absent of incentives, and decreased control and autonomy (Creasey, 2024). Typically, people prefer to maintain the status quo and adhere to routine and habitual behaviours (Ford et al., 2008; Oreg, 2003). More specifically, people tend to be especially sensitive to the uncertainty, apparent riskiness, and potential for failure that accompany creative efforts, resulting in them resisting to change their normal way of thinking, which stymies creativity and inhibit innovation (Jermier et al., 1994). The individual dispositional resistance to change is likely to be detrimental to individual's creative performance, since it prevents them from taking appropriate risks, adopting new procedures and way of thinking, and initiating change, which all are fundamental requirements of creative performance (Ford et al., 2008).

From the management perspective, resistance to changes is present as well, as managing directors have reported that organisational culture is a primary cause of resistance (Creasey, 2024). Participants in research have included risk-averse culture, past less successful experience with change, groupism versus organisational dedication, and problems like mistrust across departments and reporting levels (Panorama Consulting Group, 2021). Furthermore, managers tend to resist change due to lack of knowledge about what a change entails, including lack of information and understanding about return of investment (Panorama Consulting Group, 2021). Issues on the project management side of changes consistently causes manager resistance as well, which includes the pace of the change, lack of metrics, metrics that do not align with parameters for promotion, or misalignment of incentives (Creasey,

2024). Manager resistance may also be present due to their inability to engage as the leader of changes and facilitate its adoption. Some managers resist because they are unable to effectively manage resistance from other employees and communicate difficult messages to direct reports (Creasey, 2024).

In order to understand and change the thoughts, behaviors, and actions of employees within a firm, the COM-B framework is an effective tool to develop targeted strategies to promote the adoption of new practices (Askham, 2023). The COM-B model is a theory of change model that focuses on three key components: capabilities, opportunities, and motivation. These components interact to influence behavior change of employees at a workplace, with the understanding that behavior change is more likely to occur when all three components are present and adequate (Mayne, 2016). The model emphasises the importance of addressing the capabilities of knowledge and skills, the opportunities of external factors, and attitudes and aspirations included in the motivation aspect in interventions aimed at changing behavior (Mayne, 2016). The capability component can be defined as the individual's psychological and physical capacity to engage in the activity concerned, while the motivation aspect can be defined as all the brain processes that energise and direct behavior including habitual processes, emotional responding and analytical decision-making, and the opportunity component as all the factors that lie outside the person that make the behavior achievable (Michie et al., 2011).

When implementing the COM-B framework into the agenda for organisational change, combining it with behavioural and cognitive approaches for changes, the collaborative approach can be successful in driving organisational change by addressing both the observable behaviors and underlying beliefs of individuals. By using the COM-B framework for identifying key factors influencing behavior change and designing interventions that target these factors, firms can create a more comprehensive and tailored approach to change management and establish a valuable strategy.

2.4.2 Processes

Processes for making changes within an organisation requires an end-to-end mindset, where emphasis on rethinking of ways to meet customer needs, seamless connection to work activities, and the ability to manage across silos going forward (Davenport & Redman, 2020). The process component of the PPT-framework enables this by acting as the foundation that aligns people with the culture and quality of work a project or initiative needs (Olmstead, 2024). To accomplish the desired outcomes of changes, certain processes needs to be established for guiding teams through the proper steps of establishing a competitive advantage.

To ensure success and achieving sustainable competitive advantages over time, firms and organisations must pay special attention to strategies and management processes. Customer focus and the value that firms are able to provide constitute key elements to achieve such sustainable advantages (Cepeda-Carrion et al., 2017). As KM becomes a key management capacity, the importance of this capacity roots on

the consideration of knowledge as a key strategic resource (Grant, 1996; Van den Hooff & Huysman, 2009). Thus, if firms aims to take advantage of their possessed knowledge, they have to enable individual and collective knowledge creation, transfer, and leverage (Ipe, 2003). Understanding how organisations are able to generate and maintain a competitive advantage becomes fundamental in the field of strategic management (Zott, 2003), as the differences in performance between companies are due to their specific sets of resources and capabilities (Helfat & Peteraf, 2003).

In order to create and sustain a competitive advantage, firms must develop dynamic capabilities, which is a concept that can be defined as the ability of the firm to integrate, build, and reconfigure internal and external competencies to manage rapidly-changing environments (Teece et al., 1997). The microfoundations of dynamic capabilities are defined as a set of tasks that a firm must address in order to develop its dynamic capabilities (Teece, 2007). These tasks are called sensing, seizing, and reconfiguration, see Figure 2.2.

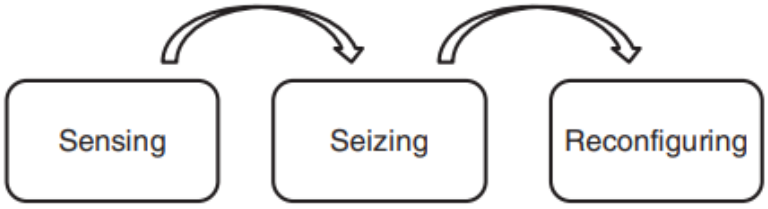


Figure 2.2: Sequence of the microfoundations of dynamic capabilities (Teece, 2007)

The dynamic capabilities approach suggests that to identify new opportunities (i.e., sensing), to effectively organise them (i.e., seizing), and to adopt them (i.e., reconfiguring), is more relevant than strategy itself, and that strategy is being understood as the behavior to ward off competitors, raise entry barriers, and exclude potential new rivals (Helfat & Peteraf, 2015; Teece, 2007). In this sense, primarily firms have to focus on the activities of perception (sensing), to find out new opportunities. In order to do that, managers must scan, learn and interpret all the existing information (Cohen & Levinthal, 1990). These tasks will generate new opportunities, as they enable the discovery of latent opportunities. Firms will have to carry out these activities systematically and intentionally, and not leaving matters to chance. When a new opportunity has been detected, the following step will be to assess the opportunity, which is seizing. To do this, it is necessary to determine the business model, understand resource needs and make decisions to invest in technology or other resources required, while permitting others to make appropriate changes. The fact that numerous functional areas are involved, it is necessary to achieve an important coordination of activities that affect these various functional areas, and also the associated investments that should be made simultaneously and not sequentially (Teece, 2007). After the assessing of opportunity, the reconfiguration of resources becomes necessary, which involves the reallocation of resources so that new combination increases the value of the firm. The reconfiguration results in the firm becoming able to adapt for changes in the environment, to dispose of obsolete routines and to allow increased and sustainable results.

The reconfiguration of resources can be affiliated with the critical process of absorptive capacity within KM. The process of absorptive capacity involves developing new knowledge or replacing the existing one (Pentland, 2013). It includes the performances of identifying new knowledge and information from both external and internal sources of the firm, leading in turn to new knowledge generation (Cepeda-Carrion et al., 2012). Absorptive capacity can be defined as the set of organisational routines and processes through which firms collects and distribute, assimilate, transform and exploit knowledge to shape a dynamic organisational capacity (Zahra & George, 2002). The ability to effectively exploit external knowledge is a critical factor for firms being interested in achieving higher benefits and innovation outcomes (Cohen & Levinthal, 1990). A firm's absorptive capacity performs as the enabler that permits turning knowledge into new products, services, or processes to support innovation and, hence, the firm's ability to restrict competitive forces (Leal-Rodríguez et al., 2014; Newey, 2009).

Another critical process that is comprised in KM is the knowledge transfer, which refers to the knowledge exchange that occurs between individuals or groups, from individuals to explicit sources, and from a group to the firm (Alavi & Leidner, 2001). However, knowledge transfer has motivational and perspective obstacles. For instance, employees may resist receiving new knowledge from other groups, sections or departments because it is not related to their prior knowledge (Szulanski, 1996). To assist firms in overcoming these obstacles, researchers has considered social capital as a facilitator for this (Kang & Hau, 2014; Kang & Kim, 2013). Knowledge transfer, conceptualised as reciprocal exchanges of organisational knowledge a source and a recipient unit, includes two agents: a source and a recipient. Social capital theory suggest that knowledge activities for these components can be stimulated and facilitated through social relationships. From a knowledge source's perspective, good social relationships among employees can increase trust, thus facilitating knowledge transfer. From the recipient's perspective, good relationships with coworkers facilitate the access to varied and different knowledge (Cepeda-Carrion et al., 2017). However, recipients who lack prior associated knowledge may find it difficult to learn the source's knowledge and fight accepting it (Kang & Hau, 2014).

A third critical process resides in knowledge application, as the application of knowledge is what actually creates the basis for organisational competitiveness, and not the knowledge itself (Alavi & Leidner, 2001). Knowledge application is a complex process since it consists of a loop. For knowledge application to take place, a prior phase of absorptive capacity is required and transfer mechanisms are essential for sharing and storing knowledge. When the individuals apply their knowledge, through feedback, they are able to verify the results of that applied knowledge and check for deviations from the objectives of the application. As a consequence, this process will generate new knowledge that may be stored and transferred again. Therefore, internalisation of knowledge is involved in the knowledge application within a firm (Cepeda-Carrion et al., 2017).

2.4.3 Technology

In order to establish an absorptive capacity of sharing and storing knowledge, the technological tools and systems that function as transfer mechanisms are carried out in the technology component of the PPT-framework (Olmstead, 2024). Today, technology has become the focal point of organisational transformation across industries. In the first half of 2023, 54% of organisations said that the type of change they experienced at work was technological (Wolf et al., 2023). Most firms have now shifted from the industrial economy to the knowledge economy for gaining a competitive advantage (Okour et al., 2021). However, this achievement is conditional upon effective KM practices and technological solutions.

In addition to well-defined processes, competitive advantage is established from effective management and utilisation for knowledge assets that are difficult to duplicate (Chin Wei et al., 2009). New strategies and technologies are deployed to get the maximum pay-off from organisational knowledge, as information technology (IT) systems can play a crucial role in the success of a business. Nowadays, executives are more aware of the importance of IT systems in achieving a competitive advantage (Alavi & Leidner, 2001). Due to the increased interest in organisational knowledge, researchers have promoted a set of IT systems called knowledge management systems (KMS). KMS refers to IT systems developed to enhance and support the processes of knowledge creation, storage, transfer and application within a firm (Alavi & Leidner, 2001). By using the implemented KMS, several strategic benefits can be achieved, for instance, boosting decision makers' capabilities in producing more effective decisions (Okour et al., 2019). Nevertheless, if KMS is not brought to an actual level of system usage, it will not provide additional value (Al-Busaidi, 2005).

The KMS are advanced and sophisticated information systems that consists of databases, directories and applications where users' exploration is a crucial factor to be used (Tiwana & Bush, 2005). KMS can provide decision makers with in-depth information in terms of market information, competitive information, customer information, business partner information and supplier information (external knowledge) (Xu & Quaddus, 2005). Furthermore, KMS have been indicated to be effective technologies in terms of the diffusion of explicit and tacit knowledge, with its importance from its ability to link the knowledge seeker with the knowledge granter (Oyebisi Oyefolahan & Dominic, 2013). Using KMS allows decision makers to successfully engage with the system in terms of knowledge storing, communication and collaboration by which they can efficiently develop their capital and cognitive skills. As a result, it enhances the performance of decision makers, especially their ability to make better decisions in comparing with old techniques (Abdelrahman, 2019).

The adoption of technological solutions for the development of new processes and products, habits, and good practices increases the innovation capacity of firms, enables them to meet the needs of a continually changing market (Gil-Gomez et al., 2020). Knowing the status of processes and resources through more modern and sophisticated analysis systems, and detecting the degree of interrelationships be-

tween the information contained in the database, will result in the firm gaining a competitive advantage (Ferraris et al., 2019). Therefore, innovation is configured as a governance issue, which influences the business model, pushing entrepreneurs to develop intervention strategies capable of satisfying the contingencies of an increasingly globalised and liberalised market (Ghezzi & Cavallo, 2020). In particular, firms have developed specific awareness of the externalities related to the production and consumption process. Hence, they try to transform their management models to limit the negative impacts of their business activity, without reducing the profits (Kamble et al., 2020). In the context of digital transformation and utilisation of Big Data, which are large data sets containing a heterogeneity of information (Rialti et al., 2019a; Rialti et al., 2019b), practices that improve the centrality of knowledge and KMS must be prioritised, favoring the creation of shared and integrated systems capable of improving business performance (Abubakar et al., 2019). The most advanced KMS are based on the integration of Big Data into corporate strategies, improving the quality of managers' choices through the predictive ability of the analysis processes, based on the association of data. In this way, firms are able to direct their behavior towards innovative and sustainable business models (Intezari & Gressel, 2017).

