Universitetet i Stavanger

DET TEKNISK-NATURVITENSKAPELIGE FAKULTET

MASTEROPPGAVE

Studieprogram/spesialisering: Industriell økonomi, prosjektledelse	Vårsemesteret, 2021 Åpen
Forfatter: Sina Furenes, Magnus Kvanvik	*Sina Furenes Magnus Kvanvik*
Fagansvarlig: Eric Christian Brun Veileder: Samya Halim	
Tittel på masteroppgaven: Implementering av Agile Prosjektledelsesmetoder i et Brønnintervensjons-selskap Engelsk tittel: Implementation of Agile Project Management Methods in a Well Intervention Company	
Studiepoeng: 30	

Emneord:
 	
  Prosjektledelse
  Agil prosjektmetodikk
  Implementering av agil
  prosjektmetodikk
  Scrum
	Sidetall: 102
	
	+ vedlegg/annet: 7
	
	Stavanger, 15. juni 2021

Abstract

Projects are progressively becoming more complex with a higher number of tasks and complex interrelations. The field of project management must manage an increasing degree of change, which makes the traditional approach to project management less and less suitable to the projects of today. Agile methodologies from the software community offers a new way of thinking and is specifically designed to embrace complexity and change. Following, the use of Scrum has escalated in the last decade and has begun to spread to other industries.

This study is written in collaboration with a well service company in the Norwegian Oil & Gas industry. Despite great promise from early pilots, heavy-asset industries such as the Oil & Gas industry have to a great extent held back from the agile revolution. The purpose of this thesis is to create a theoretical overview over Scrum and its framework and research how Scrum has been implemented in domains outside software development. Then, the company's current practice is mapped out through meetings and interviews, and challenges are identified. The interviews, Scrum framework and the research on previous implementations are used together with the findings on today's practice to propose a way to implement Scrum in the company. Ultimately, it is discussed how Scrum can improve the current process of planning and execution of well intervention services.

The results of the study have found that the company faces challenges related to scope change, interdependence between projects and organisation. A traditional approach cannot handle changes and interdependencies to the degree that the company is facing. Operations Supervisors describe that a significant part of the work done in relation to planning and following up an operation is handling changes. In addition, the model the company uses for planning and execution does not include a satisfactory opportunity to improve work processes. However, the traditional approach has some benefits that suits the company in form of standardisation and linearity.

The suggested solution for implementation of Scrum is to keep the traditional model used today and implement Scrum to the operational process for delivering services. By starting with a pilot team, the framework is adjusted to the company before considering a large-scale implementation. There is no need for large adaptations from the current practice with this solution. The team will work as before, but the Sprint with its events will be incorporated as an addition. There are some challenges with the current solution in terms of client involvement and team composition to mention a few.

The Scrum framework provides an opportunity for empirical learning which improves the planning and execution process continuously. This leads to a slow and steady removal of impediments which increases productivity. Implementing a cross-functional Scrum team can lead to higher focus and less distractions in terms of switching between projects. Silos are removed, and completing the tasks related to an operation is now a team effort. Weekly Sprints makes the team plan their upcoming week, which will structure the work week. Each Sprint will provide empirical learning and historical data-gathering. This learning can lead to a more predictable work week, a reduction in scope change and interdependence, as well as improving internal challenges related to the organisation.

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1 Introduction

This section presents the background for the thesis, problem statement with research questions and an overview of how the thesis is structured.

1.1 Background

Projects are progressively becoming more complex with a higher number of tasks and complex interrelations (Hass, 2007). In environments driven by continuous change and transformation, organisations face the need to adapt themselves in order to gain strategic advantages and market success (Stoica et al., 2013). Takeuchi and Nonaka (1986) emphasise that flexibility and cooperation are key characteristics, as they enables organisations to quickly adapt to change and innovation. A weakness of the traditional project management approach, is that it is not suited to handle all the complexity and dynamics of projects today (Cicmil et al., 2006, 2009; Williams, 2005; Špundak, 2014). As a result, agile approaches were developed in the software community. The idea was to develop an approach that welcomes and embrace change (Wysocki, 2014; Aguanno, 2005). For many, agile approaches offers a new way of thinking (DeCarlo, 2010; Shenhar and Dvir, 2007).