To design a KMS that can help a firm improving its overall performance, there are four different aspects that should be considered. The first is the human aspect, where it is suggested that the firm appoint a knowledge manager responsible for managing the KMS by encouraging employees to document and publish their knowledge, organise files, delete irrelevant knowledge, and set up a reward or punishment system (Ahmad, 2023). The second aspect of consideration are the processes, which are designed that apply the concepts of the SECI model, which proposes socialisation, externalisation, combination, and internalisation as the four forms of knowledge production, in their implementation (Ahmad, 2023). The third and fourth aspects are the technology and the content management of the KMS. The technology makes proposals for additional infrastructure needed to support running the KMS effectively, while the content of the KMS has been designed in the form of a knowledge database and documents employees need to carry out their duties and obligations (Ahmad, 2023).

3
Methods

In order to investigate how internally generated LL are managed within the context of a global oil and gas energy solutions provider, a case study was conducted at AB SubSea. The firm expressed that their LL-process has worked sub-optimally in the past, however they have now begun an initiative to improve this process going forward. The case study design is usually appropriate whenever the aim of the researcher is to highlight the unique features of a case (Bell et al., 2019). By adopting this approach, the case study design allows for a comprehensive exploration of how the management of LL is conducted within the specific context of a global oil and gas energy solutions provider, contributing to both the existing body of research and practical application.

Knights & McCabe (1997) argues that one of the strong points of the case study research design is that it provides a vehicle through which several research methods can be combined. This study followed a mixed methods research design combining both qualitative and quantitative research. More specifically the study followed an exploratory sequential research design, meaning that qualitative data is first collected and analysed, followed by the collection and analysis of quantitative data (Bell et al., 2019). Using an exploratory sequential research design, the qualitative findings could be tested using quantitative research to triangulate the results and enhance their validity.

3.1 Study Context

As mentioned in the chapter 1.2 this report primarily focused on the production and development of the umbilical system at AB SubSea. The umbilicals work package consist of approximately 500 employees split between two production sites, one in Norway and one in America. Although these sites predominantly operate separately, AB SubSea has recently began an initiative to increase coordination and communication between the two sites, and with that the sharing of LL globally. For this study however, only people working at the Norwegian site was interviewed.

The umbilical work package nearly exclusively operates on a project basis as it develops and produces engineered-to-order umbilicals tailored to the client's needs. Each umbilical project hence follows roughly the same process of, designing the umbilical, conducting a technical analysis, purchasing material, producing the design, testing,

and delivering. When a product is engineered-to-order it means that the customer order decoupling point is located at the design stage in the process (Gosling & Naim, 2009). The customer order decoupling point refers to the point in the supply chain where everything upstream is produced to forecast, and everything downstream is pulled by the end user (Gosling & Naim, 2009). No production or purchasing of material can hence precede the design phase of the project. For the operations of each project there are three main business functions involved that are tightly linked to the different phases of the project process. Engineering which perform the technical analysis and design the umbilical based on the customer's needs, procurement which purchase the materials based on the design developed by engineering, and finally manufacturing which produce and test the umbilical. On top of the three business functions, each project also include one project manager and at least one quality engineer, who are responsible for ensuring that all deliverables are met and are delivered on time.

Although each function is linked to a different phase of the project process, the different business functions work closely together as the different phases are greatly dependent on one another. For example, the engineering and procurement business functions must collaborate to ensure that the purchased material meets the technical requirements of the designed umbilical. Many of LL generated during and between projects hence often impact multiple business functions at once. In turn, there is a need to share LL with all business functions to avoid knowledge silos and to investigate conflicting impacts of LL. In situations where the implementation of LL may positively impact one function and negatively impact another, the net impact is investigated and used as the determinant for whether or not to implement the LL.

3.2 Data Collection

In this study, a combination of documentary data collection, interviews, participant observations, and questionnaires was used to help build a comprehensive understanding of KM within the oil and gas energy solutions industry. By introducing a diverse range of data collection methods, over-reliance on a single method can be avoided, potential biases can be mitigated, and new perspectives can be highlighted.

3.2.1 Documentary Data Collection

The documentary data collection was structured based on three of the four stages of the life-cycle of LL highlighted in the introduction. These are the collection, distribution, and assimilation of LL. For each step of the life-cycle, documentary data, in the form of governing documents, was first analysed. The documents were collected from AB SubSea's global management system and the keywords used to search within the management system include those highlighted in Table 3.1. The keywords were selected based on the findings from the theoretical background and initial discussions with employees of AB SubSea.

Keywords	
Lessons learned	Continuous improvement
Non-conformity report	Project execution model
Change management	Quality control

Table 3.1: Key words for documentary data collection

The goal of the documentary data collection was to help build a better understanding of the firm's processes for managing LL, and highlighting key stakeholders for future interviews. A flowchart was constructed based on AB SubSea's documented processes, visualising how a LL moves throughout the organisation from the point it is collected, to when it has been assimilated. Using this flowchart, gaps among the documented process could be identified and interesting areas for future research could be highlighted.

3.2.2 Interviews and Observations

The documentary data collection was then followed by semi-structured interviews and participant observations, with key stakeholders. The key stakeholders selected for the interviews were identified during the documentary data collection and consisted of individuals who were all responsible for one or multiple steps of the LL-process. The interviewees included business function leads, project managers, and quality engineers from multiple different projects to get a more well-rounded perspective of how LL are managed within the firm. The goal of the interviews and observations was to help build an in-depth understanding of how the firm actually works with LL in practice, and see if any differences exist compared to what is stated in the analysed documents. Table 3.2 lists all individuals who were interviewed and their corresponding role within the firm.

Interviewee	Role
Interviewee 1	Project Quality Engineer
Interviewee 2	Senior Project Quality Engineer
Interviewee 3	Senior Project Manager
Interviewee 4	Manufacturing Lead Engineer
Interviewee 5	Procurement Lead
Interviewee 6	Senior Project Engineering
Interviewee 7	Project Quality Engineer
Interviewee 8	Project Quality Manager
Interviewee 9	Performance Specialist
Interviewee 10	Project Quality Manager
Interviewee 11	Senior Manager

Table 3.2: Interviewees and their respective roles within AB SubSea

Prior to the interviews a handful focus areas, to be covered, was decided based on the findings from previous analysis of the documentary data. A semi-structured

interview format was used to support the explorative nature of the study, whilst ensuring that all the pre-decided focus areas were covered (Bell et al., 2019). See Appendix A for a summary of the focus areas used during the interviews.

On top of interviews, a participant observation session was also conducted with the aim of not only capturing explicit knowledge, but also identifying tacit knowledge among key stakeholders, of which they may not be aware of themselves. The observation session was conducted at a *LL session*, for a given project, which is a meeting for the collection and follow-up of LL. The meeting lasted a total of 90 minutes and was attended by all business function leads and quality engineers working in the project, including Interviewee 7. All invited participants were present for the meeting and in total eight people attended the meeting, excluding the observers.

3.2.3 Questionnaire

Finally, once a comprehensive understanding of the current state had been achieved, a questionnaire was sent out to a select number of people. The respondents were selected using purposive sampling, as all business function leads, quality engineers, and project managers were sent the survey (Bell et al., 2019). The questionnaire asked focused questions on specific topics of interest, that were highlighted during the previous rounds of data collection. Those topics included, the definition of LL, whether the respondents use and prefer written or verbal communication of LL, whether respondents prefer push or pull distribution of LL, and the usefulness and applicability of LL in practice. The questions were primarily quantitative in nature and included both short answer questions and questions where the respondents had to rate how much they agreed with a set of statements from a scale of one to six. See Appendix B for the questions asked in the questionnaire. Through the questionnaire a greater number of insights could be gathered in relation to specific areas of interest. The people selected to respond to the questionnaire included all business function leads, quality engineers, and project managers working within the umbilicals work package. Table 3.3 shows the descriptive statistics of the questionnaire and the number of responses per business function.

Sample overview	
Number of people sent out to	23
Number of responses	20
Response rate	87%
Responses per business function	
Engineering	6
Procurement	5
Project management	5
Quality	4

Table 3.3: Descriptive statistics of the questionnaire

3.3 Data Analysis

As this study followed an exploratory sequential research design, different data analysis methods were used for the qualitative and the quantitative sections of the study.

3.3.1 Analysis of Qualitative Data

Firstly, to support the explorative nature of the first step of the study, where a large amount of unstructured qualitative data was collected through interviews and participant observations, a grounded theory methodology was used. Grounded theory is an iterative approach to conduct qualitative research, with a repetitive interplay between data collection and analysis (Bell et al., 2019). The method challenges the notion of positivism in social research and is built upon the concepts of "constant comparison" and "theoretical sampling" (Glaser & Strauss, 1967). "Constant comparison" refers to the simultaneous collection and analysis of data, and "theoretical sampling" refers to data being sampled based on the theory that is being constructed (Glaser & Strauss, 1967). The methodology is useful when navigating through previously unexplored research areas and provides a clear and structured approach for compiling qualitative and unstructured results. The process follows a cyclical structure as data is collected, then analysed, and then collected again based on the findings from the analysis. The empirical observations are coded and grouped into categories that are then iteratively revisited after each round of data collection (Bell et al., 2019). Each category relates to the research questions and provide a basis for theoretical understanding. Grounded theory follows, primarily, an inductive reasoning approach to research. Inductive reasoning is defined as "an approach to the relationship between theory and research in which the former is generated out of the latter" (Bell et al., 2019, p. 592). The methodology hence starts with specific observations and uses those to develop generalisable theories and propositions.

3.3.2 Analysis of Quantitative Data

Once a handful of propositions had been developed, the second step of the study involved analysis of the results from the questionnaire to triangulate the findings from the previous step. Although the questionnaire included two different types of questions, short answer and rating on a scale, similar methodologies were used for analysing the results. As both question types were primarily quantitative in nature, the frequency of responses were assessed and analysed for both question types. For the short answer questions however, the responses were grouped into common themes and then the frequency of responses within each theme was assessed, whilst for the rating questions, which only considered a single variable at a time, a univariate analysis was conducted (Bell et al., 2019). The frequency, the arithmetic mean, and the standard deviation of responses was calculated for each set of questions, to provide a foundation for which to validate the theories developed earlier.

This step of the data analysis process hence followed more of a deductive approach to research, as the validity of the theories generated earlier was assessed using the empirical data collected from the questionnaire (Bell et al., 2019). Deductive research is referred to as the opposite of inductive research, and can hence be defined as "An approach to the relationship between theory and research in which the latter is conducted with reference to hypotheses and ideas inferred from the former" (Bell et al., 2019, p. 591).

3.4 Research Quality and Ethics

Although the case study design is a common method within many scientific disciplines, some researchers have criticised the quality of the research design, in regard to the scientific applicability, reliability, and repeatability of the results (Dubois & Gadde, 2002; Bell et al., 2019). One common criticism against the case study design is that the findings are too situation specific and in turn provide little basis for scientific generalisation (Dubois & Gadde, 2002). Additionally, as the context specific situation may change, Weick (1979) also argues that the findings from case studies are unstable over time. The quality of the research can hence be put into question as the reliability and repeatability of the results are dependent on context specific factors that may vary over time and are not possible to control. However, although these criticisms do hold merit, Dubois & Gadde (2002) argues that in-depth case studies are the best ways to understand the interaction between a phenomenon and its context. Learning from a specific case hence should be viewed as a strength rather than a weakness. Since this study looks to develop an understanding of the practical application of KM in the specific context of a energy solutions provider, the case study design was deemed appropriate.

Potential biases within the data collection should also be noted. All interviewees and respondents of the questionnaire were selected to be a part of this study because they were highlighted as key stakeholders of the LL-process. Although different people from different parts of the process were selected, all respondents are employees of AB SubSea, making the results vulnerable to cultural bias. Cultural bias is defined as the interpretation of words or actions according to a culturally derived meaning (Haddad et al., 2019). This could potentially influence the results if all interviewees and respondents of the questionnaire are exposed to the same type of cultural bias as a result of the culture of the firm. In order to mitigate the influence of cultural bias, additional case studies at different firms would need to be conducted, which was outside the scope of this study.

Observer bias, also known as the Hawthorne effect, could also impact the results from the participant observation session. Observer bias is a common research bias which refers to when the people modify their behaviour because they know they are being observed (Bell et al., 2019). To mitigate any impact of observer bias, a purely observatory position was taken during the participant observation session, with the aim of not disturbing the people being observed and to emulate natural working

conditions. The session was also attended digitally to further minimise the effect associated with the presence of the observers.

Diener & Crandall (1978) highlight four main ethical principles in business research. These principles are based on certain recurrent issues in business research and include harm to participants, lack of informed consent, invasion of privacy, and deception. To protect the privacy of the participants in this study, and avoid any harm to future career prospects, all responses to the interviews and the questionnaire were kept fully anonymous. Only the role of participants was collected. Furthermore, participation in both the interviews and the questionnaire was kept fully voluntary. To allow all participants to make an informed decision of whether or not to participate, prior to the start of this study all business function leads, project managers, and quality engineers were made aware of our study, and what we aim to do, by the firm itself. Prior to each interview the aim of the interview was further emphasised as well to avoid any sort of deception and ensure that the individuals could provide informed consent.

4
Results

The results presented below are structured based on the steps of the exploratory sequential research design, presented in the methods chapter. These include firstly the qualitative findings from the documentary data, interviews, and participant observations, followed by the quantitative results from the questionnaire.

4.1 Qualitative Results

The qualitative results are divided into two sequential steps as the results from the documentary data collection precede, and lay the foundation for, the interviews and participant observations. The current state of AB SubSea's LL-process was assessed and the people, processes, and technology associated with the collection, distribution, and assimilation of LL were evaluated.

4.1.1 Documentary Data

The documentary data collected consists mostly of AB SubSea's governing documents, which are documents containing well-defined processes of how AB SubSea should conduct its operations. Although the firm has well-defined processes for most of its operations, no pre-defined comprehensive processes exists for the LL-process itself. In turn a flowchart was created based on the life-cycle of LL, presented in chapter 2.2, where AB SubSea's better defined processes were divided based on if they contributed to the collection, distribution, or assimilation of LL. Figure 4.1 is a condensed illustration of the flowchart which was developed. See Appendix C for a more comprehensive version of the flowchart and all associated sub-processes.

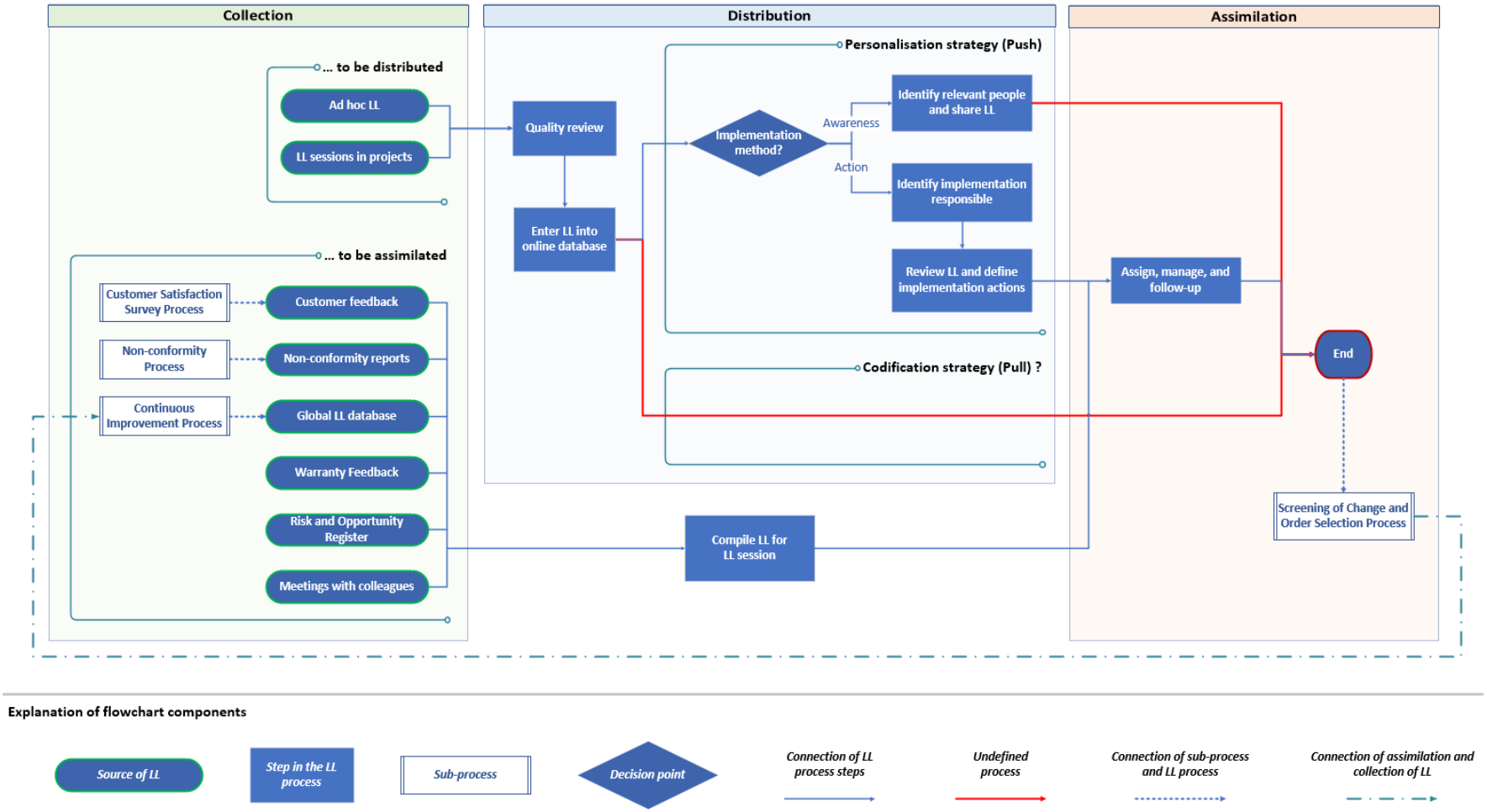


Figure 4.1: Condensed flowchart for the LL-process at AB SubSea

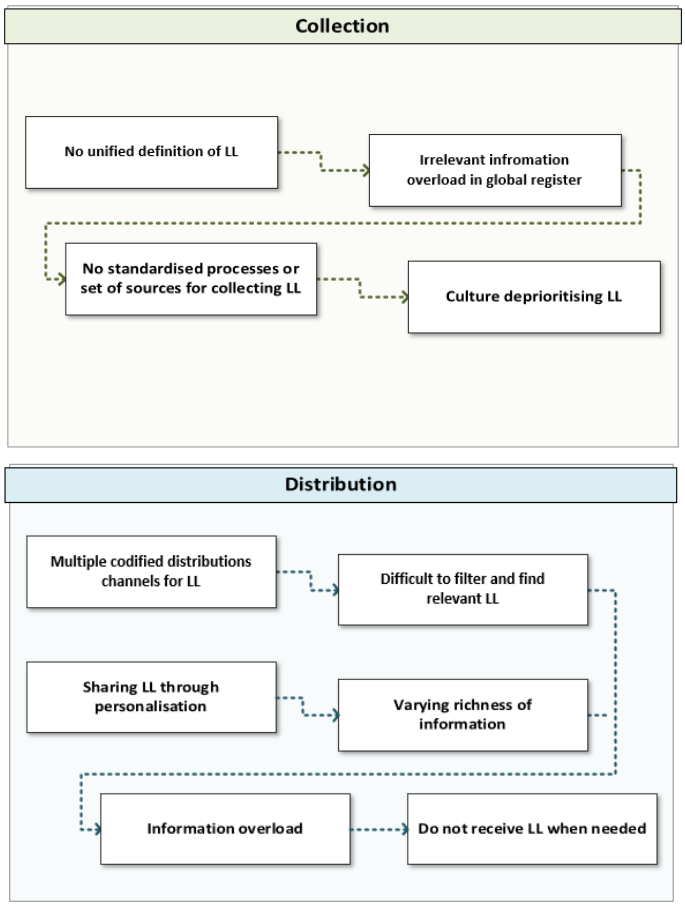
The process for the **collection** of LL was divided based on if the collected LL was to be distributed, or if it was to be assimilated. For the collection of LL which are to be distributed two sources of LL were identified. These were LL-sessions, which are held at the beginning, middle, and end of projects, and LL that may be generated ad hoc during the duration of the project. All LL collected from both sources are supposed to be reviewed by a quality and CI manager to ensure that they are of required quality and content before being shared globally throughout the firm. The three LL-sessions held throughout the project's beginning, middle, and end, although similar, all have slightly different objectives. The session conducted at the end of a project is primarily aimed towards the collection of LL from the recently finished project, to be distributed throughout the firm, and the session at the beginning of a project is primarily aimed towards the collection of LL from other projects to be assimilated and used by the project team. The session in the middle, contain a combination of collection of LL to be distributed and to be assimilated. The LL-sessions at the beginning and middle of projects are the primary facilitators for the collection of LL to be assimilated. Prior to the LL-sessions the quality lead of the project compiles LL, which they deem to be relevant, from six different sources and share those with the project team. The sources include LL from customer feedback, non-conformities, the global LL database, warranty feedback, a risk and opportunity register, and meetings and discussions with colleagues. Preceding the sources, standardised and well-defined processes do exist, such as the customer satisfaction survey process for LL from customer feedback, the non-conformity process for LL from non-conformities, and the CI process for entries into the global LL database.

Once the LL have been collected, there exist a handful of processes for the **distribution** of LL. All LL that have been collected to be assimilated, are complied by the quality lead and assigned to the different business function leads, who are responsible for their implementation. For LL that were collected to be distributed the process looks slightly differently. As described in chapter 2.3 there exist two strategies for managing knowledge, personalisation and codification, and two means of distribution, push or pull. AB SubSea's governing documents defines a personalisation strategy that the firm should use, where LL are pushed throughout the organisation. In the defined processes the quality and CI manager is responsible for identifying the people and parts of the organisation who might be in need of the LL and is responsible for communicating it directly to them. There exist however no clear processes for how the quality and CI manager should operate to identify relevant individuals, nor any dedicated tools to facilitate the direct communication of LL. The lack of a clearly defined process is visualised by the red arrow in Figure 4.1. The governing documents do not define any codification processes neither, however AB SubSea has recently invested into developing a global LL register to store and share written LL. This system supports a codification strategy where LL are stored in a written format and anyone can pull LL as needed, without having to interact with the person who submitted it. In the end, the firm's processes are defined to support a personalisation strategy, but their technologies have been developed to facilitate the codification of LL.

Finally, regarding the **assimilation** of LL, the governing documents outline clear and well-defined processes for how to implement change at AB SubSea. The processes outline how change projects should be prioritised, who is responsible, and how the projects should be conducted. There exist little documentation however, regarding how an LL goes from being distributed to starting a new change project. The governing documents state that LL should be assigned, managed, and followed-up, however there exist little documentation stating how this should be done. In the end, once the LL has been assimilated, the implementation of the change feeds into the CI process, and the global LL database, for collection of LL in the future.

4.1.2 Interviews

For the interviews and observations, the flowchart in Figure 4.1 was used as reference for how AB SubSea is supposed to work with, and manage, LL. The idea of conducting both interviews and observations was to investigate the correspondence between AB SubSea's documented processes, and how they actually work with LL in reality. The responses from the interviewees were codified and once again divided based on the whether they related to the collection, distribution, or assimilation of LL. The codified responses were then divided into themes and an analysis was made regarding how those themes relate to one another. Figure 4.2 show an overview of the themes found from the interviews and how they relate to each other. See Appendix D for the coded responses that make up each theme as well.



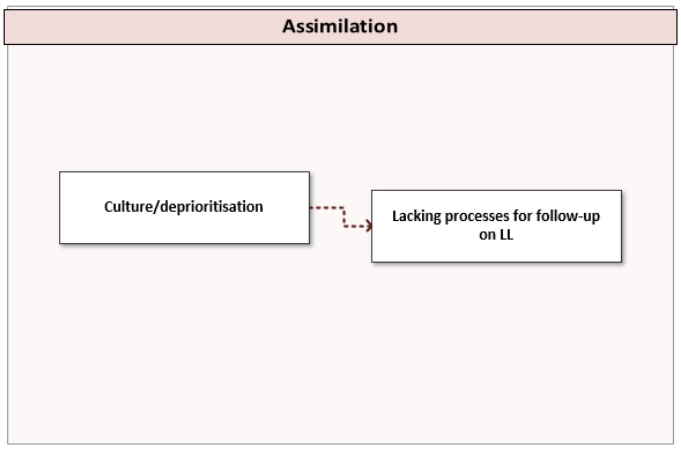


Figure 4.2: Themes identified from interview results

During the interviews, when speaking of the **collection** process, several interviewees mentioned that there exist no unified definition of LL within the context of AB SubSea. According to Interviewee 9, a standardised process for submitting LL is absent, resulting in the problem descriptions becoming very subjective. Hence, there can be a large variation of how people define LL between projects and teams. Interviewee 7 also mentioned that, a lot of times information regarding problems are collected, but not the actual LL. Nor are the actions performed to solve these problems captured. The non-unified definition of LL is in turn causing an overload of non-value adding information being added to the global LL register, making the register increasingly difficult to use. Multiple of the interviewees mentioned that the overload of information in the global LL register have made them question the register's ability to provide relevant information. Interviewees 8 and 9, highlighted that they were worried that too much noise have entered the system, and it is important to find a balance between the quantity and quality of LL that are being submitted. This in combination with it being difficult to filter the information among contradicting best practices and already implemented LL makes the system difficult to use (Interviewee 9). This have led to some interviewees and even projects to stop using the global LL register altogether and instead establish their own processes for collecting LL. For example, Interviewee 8 keep their own personal register of things they have encountered during projects to use in the future and Interviewee 1 and 2 collect LL through discussions with colleagues and SharePoints only accessible by the project team. The various approaches of conducting LL within AB SubSea creates a LL-culture where the engagement of employees varies. Interviewee 10 mentioned that LL is often deprioritised as stress and costs are increasing, and that employees need to see the value in LL to be motivated to contribute and prioritise it.