The most famous agile approach is Scrum, which is most commonly used for software and product development. The framework provides flexibility and is focused on customer satisfaction. Jeff Sutherland explains that Scrum is not a formal process or a method for development, rather it is a compression algorithm for best practices observed worldwide in over 50 years of software development (Sutherland and Schwaber, 2011). For a software development team, it is easy to implement the Scrum framework. Another interesting aspect of Scrum is that it can presumably work in any domain. *"It is a significant innovation in the way to get things done faster with higher quality while making the working experience more rewarding for all participants"* (Sutherland and Schwaber, 2011, p. 7).

Landaeta et al. (2011) suggest that there is a learning opportunity that is not being addressed in the Scrum framework, which is learning across projects. Each project is a potential source of knowledge that, when made available, has the potential to enhance the overall sustainability and competitiveness of the organisation. Project managers should focus on the importance of learning within and across projects (Landaeta et al., 2011).

> *"Project management performance is positively associated with project knowledge. Having knowledge about what could go wrong, ways to ensure success, and ways to avoid problems supports the organisation in delivering better products and services and managing projects better. Increased knowledge includes not encountering the same problems over and over again and not reinventing the solutions to problems. This knowledge helps the organisation better plan a project, meet cost, schedule, and performance requirements"* (Kotnour, 2000, p. 400-401).

The growing popularity of Agile management methods has lead to their application to a number of areas outside software development (Oprins et al., 2019). Yet, asset-heavy industries, such as the Oil & Gas industry, have to a great extent held back from the agile revolution (Handscomb et al., 2019). Sljivar et al. (2018) argues that agile methods have an immeasurable potential to benefit both operating and service companies. The early evidence from agile pilots backs up his statement. BP reported a cut of $ 1 billion from a new project in the pre-final investment-

decision, and the Company has now trained over 3000 employees in Scum practices (Venables, 2019). Another oil and gas company managed to halve the design time of new wells by forming cross-functional teams working in sprints with rapid learning cycles (Handscomb et al., 2019).

This thesis is written in collaboration with an Oil & Gas Company who provides well intervention services for several clients through long-term contracts. Their approach for planning and execution of well service follows a traditional approach. Despite a successful operation, their planning process is described as a daily fire-fighting due to a high-degree of complexity and changes.

This raises the question: *Can Scrum be implemented to a process for planning and execution of well intervention services?* We have found no published literature where Scrum has been implemented to an environment that matches the company's environment. It is therefore interesting to investigate what has been done in other domains, and to see if there are any cases to draw similarities towards this company's environment. Following, the purpose of this thesis is to study how agile approaches can be implemented, what challenges they might face and what they can benefit from switching to an agile approach. More specifically, the Study investigates how Scrum can improve their current process.

1.2   Problem Statement

The purpose of this thesis is to create an overview of current practices and challenges within the company and investigate how these challenges can be solved by implementing Scrum. The goal is to combine current practices, existing literature and lessons learned from other domains who has adopted Scrum, to create a suggested solution for Scrum implementation. From here, the Problem Statement is:

How can Scrum improve the operational process of planning and execution of well intervention services?

To answer this question, it is relevant to answer the following research questions:

1. *What are the challenges related to the company's current practice of planning and execution of well intervention services?*
2. *How can Scrum be implemented, and what issues can inhibit the implementation?*

The study consists of qualitative interviews and weekly meetings with employees at the Company. The interviews and meetings form the basis for the current challenges and contributes to the suggested solution.

1.2.1   Limitations

This study is limited to the planning and follow-up during execution of well intervention services, which is performed onshore, and does not investigate the execution of the service itself, which is performed offshore. The process is investigated from a project management perspective.

1.3 Structure

This thesis consists of eight chapters, in addition to references and appendix. The content of each chapter is presented in table 1.1.