Regarding the **distribution** of LL, the documentary data analysis presented earlier discussed how AB SubSea is said to work with both codification and personalisation. From the interviews we find that the firm works with both strategies in different ways. Regarding codification, Interviewee 2 mention that there exist a lot of different databases for LL, making it difficult to know where to look to retrieve LL. Each

project may in some instance even have their own database which only members of the project has access to. The multiple programs makes the work for the project lead to compile relevant LL increasingly difficult (Interviewee 10). In addition to the multiple databases, Interviewee 9 also discusses the difficulties that exist to retrieve relevant information from the global LL database as the filtering function is not very effective. The distribution of LL through personalisation is also performed in various ways. Interviewee 3, among others, has scheduled meetings where they talk about problem areas and key-takeaways from previous projects that can be used as LL. Interviewee 6 and 1 on the other hand mentioned that they use their own contacts and research to find LL before project start, or that they learn a lot through informal discussions with colleagues. As the richness of LL varies, some LL are fine to explain using text, whilst others need to be described in person (Interviewee 1). There hence exist a need for personalisation within AB SubSea, but as the amount of different types of sources increases, Interviewee 2, among others, mentions that this has resulted in information overload and in turn an ineffective process where LL are not being received when needed.

Finally, regarding the **assimilation** of LL and gathered knowledge in the context of AB SubSea, the firm has well-documented processes for the implementation of CI initiatives. However according to Interviewee 10, LL is often deprioritised when stress and costs are increasing. Furthermore, according to Interviewee 2 there is a lacking processes for following up on LL. Although each responsible lead is responsible for the assimilation and follow-up on LL, the interviewees agree on that the follow-up processes has room for improvement.

4.1.3 Participant Observation

From the observations conducted at the LL-session, a deeper understanding of how project teams manage and analyses LL to be assimilated was developed. For the 90 minute long meeting, the agenda consisted of four different steps. The initial step of the LL-session was an investigation and follow-up of previous LL listed in an Excel sheet. The overview of older LL was then followed by a decision-making process for the learnings, including what actions that were about to be taken and the assigning of responsible individuals for certain LL. In the third step of the session, LL were sent out to people with the ability to filter relevant LL, and lastly, the meeting was concluded with confirming that every responsible individual was going to act on their assigned learnings.

Besides observing the designated steps of the LL-session, the meeting provided insights of that the project team only considered local LL from a handful of projects, excluding an investigation of the global register. While analysing previous LL, the team was not always fully certain of what the old entries meant, as most of them were based on previous problems. The team however managed to solve this issue by discussing the problems and helping each other out to remember. Since the characteristics of the problems varied, for example being non-conformity related or other

safety measures, the session allowed for different perspectives to be compiled to find solutions for the different problems. This in turn allowed the sharing of information during discussion, which is then compiled into a document, while learnings from other projects is considered in the form of the personal experiences and expertise of the different people in the meeting.

4.2 Quantitative Results

Based on the results from the interviews, a questionnaire was sent out aimed to gain further insights regarding five main areas. These were how people define LL, whether members of AB SubSea use and prefer written or verbal communication of LL, whether they prefer push or pull distribution of LL, if they find it easy to find relevant LL, and finally how they perceive the value of LL.

The first topic covered in the questionnaire was how people define LL. As many of the interviewees highlighted that there exist no unified definition of LL, the questionnaire both asked respondents how they would define LL within the context of their current projects, and what they would include within the scope of LL. Table 4.1 shows a summary of the different definitions provided by the respondents of the questionnaire, and Figure 4.3 shows what types of information different respondents said that they include when reporting LL. Each respondent had the option to list multiple types of information to include, meaning that the sum of the responses in Figure 4.3 is greater than the number of respondents of the questionnaire.

How would you define "lessons learned" within the context of the projects that you work in?
Transmitting information about previous incidents so that new projects avoid doing the same mistakes or ending up in similar situations
Use of best experiences from previous projects/processes to ensure improved operations/design in the future
Things that have gone good or bad in project execution compared to expectation and that should be taken into account in future projects
Lessons learned is a potential learning that requires a change and the lesson is learned when the change is implemented

Table 4.1: Different definitions of LL among the members of AB SubSea

Most of the respondents define LL as some variation of experience transfer that is shared between projects. This corresponds with the definition of LL documented in AB SubSea's governing documents which states that "A lessons learned is defined as knowledge gained through experience, which shared, would benefit the work of others". There does however exist some key differences among the respondents as some only define LL to include previous incidents, some define it only to include best practices, some define it as implemented change initiatives, and some define it to include all three. When looking at Figure 4.3 we can also see that respondents

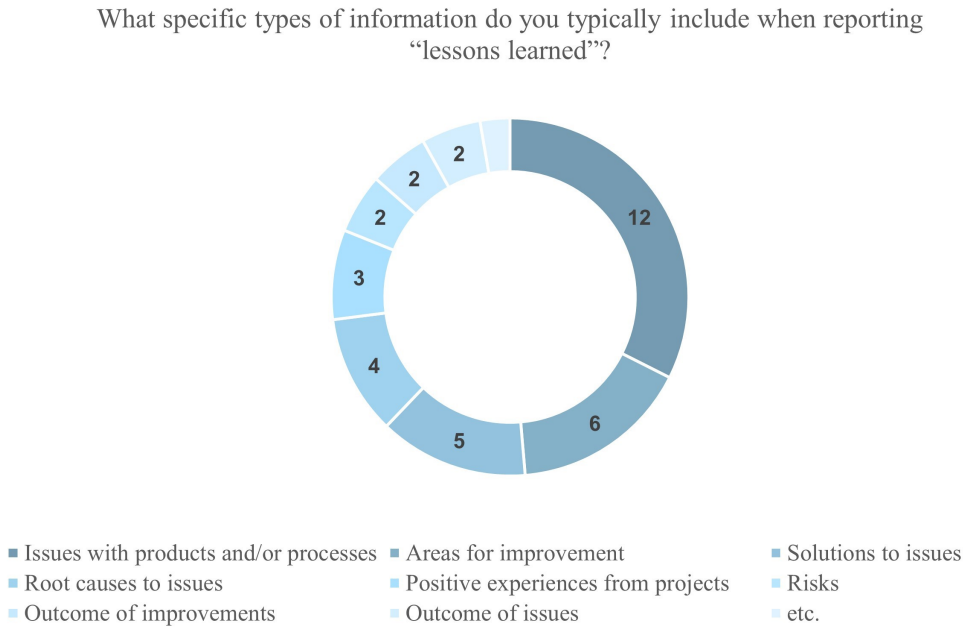


Figure 4.3: Different inputs included when reporting LL

consider more than eight different types of information to include when reporting LL. Incidents and issues with products and/or processes is the most common type of information to include when reporting LL, by a relatively large margin. This however contradicts AB SubSea's governing documents which states that "A perceived problem or solution with a process or product where a solution has not been experienced as implemented and beneficial should not be included in Lessons Learned".

The second topic which was investigated, in the questionnaire, was whether members of AB SubSea both use, and prefer to use, verbal or written communication of LL. As it was highlighted in the interviews that most people use different processes and systems for the storage and communication of LL, the questionnaire aimed to get a better idea of both how people currently work and how they prefer to work with LL. Figure 4.4 shows that although most of the respondents use verbal means of communication for communicating LL today, a majority of respondents also prefer to both share and receive LL in a written format.

Thirdly, to further develop an understanding of how people prefer to work with LL, Figure 4.5 highlights whether people prefer to look for relevant LL themselves (pull), or if they prefer to be given LL by others (push). From Figure 4.5 we can see that most people prefer to be given LL by others, and by combining that with the results from Figure 4.4, we can say that the members of AB SubSea prefer LL to be pushed throughout the organisation in a written format.

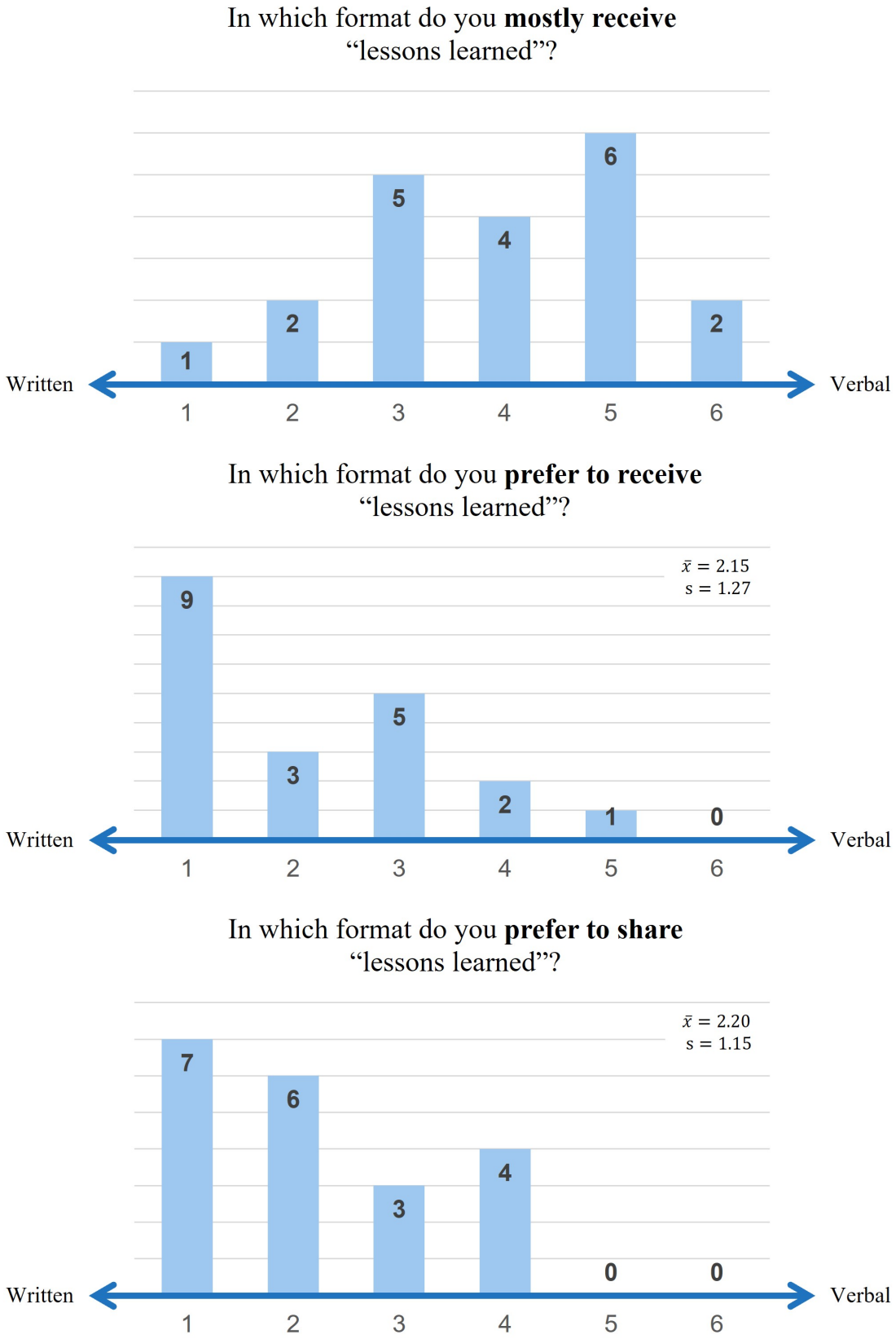


Figure 4.4: Do the members of AB SubSea mostly use verbal or written communication of LL, and which type of information do they prefer?

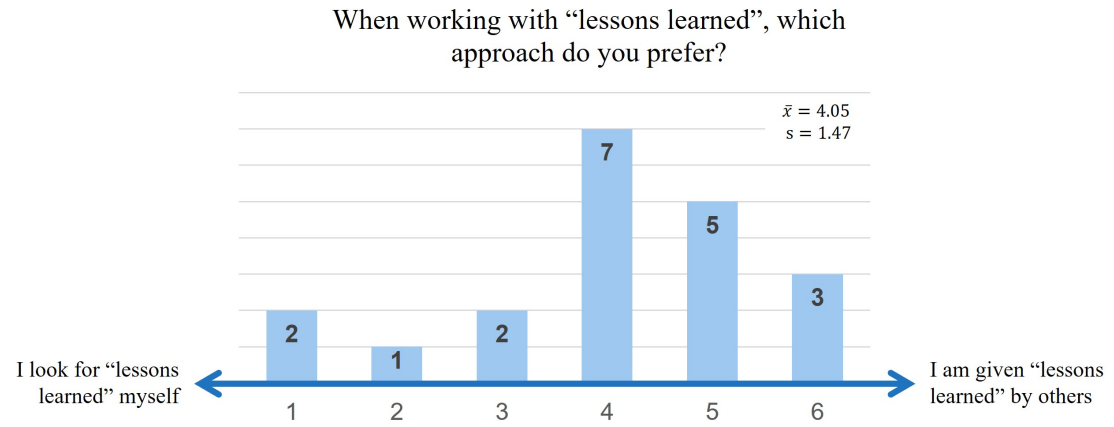


Figure 4.5: Preferences, among the members of AB SubSea, regarding push or pull distribution of LL

The fourth topic was if members of AB SubSea find it easy or difficult to find relevant LL in the current system. The interviews showed that people often find it difficult to use the current systems, and Figure 4.6 enhances this claim as most of the respondents of the questionnaire, answer that they disagree with the statement *"I find it easy to find "lessons learned" that are relevant to me (in the current system).*

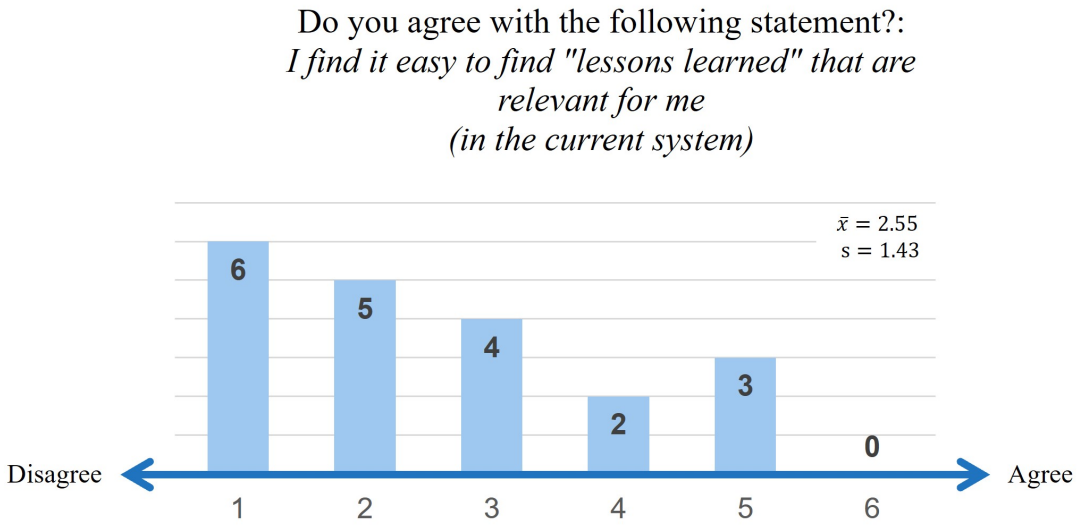


Figure 4.6: Ease of finding relevant LL using the current system

The final topic that was investigated in the questionnaire was the perceived value of LL. Figure 4.7 shows that the perceived applicability of LL and how well they are implemented, is reasonably average with an average score of 3.55 and 3.40 respectively. Nobody sees no applicability of LL, however there exist room for improvement regarding perceived applicability and usefulness of LL.

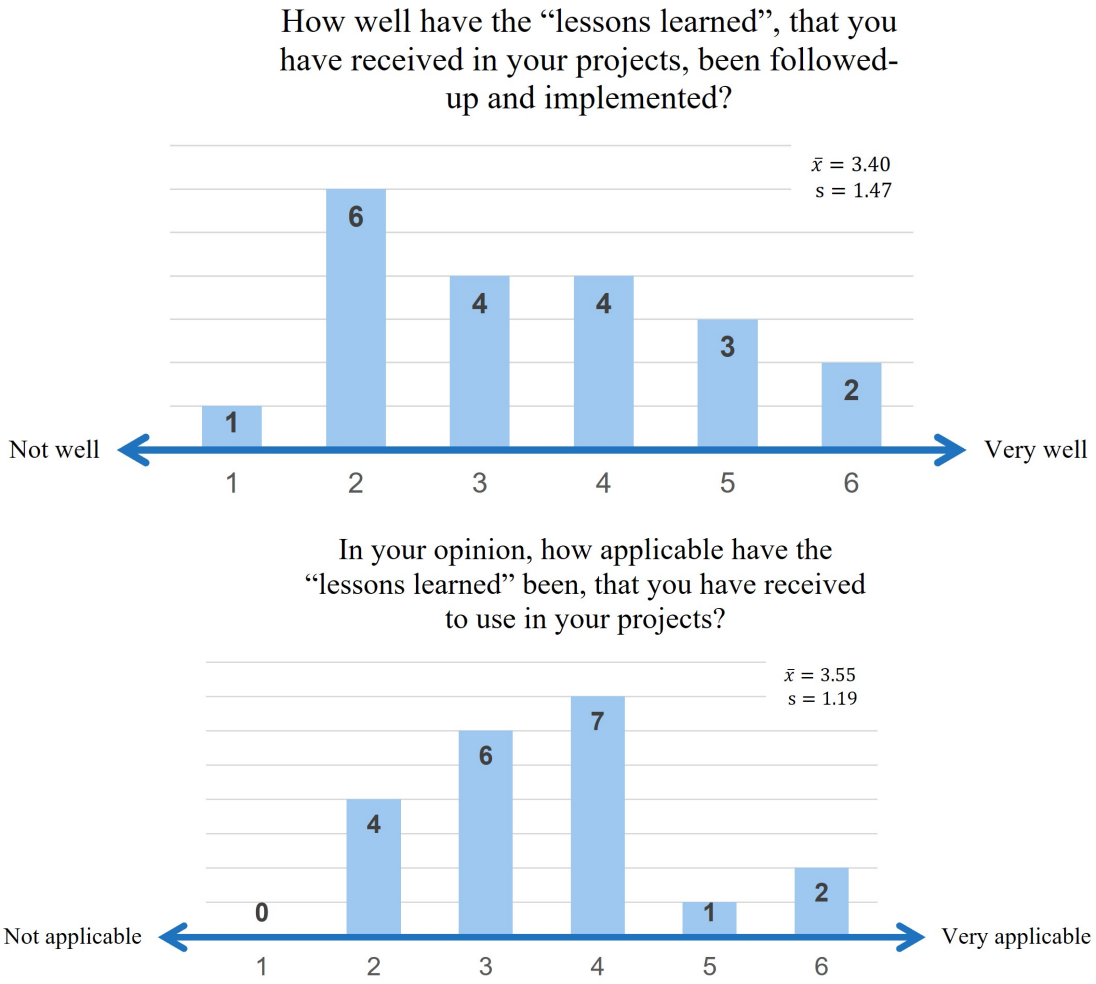


Figure 4.7: Perceived applicability of LL, and how well LL has been used and implemented in the past

5
Analysis

Using the analytical framework developed in the theory chapter, below follows an analysis of the current state of AB SubSea's LL-process and potential opportunities for improvement. To evaluate the LL-process the firm's choice of KM strategy was first examined, and the strategic alignment between the firm's organisational components was analysed. This was then followed by an analysis of other non-strategic operational inefficiencies associated with how the firm manages its people, processes, and technology.

5.1 Strategic Alignment

Although the AB SubSea's people, processes, and technology are operationally intertwined, they are not strategically aligned as the firm's people, processes, and technology all follow, or prefer to follow, different strategies. This goes against the strategic recommendations presented by Hansen et al. (1999), as the firm is not predominantly focusing on one primary strategy. Starting with the firm's processes, as visualised in Figure 4.1, according to the AB SubSea's documented processes the firm should follow a personalisation strategy when distributing LL, where LL are pushed throughout the organisation. There exist no documented processes for the distribution of codified LL. Yet, as AB SubSea has recently invested into developing a global LL register where written LL can be stored and retrieved, the technology developed by the firm hence can be said to follow a codification strategy, where LL are pulled by people throughout the organisation. Finally, from the results of the questionnaire we found that although most people do receive LL in a verbal format, which is in line with the documented processes, most of the respondents said that they prefer to receive LL in a written format. Furthermore, they also said that they prefer to be given LL, as opposed to be retrieving them themselves. Hence it can be said that the people within AB SubSea prefer to pursue a codification strategy where LL are pushed throughout the organisation. All in all, each of the components of the PPT-framework follow, or prefer to follow, different strategies as the processes follow a personalisation push strategy, the technology follows a codification pull strategy, and the people prefer a codification push strategy. Although it can be difficult to definitively say how large percentage of the firm's knowledge sharing is conducted using the different strategies, the lack of alignment between the different organisational components suggest that an optimal 80-20 strategic split has not been achieved (Hansen et al., 1999). Although the AB SubSea is currently not

at risk of over-committing to a single strategy (Venkitachalam & Willmott, 2017), by trying to excel at too many strategies at once the firm instead runs the risk of not succeeding at any.

Aligning the firm's people, processes, and technology is key for establishing successful business operations (Olmstead, 2024). In this case however, as the organisational components are heavily intertwined, the contradicting strategies may result in a negative cycle and added confusion, within the organisation, of how to work with LL. To start off the cycle, the documented processes contains how the firm should work with LL, however as the technology used by the firm is not built to facilitate the process, the documented processes work sub-optimally. The technology is instead built to facilitate another type of process, but as this process is not documented, people within the firm are not aware of how to most effectively utilise it and the technology is also in turn used sub-optimally. The sub-optimal processes and technology hence results in people not witnessing the full potential and value of LL and in turn people deprioritise it in times of stress. Additionally as people prefer a strategy that does not align with either the documented processes nor the technology, this could potentially make people less motivated to use the current processes and technology. The lack of motivation causes the processes and technology to be utilised less, resulting in people seeing even less value in LL and in turn closing the loop. All in all the firm runs the risk of being potentially stuck in a negative cycle as the lack of alignment between the firm's people, processes, and technology creates added friction within the LL-process.

5.2 Operational Inefficiencies

In addition to the KM strategies used by AB SubSea there also exists areas of improvement regarding operational inefficiencies associated with the firm's people, processes, and technology. Although these improvement areas are in large part connected to the strategic decision-making of the firm, these inefficiencies are not a direct result of strategic choices and could hence still be present no matter the choice of strategy. These operational inefficiencies, their root causes, and areas of improvement are presented here below.

5.2.1 People

As a result of LL-process being sub-optimal, the perceived value of LL among employees was found to have been impaired. From the survey we found that the applicability of LL was deemed to be average, and so was the implementation process. As each time an LL is assimilated it will lead to some degree of change, and people are generally reluctant to change (Creasy, 2024; Jermier et al., 1994), it can be argued that people are generally reluctant to the LL-process. In turn, in the current state, as the changes the LL-process has contributed, so far, has only showed average applicability, this reluctance may be further amplified. The reward associated with the

changes from LL has not been found to outweigh the effort and apparent riskiness it brings. Hence people are not motivated to prioritise working with LL and tend to deprioritise it in times of stress.

To overcome this reluctance, there exist a need to revers the perception of the risk versus reward associated with LL. The development of the LL-process is iterative, and is dependent on employee engagement over time as the process itself continuously improves. As mentioned in the COM-B framework, AB SubSea must hence establish a sense of motivation, among employees, to want to work with and improve the LL-process, and to elevate peoples' attitude and aspiration for change (Mayne, 2016; Askham, 2023). Some of the interviewees even expressed that there exist a need to improve the LL-culture within the firm. Fostering a LL-culture is of importance no matter the choice of strategy, to ensure engagement of learning and potentially trigger a positive cycle where people are motivated to share and retrieve LL (Olmstead, 2024). No matter the choice of final strategy, there exist a need within AB SubSea to change the perspective of LL among employees and highlight the long-term benefits associated with an effective LL-process.

5.2.2 Processes

One of the root causes, identified during the interviews, to why the LL-process does not work as intended, and why the global LL register is difficult to use, is that too much non-value adding information is added to the system. Currently the quantity of information in the system outweighs the quality of the information. This is in large part caused by a non-unified definition of LL. As mentioned by the interviewees, and later confirmed through the questionnaire, the definition of LL can vary among employees and projects. The different definitions in turn leads to a non-unified framework for what to include when reporting LL. Additionally, the most common response for what to include when reporting LL was "issues with products and/or processes" which goes against what is mentioned in AB SubSea's governing documents, which states that "a perceived problem or solution with a process or product where a solution has not been experienced as implemented and beneficial should not be included in Lessons Learned". The non-unified definition of LL results in a greater subset of information being collected and classified as LL, which exposes the firm to the risk of information overload (Bock et al., 2010), and may in turn negatively impact AB SubSea's dynamic capabilities (Teece et al., 1997, 2007). The non-unified definition of LL can be said to primarily affect the firms dynamic capabilities through how the firm works with sensing. Although the large amounts of information may promote the existence of a more opportunities, it also makes it increasingly difficult to identify them, as they are hidden among large amounts of unstructured and non-value adding information. Sensing constitutes the first part of the three step process presented by Teece et al. (2007) and if sensing does not work, neither will the subsequent steps of the process, compromising the firms dynamic capabilities.