Table 1.1: Structure of thesis

Section	Content
Section 1	Presents the background of the thesis, problem statement with research questions, limitations and the structure of the thesis.
Section 2	Presents the concepts of traditional and agile project management, in addition to challenges and success factors of agile implementations.
Section 3	Presents the framework of Scrum, how Scrum has been implemented in other domains than software, and what lessons are learned from these implementations.
Section 4	Presents the methods that are used for this thesis.
Section 5	Presents the company's current practice of planning and execution, and the challenges related to this practice.
Section 6	Proposes a suggested solution for implementation of the Scrum framework in the company, based on theory and results from interviews and meetings.
Section 7	Discusses the results in light of the theory. Divided into three parts: • Challenges with current practice. • Implementation of Scrum • How Scrum can improve the current practice.
Section 8	Presents the conclusion.
References	Presents the references used in this thesis.
Appendix	Presents interview guides, responsibilities of different roles in the company and reasons for extra and corrective shipments in 2020.

2 Project Management Theory

An organisation's activity can be divided into two categories: operations and projects. Operations are repetitive, ongoing activities, such as production, service, or manufacturing. Projects are unique, one-time initiatives, such as product launches, improving existing products, or investing in the company's infrastructure (Shenhar and Dvir, 2007). Srivannaboon (2009) points out that business strategy can be delivered through projects, and project management is key for an organisation to deliver its strategic intent. Shenhar and Dvir (2007) emphasise that the only way to innovate, change, implement a strategy, or gain competitive advantage within an organisation is through projects.

There are several definitions to what a project is. The Project Management Institute defines a project as *"a temporary endeavour undertaken to create a unique product, service or result"* (PMI, 2017, p. 3). Shenhar and Dvir defines a project as *"a temporary organisation and process set up to achieve a specified goal under the constraints of time, budget and other resources"* (Shenhar and Dvir, 2007, p. 5). A projects temporary nature indicates that a project has a definite beginning and end. The project's end is reached when the objectives of the project have been achieved or cannot be met. The outcome of the project is a unique product, service or result. Some projects may have repetitive elements but repetition does not change the unique characteristics of the projects (PMI, 2017).

Wysocki (2014) has defined a project landscape using two variables - goal and solution. When goal and solution is clear, it generates the *Traditional Project Management* (TPM) category. When the goal is clear, but the solution is not, it generates the *Agile Project Management* (APM) category. The study will look at both categories in this section.

2.1 Traditional Project Management

Project management principles established in the 1950's advised that every project should apply methods and procedures in a uniform way to ensure robustness and applicability to projects ranging from simple and small to complex and large (Špundak, 2014). The traditional approach to project management assumes that projects are simple, predictable and linear, with clear boundaries which enables detailed planning without much re-planning because of changes (Andersen, 2006; Boehm, 2002; Boehm and Turner, 2003; Cicmil et al., 2009; Collyer et al., 2010; DeCarlo, 2010; Leffingwell, 2007; Shenhar and Dvir, 2007; Williams, 2005; Wysocki, 2014; Špundak, 2014). The goal is clearly specified by the client and the project team has clearly defined how to reach that goal. Therefore, the client is often involved in the beginning of a project and then less involved for the remainder of the project (Wysocki, 2014). The success of a traditional project is measured by time, cost and scope, often referred to as the iron triangle (Atkinson, 1999), but studies have shown that these measures are not sufficient (Papke-Shields et al., 2010; Shenhar, 2004). When evaluating the success of a project, dimensions such as business results and preparing for the future should also be considered (Saladis and Kerzner, 2011; Sauser et al., 2009).

Figure 2.1 shows a general model for traditional projects with five process groups or stages defined by the Project Management Institute; Initiate, Plan, Execute, Monitor and Control, and Close (PMI, 2017). Wysocki (2014) refers to this model as the Linear Project Management Life Cycle model, and refer to the initiating stage as scope and the

execution stage as launch. When predefined milestones or objectives are achieved, the project moves sequentially from one stage to the next, and each stage produce a deliverable in form of documentation of the work undertaken, rather than the product itself (Ahimbisibwe et al., 2015; Boehm and Turner, 2003). The project is designed to be completed in one unique cycle (Ramesh et al., 2012) and once a stage is completed, it is assumed that it will not be revisited (Hass, 2007).

Figure 2.1: The Linear Project Management Life Cycle model (Source: (Wysocki, 2014, p. 43))

Strengths

The strengths of the traditional approach lie in the standardisation and robustness which brings the ability to compare and repeat projects (Boehm and Turner, 2003). The entire project can be scheduled in advance by laying out the steps of the project, and the importance of defining requirements is stressed (Hass, 2007). By defining the way specific processes are performed, any person with training in the organisational process will know where to find information and how to estimate common work. With much information maintained within the process, team members can be moved quickly between projects without a great deal of training (Boehm and Turner, 2003). This means that the most skilled resources are not required for a project, and loss of key personnel will not necessarily doom the project (Boehm and Turner, 2003; Wysocki, 2014).

Weaknesses

If the traditional method is too strictly applied, plans and processes can hinder innovation or lead to a mechanical checklist mentality, where the plan becomes the main focus and the product (and customer) has less priority (Boehm and Turner, 2003; Wysocki, 2014). Even though robustness is emphasised as one of the strengths of traditional approach, stating that the same methods and techniques can be applied to all projects is increasingly mentioned as one of its weaknesses (Špundak, 2014). Projects are progressively becoming more complex, with a higher number of tasks and complex interrelations. This is a problem for the traditional approach, as its linear task relations and cannot handle the complexity and dynamics of the modern projects (Cicmil et al., 2006, 2009; Collyer et al., 2010; Hass, 2007; Williams, 2005; Špundak, 2014).

Assuming that the project is isolated from its environment is also a weakness to this approach (Cicmil et al., 2009; Shenhar and Dvir, 2007). Changes, in any form, are inevitable due to unpredictable and dynamic changes in the project environment or within the project itself (Collyer et al., 2010; Špundak, 2014). Traditional projects are intolerant to changes. The focus is to deliver within time and budget, rather than delivering business value, by following the initial detailed plan in an effective and optimised way (DeCarlo, 2010; Shenhar and Dvir, 2007; Wysocki, 2014). Ironically, Wysocki (2014) also lists time and cost overruns as one of the weaknesses of the traditional approach.

2.2   Agile Project Management

The weaknesses in traditional approaches is highly connected to complexity. However, in the context of project, the term complexity is ambiguous (San Cristóbal et al., 2018). One definition of complexity is the degree of manifold, interdependence and the consequential impact decision field (Brockmann and Girmscheid, 2007). In similar fashion, Zolin et al. (2009) define a complex project as one that *"demonstrates a number of characteristics to a degree, or level of severity, that makes it extremely difficult to predict project outcomes, to control or manage project"* (Zolin et al., 2009, p. 5).

Baccarini (1996) highlights the importance of complexity and its effect on projects in terms of experience requirements, procurement arrangements, project organisation, goals and objectives. This is supported by (Parsons-Hann and Liu, 2005) conclusion that complexity is a contributing factor to project failure. Thus, knowing how to avoid or mitigate complexity is a key aspect of project management (Vidal and Marle, 2008). As complexity in projects progressively grew, frustration over the traditional model's shortcomings grew among project management. As a result, in February 2001, members from the software community created the *Agile Manifesto* in an attempt to control and manage complexity (Beck et al., 2001). The manifesto is in many ways fundamentally different from traditional project management approaches. Whereas traditional management underlines a rigid plan, comprehensive documentation, avoiding change, the manifesto focus on (Beck et al., 2001, p. 1):

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

The agile manifesto marked the beginning of Agile Project Management (APM) (Cervone, 2011; Ciric et al., 2018). Following, *"APM is the collection of Project Management Life Cycles (PMLC) models that can be used to manage complex projects, whose goals are clearly specified but whose solutions are not known at the outset of the project"* (Wysocki, 2014, p. 328). Compared to traditional approaches, these methods welcome change and shines in dynamic and continuously changing environments. Today, agile methods are primarily used in software development, where it has is origin. According to the literature, APM is preferred when the some of the following characteristics describes the project (Ciric et al., 2018; Špundak, 2014; Fernandez and Fernandez, 2008; Nicholls et al., 2015):

- The Scope is poorly defined
- When there is a number of unknown task and incomprehensible task times
- When there is unknown task dependencies and resource availability
- Small and collocated project teams
- Innovative or unclear requirements
- Frequent contact with end user
- Complex and iterative plan

APM models can further be classified as either an Iterative or an Adaptive model (Wysocki, 2014). Iterative PMLC models are appropriate for projects where most of the solution has been discovered. In comparison, adaptive PMLC models are advised for projects where very little of the solution is known (Fernandez and Fernandez, 2008).