In addition to exposing the firm to information overload, the non-unified definition of LL among employees and the firm, may also expose the AB SubSea to contribution overload (Bock et al., 2010). Currently there exist no clear framework of what to include when reporting LL, meaning that people may spend unnecessary amounts of time collecting, storing, and adding information to the system which will not provide future value. Furthermore, as people have different understandings of what should be stored on the global LL register, people may also try to retrieve different types of information from the system. As not all employees store the same type of information at the same place, this may cause inefficiencies in the LL-process as people can not find what they are looking for and information may be lost over time. In the end there exist a need for AB SubSea to develop a unified definition of LL among employees and make that definition aligned with the one defined in the firms governing documents. Although this has currently in large part affected the codified global LL register, a unified definition of LL would also be need if a personalisation strategy is to be followed. Having a unified definition of LL affects the sharing of LL no matter the format.

5.2.3 Technology

Finally, multiple of the interviewees expressed difficulties when it came to using the global LL register and sorting among the information within current system. This may be caused by the current system being built to handle a much smaller quantity of data compared to what it is currently being supplied. In accordance with the Al-Busaidi (2005), the KMS is not brought to system usage, as the quantity of data exceed the capacity of the system, resulting in the system no longer providing additional value on the same level as first intended. Instead employees opt to use their own registers and processes which harms the scalability of the LL-process and causes information to be potentially siloed and lost (Spender, 1996). Furthermore, when analysing the current system using the four aspects of a successful KMS, presented by Ahmad (2023), we also find that the technology infrastructure is not built to facilitate the current processes and the varying types of content, and large quantities, of information it is supposed to work with. If AB SubSea wishes to commit to a codification strategy, for it to be effective, either the firm must alter the processes surrounding the system and have better control of the content it is being supplied, or they must re-build the system to better align with their current processes and content.

As expressed during the interviews the firm needs to find a balance between the quality and quantity of information which the system is supplied. Currently this balance has not been found resulting in the system falling into the pitfall of information overload (Bock et al., 2010). In an optimal scenario, the trade-off between the quantity and quality of information is negligible. In this hypothetical scenario information overload is not an issue, but rather the large amounts of information is instead used as an asset. For this to be possible, it would require a different IT-system, with big data integration, which could both store and organise large

amounts of information (Rialti et al., 2019a, 2019b). The system should be accessible for everyone and people need to be able to effectively filter among the information to find relevant LL just for them. This is however not the case with the current state.

6
Discussion

Based on the opportunities for improvement identified in the analysis, below follows a discussion regarding different barriers for improvement. The specific context of AB SubSea is taken into account as both cultural and contextual barriers are highlighted. Additionally the practical and theoretical contributions of this study, and limitations and areas of future research are also discussed.

6.1 Barriers for Improvement

Although a handful of improvement opportunities were identified during the analysis, there also exist barriers for improvement which exerts additional challenges for AB SubSea. These barriers for improvement are below divided into cultural and contextual barriers.

6.1.1 Cultural Barriers

Cultural barriers refers to barriers which exist as a result of the firm's people, culture, and organisational structure. One such cultural barrier is the misalignment between the strategy which is theoretically most suitable for AB SubSea's operations and the employee's strategic preferences. As each of AB SubSea's projects are developed bespoke to the needs of the clients, collaborative problem solving and sharing of tacit knowledge is key to efficiently provide customised solutions. For firms whose operations possess these attributes, according to Hansen et al. (1999), a personalisation KM strategy is most suitable. However, although the personalisation strategy is favorable in regards to AB SubSea's operations, the preferred working method of the firm's employees, according to the questionnaire, is a push codification strategy. Considering the knowledge intensive nature of the firm, the firm's people, their individual knowledge, and creative way of thinking, makes out some of the most valuable assets for the firm. Since it is the people initiating the transfer and organisation of knowledge during projects, they are key whenever the firm works to develop customised solutions and product innovation. The people within the firm could be argued to be the most important part of the PPT-framework for AB SubSea. The misalignment between the strategy which best suit the firm's operations and the strategic preferences of the employees, may make up a potential barrier for improvement as if people do not want to work with the process, it may negatively impact employee engagement. Keeping employees engaged is key for the continuous

improvement of the LL-process over time, especially when the people make out one of the firm's most important assets. AB SubSea hence need to either decide upon a strategy which suits both its operation and its people, or work to keep employees engaged despite their contradicting preferences.

Other cultural barriers may also exist when attempting to establish a globally unified LL-culture. Since the people of the organisation are the ones controlling both how the processes of the firm are structured, and how their KMS are characterised, focus needs to be aimed at establishing a better integrated LL-culture within the firm. However, even if tools, such as the COM-B framework, are utilised for changing the behavior and actions among employees, the establishment of a more globally unified LL-culture may be difficult to achieve. As AB SubSea is a large multinational company, with umbilical production sites in both Norway and America, there might exist cultural barriers for implementing a unified LL-culture, due to the domestic civilian cultures. The preferred KM strategy may be different among employees working at different offices and locations worldwide. For example, while strategic changes made for areas of the company located in Norway may be beneficial there, it does not necessarily mean that the same implementations will yield the same outcomes in America, and vice versa.

6.1.2 Contextual Barriers

Contextual barriers include barriers which exist due to the wider context of the firm and the nature of the oil and gas industry. The characteristics of the industry may make out a contextual barrier for the development of the LL-process at AB SubSea, as although the objective of the LL-process is to provide organisational improvements over time, there is no guarantee that so will always be the case. Whenever a LL is assimilated it leads to some degree of change, and whenever change is implemented there is always some degree of risk involved. Considering the projects conducted by AB SubSea run across several years, require large amounts resources, and handle very sensitive commodities, any errors within the firm's processes or products could potentially lead to large negative financial and environmental impacts. Maintaining high quality of the SPS, is hence critical, and although this could be used as an argument to promote the importance of the LL-process, as it facilitates continuous improvement, the high risk associated with errors could also make people increasingly risk-averse and reluctant to change. This may constitute another barrier for improvement as even if LL are meant to be continuously assimilated to enhance the overall efficiency of the company's operations, people may overlook the potential improvements and be reluctant to change, as they are afraid that the implementations could instead result in greater losses. Therefore, employees could prefer keeping the already established procedures and technologies, that is already known to function properly, and avoid engaging in the LL-process.

Another contextual barrier for improvement, for firms active in the oil and gas industry, is that while an effective LL-process may be beneficial for the firm's bottom line, as it promotes increased efficiency and effectiveness of the firm's operations, it

may also have an opposite effect on the environment. As the world is transitioning to sustainable energy solutions, by increasing the output of oil and gas produced, this may counteract this transition. Hence, potential impacts on the environment caused by implementation of LL must be handled sensitively. All LL must be evaluated to a greater degree, than in perhaps many other industries, as both the financial and environmental impact must be considered. Additionally, as society is becoming more sustainability-oriented, firms active in the oil and gas industry are encountering increasing regulatory and public pressure, which will likely only continue to grow over time. Hence, there is further need to carefully evaluate all LL, which may slow down the LL-process.

6.2 Practical and Theoretical Contributions

This report provides practical contributions to firms both within and outside the oil and gas industry, as although the results from this study are in large part dependent on the context of the case company, the findings are likely not unique and it is probable that similar issues can be found in other organisations as well. As mentioned in the introduction, only 18% of KM professionals express a high level of satisfaction towards their current KM solutions (McKendrick, 2023). In addition to this, McKendrick (2023) also lists, cultural issues and a lack of strategy are some of the reasons for why these results look the way they do. More firms are hence likely experiencing some of the challenges which we have identified and the findings and opportunities for improvement found at AB SubSea, could hence potentially be found in other organisations as well. This report raises the awareness for these improvement opportunities, and provides suggestions for how they can potentially be handled.

The study also contributes to theory in two main ways. Firstly, the study builds on the existing body of KM research by providing a deep dive into how LL are managed within the specific context of a global oil and gas energy solutions provider. The findings from this study can later be compared against similar studies conducted at other firms as well to see what similarities and differences may exist, and to investigate the extent of which the improvement opportunities, that were identified, may exist elsewhere. Secondly, in this report we developed a new model for depicting and breaking down the life-cycle of LL. We condensed previously established frameworks for managing knowledge and LL, and divided the LL life-cycle into four main steps. The generation, collection, distribution, and assimilation of LL. The model provides a new perspective for breaking down LL and is unique in that it firstly, both accounts for the collection of LL to be distributed and the collection of LL to be assimilated, and secondly, it separates the parts of the process which are the responsibility of the firm, and which parts exist among the individual.

6.3 Limitations and Areas of Future Research

Based on the limitations and findings from this study, a set of interesting areas of future research were identified. Firstly, one key limitation of this study is that all our findings are based on a single case study. Although we can suspect that our results are not necessarily unique to AB SubSea, it would be interesting to confirm this and build on this study by investigating the generalisability of our results to other firms as well. It would be interesting to see what differences exist in the LL-process at other firms, both within and outside the oil and gas industry, and how they work with strategic KM.

Secondly, in this study we followed the assumptions of the knowledge-based theory of the firm and assumed knowledge to be a resource which exist among the individual members of the firm (Grant, 1996). The role of the firm was hence assumed to only constitute the integration of specialist knowledge that exist among its members. It was hence decided that the generation phase of the LL life-cycle was to be excluded from this study. Although the generation of LL does occur on an individual basis, the individual is affected by the actions of the firm surrounding him or her. Hence, to get a more holistic perspective of how the firm's actions may impact the entire LL life-cycle, the firm's contribution to the generation of LL could also be an interesting area of future research.

Finally, one of the key take-aways from the analysis was that the firms current KMS is not built to facilitate the large variety and quantity of data which it is currently being supplied. To mitigate the trade-off between quality and quantity of information, big data integration was mentioned. However, one interesting avenue of big data in KM is the usage of artificial intelligence (AI). According to Jarrahi et al. (2023), AI excerpts interesting possibilities when applied in the field of KM, as it may promote the creation, storage and retrieval, sharing, and application of knowledge. Additionally, the possibilities of AI also opens up other interesting research areas, for example in its ability to potentially bridge the gap between codification and personalistaion.

7
Conclusion

The purpose of this report was to investigate and understand how LL are managed and utilised throughout the organisation of a oil and gas energy solutions provider, focusing on subsea solutions. Through studying the practical application of the LL-process at AB SubSea, we can now answer our two research questions.

RQ1: How are lessons learned between projects collected, distributed, and assimilated within the context of a global oil and gas energy solutions provider?

Although, the firm has well-documented process for most of its operations, no predefined process exist for the actual LL-process itself, covering all steps of the LL life-cycle. The collection of LL was the best documented part of the process, as AB SubSea conducts three pre-planned LL-sessions throughout all projects. One during the beginning, one during the middle, and one during the end of all projects. Regarding the distribution and assimilation of LL however, the lack of well-documented processes was more evident. In turn, this resulted in people using their own processes for storing and sharing LL, LL being shared in different formats, and the processes for following up on LL being less well-defined.

RQ2: What potential opportunities and barriers exist for improving the management of lessons learned within this context?

The potential opportunities for improvement, which were identified, can be divided into two categories. Firstly, AB SubSea should strategically align its people, processes, and technology. Currently the firm's people, processes, and technology all follow, or prefer to follow, different strategies causing the LL-process to work suboptimally. Secondly, there exist non-strategic operational inefficiencies which should be addressed. These inefficiencies are causing friction within the LL-process, and include improvement areas such as increasing the motivation to work with LL among employees, creating a unified definition of LL to avoid information overload, and developing the technology to facilitate the varying types, and large amount, of information it is being supplied. Together, the two categories constitute opportunities for improvement, which if addressed and mitigated could potentially facilitate the effectiveness of the LL-process. When addressing these improvement areas however, there does exist a handful of both cultural and contextual barriers for improvement, as the strategic preferences among AB SubSea's employees goes against what best suits the firm's operations, the firm must consider different local cultures, the nature of the industry promotes risk-aversion, and the firm is facing increasing environmen-

tal pressure. These barriers exerts additional challenges on the improvement work and needs to taken into consideration.

In the end this report highlights a unique example for the practical application of LL, and raises the awareness of certain improvement opportunities, which are likely applicable to wider range of firms and industries.

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A

Focus areas for interviews

The focus areas for the interviews can be summarised into the following four questions:

- How is knowledge generated in other projects/parts of the organisation collected to be used in your project?
- How is knowledge generated in your project collected to be distributed to other projects/parts of the organisation?
- Once the knowledge has been collected, how is it then distributed throughout the organisation?
- Once the knowledge has been distributed, how do you work to ensure that the knowledge then is assimilated and utilised?

B

Questionnaire

Short written response:

- What is your role at AB SubSea?
- How do **you** define "lessons learned" within the context of the projects that you work in?
- What specific types of information do you typically include when reporting "lessons learned"?