The Iterative PMLC model, presented in Figure 2.2, consists of a number of repeated cycles that include a feedback loop after a singular or multiple stages are completed (Fernandez and Fernandez, 2008). The cycles are designed to identify, select, and integrate the missing pieces of the solution (Wysocki, 2014).
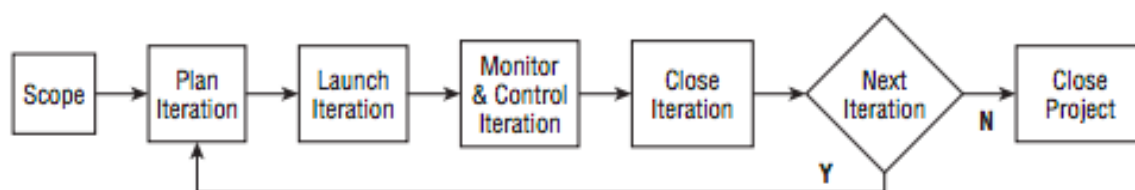
Figure 2.2: The Iterative Project Management Life Cycle model (Source: Wysocki (2014))

As figure 2.2 shows, the foundation of the iterative approach are short iterations (Salameh, 2014), where each cycle is complemented by ongoing learning (Sauer and Reich, 2009). The planning is often done at two levels. Since the solution details is missing initially, the first planning phase consists of developing a high-level plan without much detail. The high-level plan consists of a prioritised list of features and requirements based on perceived client value (Salameh, 2014). The next cycle will then be planned in more detail based on the highest prioritised requirement. The idea is to deliver an intermediate and often incomplete solution of value to the client at the end of each cycle, and ask for feedback (Wysocki, 2014). Based on the feedback, changes and/or addition are integrated to the solution during the next cycle (Salameh, 2014). Following, the specific details will become clearer as the client work with the most recent solution in a prototyping sense. The process repeats itself until the client is satisfied or until the budget and/or time runs out (Wysocki, 2014). Collaboration and strong communication between the contractor and the client are a fundamental part of the iterative PMLC. The assumption is that the client learns and discovers more details about the solution from the current iteration (Wysocki, 2014).

In general, the main strengths of the iterative cycle are (Fernandez and Fernandez, 2008; Nicholls et al., 2015):

- Faster produced business value
- Change request can be accommodated between increments
- Change request can be discovered through incremental solutions
- Stronger focus on customer value compared to the traditional approach
- Increased efficiency, productivity and responsiveness to customers

On the other hand, its main weaknesses are difficulty in defining function/feature dependencies and that it requires heavier customer involvement compared to the linear approach (Fernandez and Fernandez, 2008).

2.2.1 Challenges With Agile Implementations

Agile methods can be difficult to implement, and there are several identified challenges related to large-scal agile implementations (Dikert et al., 2016). In the transformation to agile methods, there has been a general resistance to change (Dikert et al., 2016; Nerur et al., 2005). People are not willing to change unless they understand the reason for change, and the change is perceived as easy enough. Scepticism often arise from misconceptions, such as; agile does not work for complex products, new ways of working, agile needs to be implemented in a prescriptive by-the-book way, frequent meetings will cause overhead and agile equals avoiding governance and working without a plan (Dikert et al., 2016).

A lack of investment can also challenge the transformation. Lack of training and coaching can create difficulties in the transformation (Dikert et al., 2016; Ozierańska et al., 2016; Akif and Majeed, 2012). To coach teams in their real work environment is critical, as a proper change in mindset is difficult to achieve through training sessions (Dikert et al., 2016; Conboy et al., 2011). Too high workload can also be an issue. Overloaded teams will not be able to change their behaviour and learn new ways of working. In some cases of agile implementations, workload has not been adjusted to facilitate the change process. Despite the implementation, old commitments are sometimes kept. In one case, people are forced to remain committed to firm deadlines which resulted in ignoring new agile practices (Dikert et al., 2016).

A common challenge is that it is difficult to implement an agile mindset. The values of the agile manifesto are not understood in many cases, and agile practices can therefore be carried out without actually understanding the purpose (Dikert et al., 2016; Conboy et al., 2011). Several cases describes that agile methods are hard to learn from literature (Dikert et al., 2016; Hajjdiab and Taleb, 2011), as it can be difficult to find a balance between a by-the-book implementation and giving too much freedom in the agile methods. The first may put people off, and the second may weaken core practices. As a by-the-book implementation often is not feasible, attempts to tailor the agile method to suit the organisation's needs are made. However, skipping practices or ignoring core elements, can lead to problems (Dikert et al., 2016; Ozierańska et al., 2016). In contrast, some overemphasise adherence to framework instead of the value the framework can bring (Conboy and Carroll, 2019). In general, challenges in the transformation can lead to people reverting to the old way of working (Dikert et al., 2016).

2.2.2 Success Factors for Agile Implementations

Dikert et al. (2016) identified 29 success factors for large scale agile implementations in a systematic literature review where a total of 52 papers were analysed. These success factors are presented in table 2.1. The success factors are divided into 11 categories.

Table 2.1: Success Factors for Large Scale Agile Implementations (Dikert et al., 2016)

Success factors	
Management support	• Ensure management support • Make management support visible • Educate management on agile
Commitment to change	• Communicate that change is non-negotiable • Show strong commitment
Leadership	• Recognise the importance of change leaders • Engage change leaders without baggage from the past
Choosing and customising the agile approach	• Customise the agile approach carefully • Conform to a single approach • Map to old way of working to ease adaptation • Keep it simple
Piloting	• Start with a pilot to gain acceptance • Gather insights from a pilot
Training and coaching	• Provide training on agile methods • Coach teams as they learn by doing
Engaging people	• Start with agile supporters • Include people with previous agile experience • Engage everyone in the organisation
Communication and transparency	• Communicate the change intensively • Make the change transparent • Create and communicate positive experiences in the beginning
Mindset and Alignment	• Concentrate on agile values • Arrange social events • Cherish agile communities • Align the organisation
Team autonomy	• Allow teams to self-organise • Allow grass roots level empowerment
Requirements management	• Recognise the importance of the Product Owner role • Invest in learning to refine the requirements

3 Scrum Theory

The most popular and famous agile project management approach is Scrum (Wysocki, 2014; Mahalakshmi and Sundararajan, 2013). The method derives from complex adaptive system theory and is influenced by best practices in Japanese industry (Sutherland and Schwaber, 2011), and especially by lean principles (Poppendieck, 2005) that were implemented at Toyota (Krijnen, 2007) and Honda (Holford and Ebrahimi, 2007). Ken Schwaber and Jeff Sutherland developed the methodology in the early 1990s, and wrote the Scrum Guide in 2010 which has been updated regularly since then. Scrum is based on the theory of Empirical Process Control, which emphasis *that decisions should be made based on measurements of actual facts as opposed to predictions of future results* (Fowler et al., 2019, p. 16). Fundamentally, Scrum is lightweight, easy to understand and difficult to master. The Scrum Guide boils down the framework into three *roles*, three *artefacts* and five *events*. Combined with an iterative and incremental approach, these 11 elements optimises predictability and risk control (Schwaber and Sutherland, 2020). Following, each element have a specific purpose to serve Scrum's three core principles: *transparency*, *inspection* and *adaption*. Leaving out elements or not following the rules of Scrum therefore limits the benefits and may even result in it being useless (Schwaber and Sutherland, 2020).