The following questions were rated based on a scale of 1-6:

- In which format do you **mostly receive** "lessons learned"?

  Written <— 1 — 2 — 3 — 4 — 5 — 6 —> Verbal

- In which format do you **prefer to receive** "lessons learned"?

  Written <— 1 — 2 — 3 — 4 — 5 — 6 —> Verbal

- In which format do you **prefer to share** "lessons learned"?

  Written <— 1 — 2 — 3 — 4 — 5 — 6 —> Verbal

- When working with "lessons learned", which approach do you prefer

  I look for "lessons learned" myself <— 1 — 2 — 3 — 4 — 5 — 6 —> I am given "lessons learned" by others

- Do you agree with the following statement?:
  I find it easy to find "lessons learned" that are relevant for me (in the current system)

  Disagree <— 1 — 2 — 3 — 4 — 5 — 6 —> Agree

- In your opinion, how applicable have the "lessons learned" been, that you have received to use in your project?

  Not applicable <— 1 — 2 — 3 — 4 — 5 — 6 —> Very applicable

- How well have the "lessons learned", that you have received in your projects, been followed-up and implemented?

  Not at all <— 1 — 2 — 3 — 4 — 5 — 6 —> Very well

C

Flowchart from document analysis

On the following page is a flowchart describing how a LL moves throughout AB SubSea from the point it has been collected to when it has been assimilated. This flowchart was developed during the document analysis and is based on AB SubSea's governing documents. Additionally the sub-processes listed in the flowchart can also be seen below.

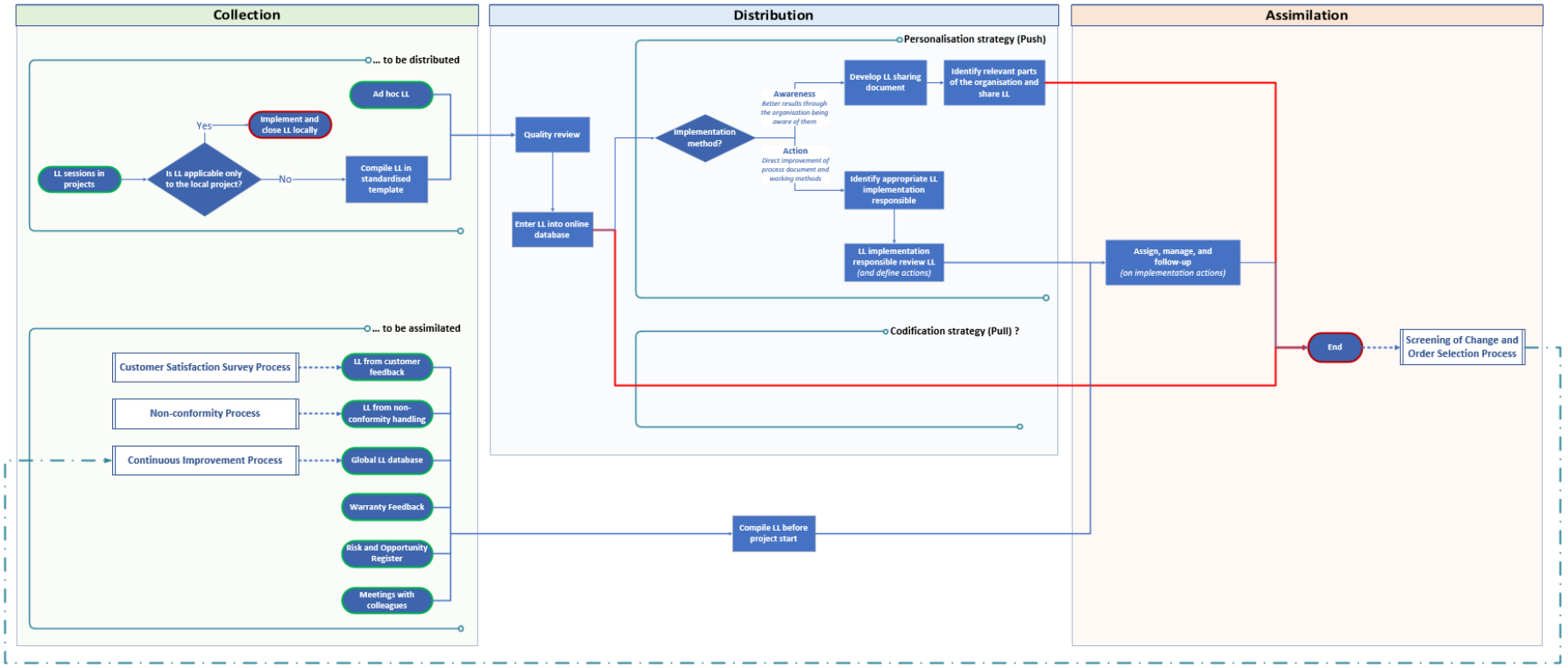

Figure C.1: Flow chart of how a LL moves throughout AB SubSea

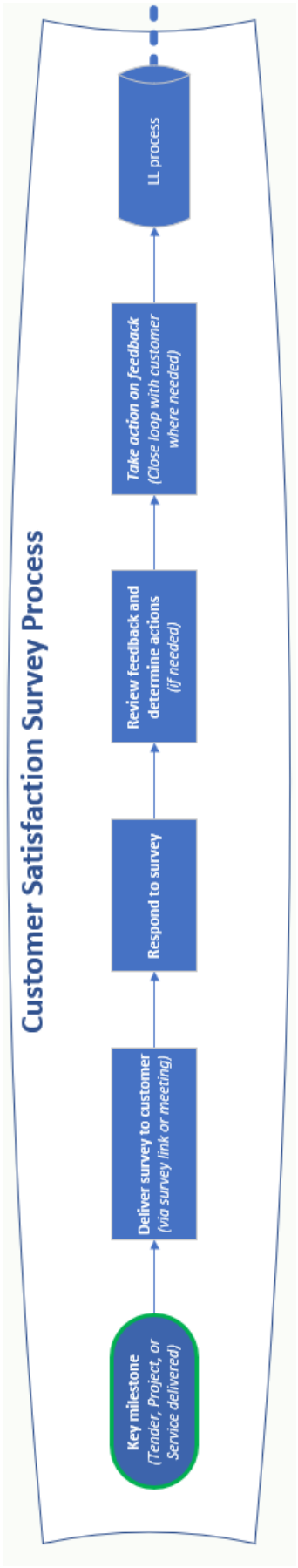

Figure C.2: Flow chart of the customer satisfaction survey sub-process

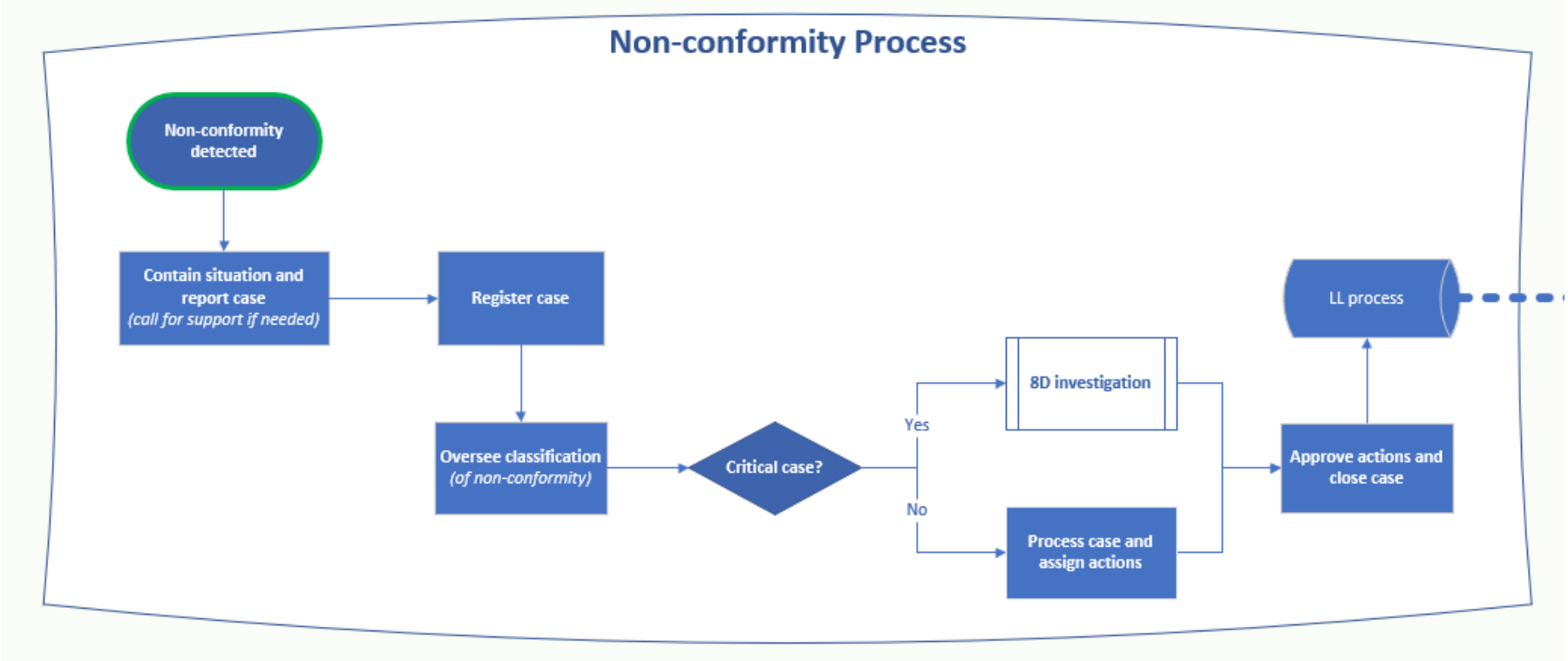

Figure C.3: Flow chart of the non-conformity sub-process

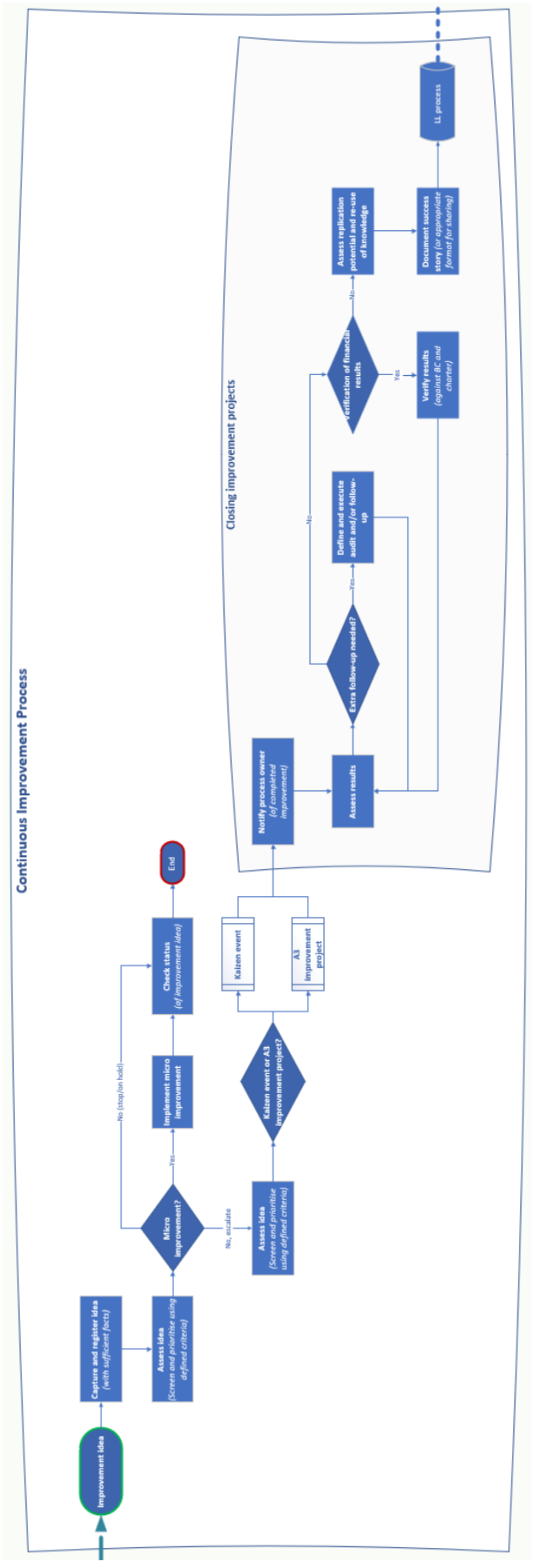

Figure C.4: Flow chart of the continuous improvement sub-process

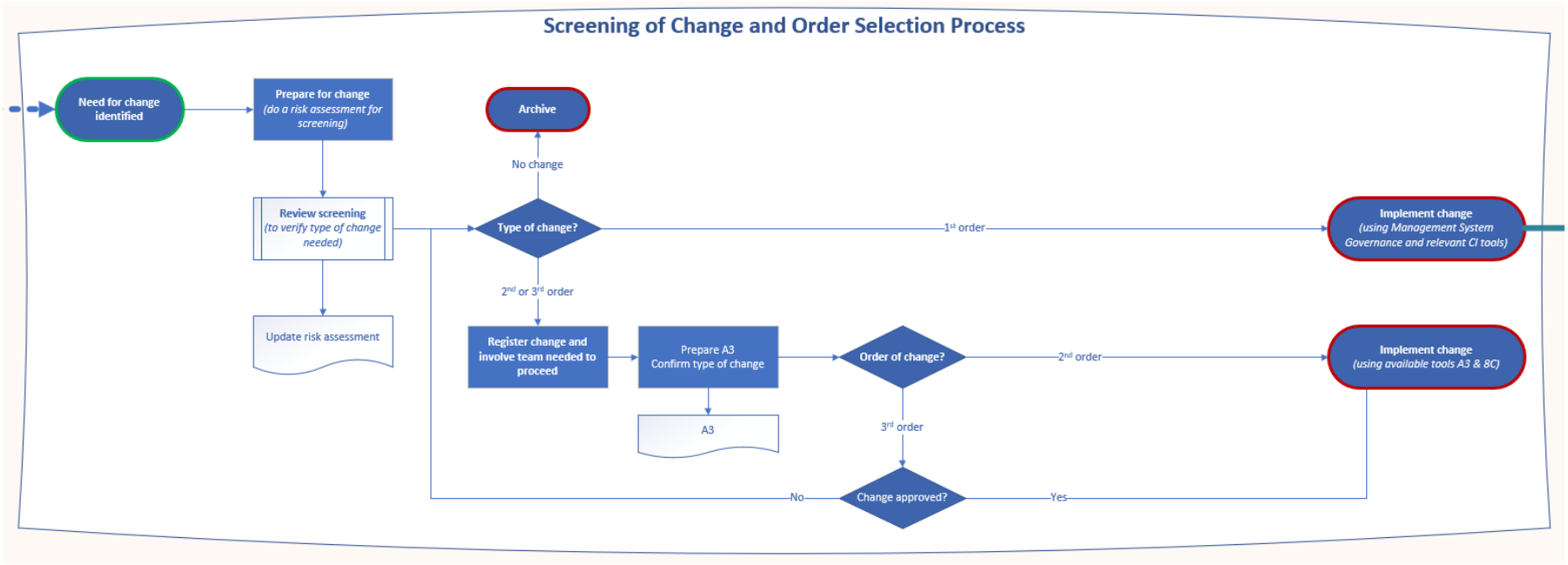

Figure C.5: Flow chart of the screening of change and order selection sub-process

D

Coded interview results

Below follows the coded responses from the interviews that have been grouped into themes. The arrows between the themes also indicate how the themes correlate with each other. The theme at the beginning of the arrow is said to directly impact the theme at the end of the arrow.

Before the coded responses, Figure D.1 shows a general overview of the structure used for the results from the interviews.

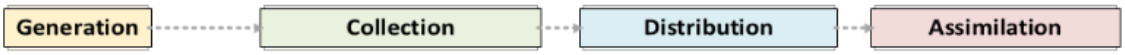

Figure D.1: Overview of structure for the results from interview

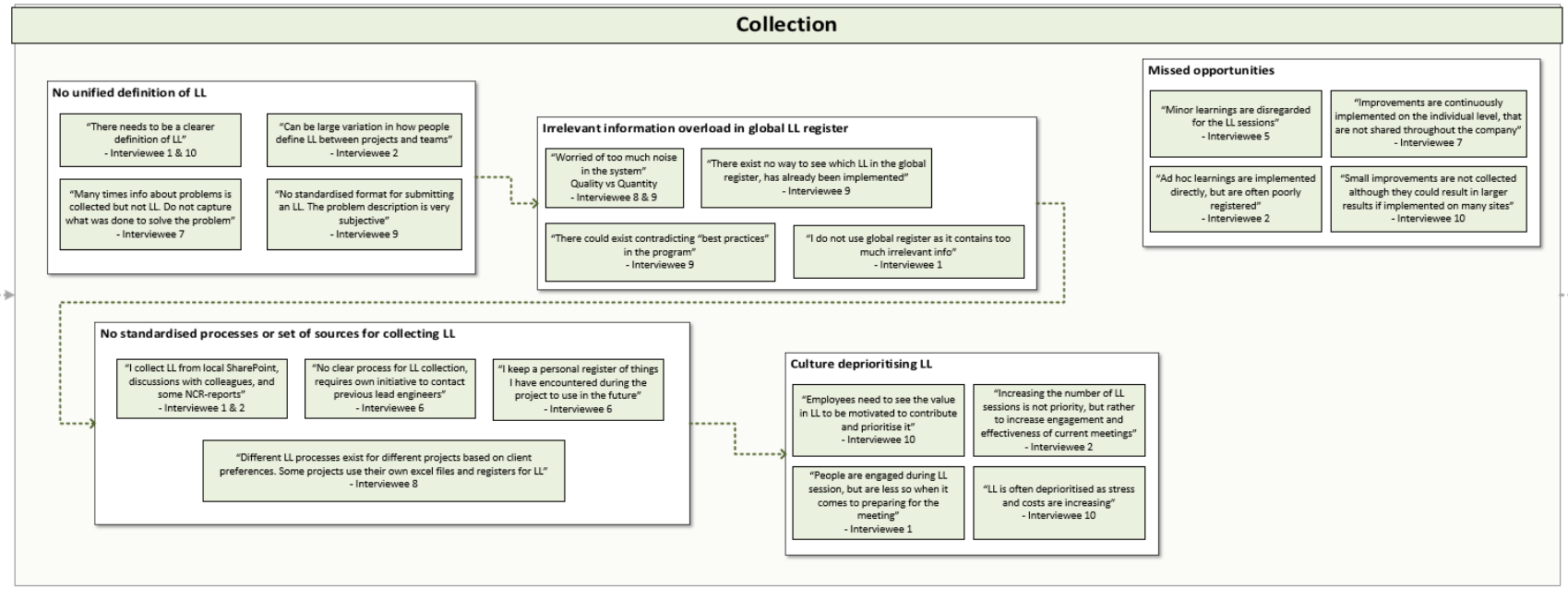

Figure D.2: Interview results collection

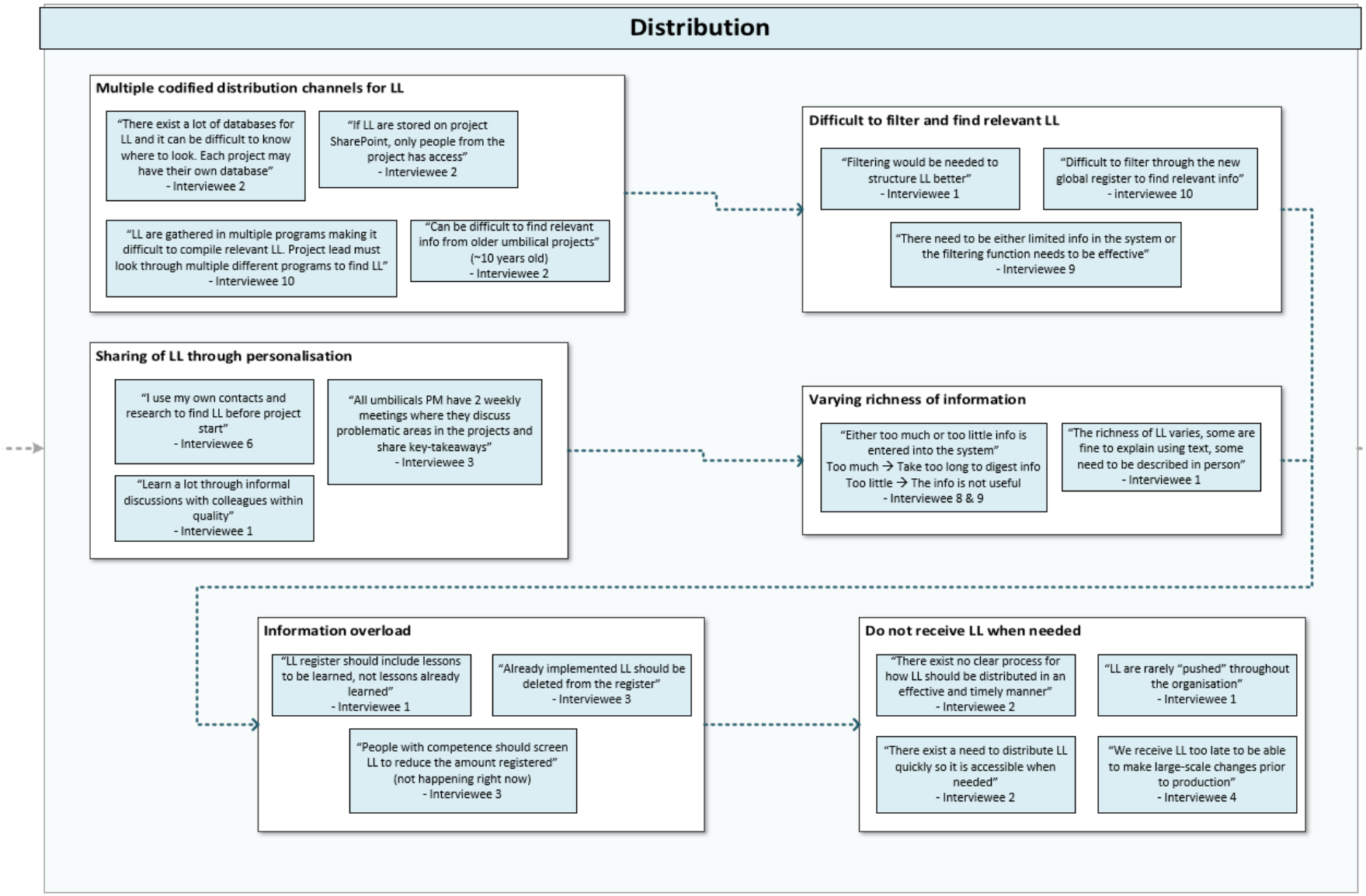

Figure D.3: Interview results distribution

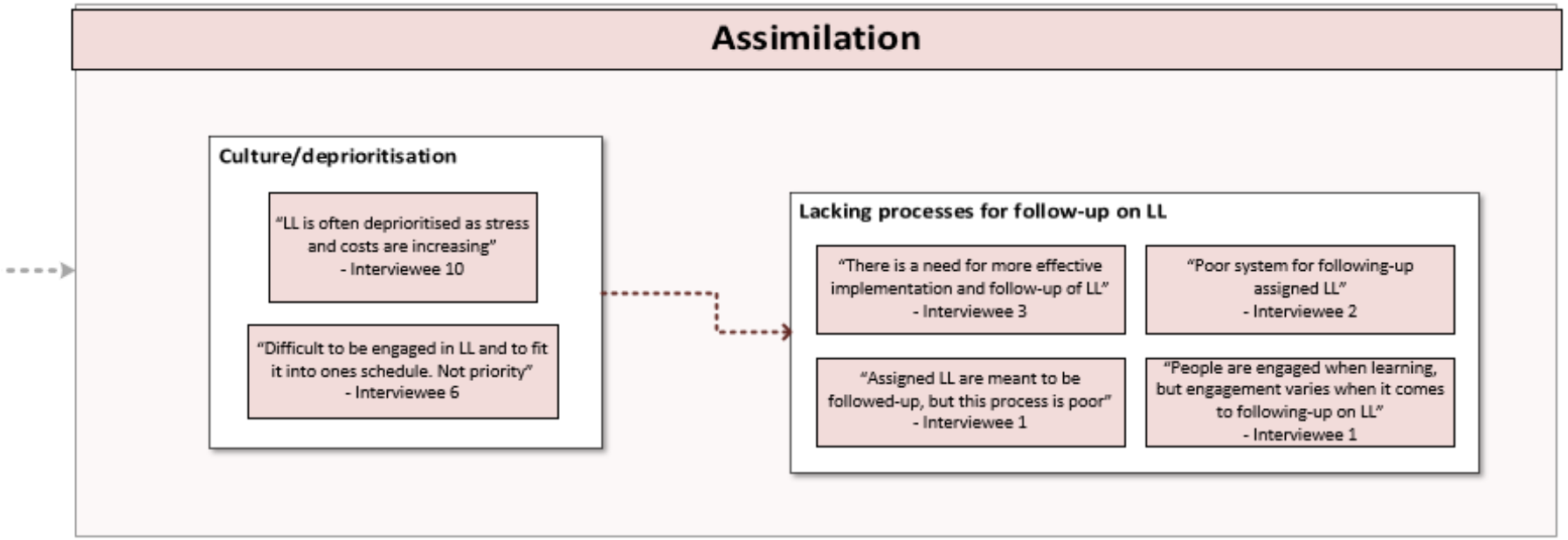

Figure D.4: Interview results assimilation

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