An overview of the framework is presented in Figure 3.1. In Scrum, the team work in iterative *Sprints* to deliver value to the customer. Prior to each Sprint, the team determines what work to be accomplished based on a ordered list of project requirements called the Product Backlog. The selected requirements are split into smaller task which together makes up the Sprint Backlog. During the Sprint, the team execute the planned tasks and have Daily Scrum meetings in order to inspect and adapt their work. Towards the end of the Sprint, the performed work gets examined in a Sprint Review. The Sprint is finally wrapped up after the team has performed a Retrospective meeting in order to improve their working process. The Sprints are performed in cycles and repeat itself until the client is satisfied or until the budget and/or time runs out.
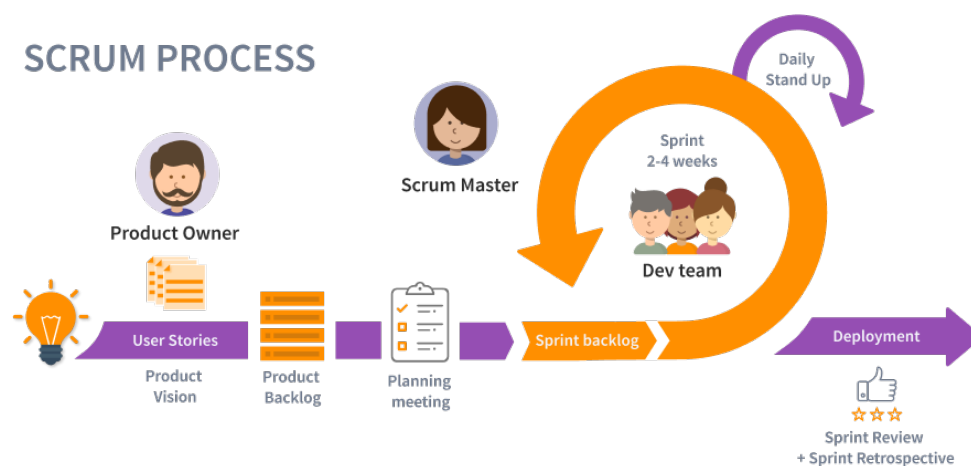
Figure 3.1: The Scrum Process (Source: Tuleap (nd))

3.1 Scrum Roles

According to the Scrum Guide by Schwaber and Sutherland (2020), the Scrum roles consists of one Product Owner, one Scrum Master and Developers. Together, they are one unit working towards the same goal (Rubin, 2012). The Product Owner is responsible for what product will be delivered and in what order (Rubin, 2012). The Scrum Master is responsible for guiding the team towards creating and following the process based on Scrum theory. The Developers are responsible for determining how to deliver the product. The team is a cohesive unit of professionals focused on one objective at a time, the Product Goal. There are no sub-teams or hierarchies within the team. The team is structured to be self-managing, and work in Sprints at a sustainable pace which improves focus and consistency in the team. The team members have all skills necessary to create value in each Sprint (Schwaber and Sutherland, 2020).

Figure 3.2: Scrum Team (Source: Rubin (2012))

3.1.1 Product Owner

Product Owners are business people, not technicians, and require expertise in understanding the marketplace in which the product will compete (Fowler et al., 2019). The Product Owner is the client representative and is accountable for maximising the value of the product resulting from the work of the Developers. This role is also accountable for effective Product Backlog management. This includes developing and explicitly communicating the Product Goal, creating and clearly communicating Product Backlog items, ordering Product items and ensuring that the Product Backlog is transparent, visible and understood (Schwaber and Sutherland, 2020).

The above work may be done by the Product Owner or the responsibility can be delegated to others, as he is accountable, not responsible. The Product Owner is one person, not a committee, and may represent the needs of several stakeholders in the Product Backlog. A key factor for Product Owners to succeed, is that the entire organisation must respect their decisions. These decisions are visible in content and ordering of the Product Backlog, and through the Increment that can easily be inspected at the Sprint Review (Schwaber and Sutherland, 2020).

Rubin (2012) explains the Product Owner as the central point of product leadership, and that this person needs to face at least two directions at the same time. On the one hand, this person must understand the needs and priorities of the stakeholders and customers well enough to act as their voice. On the other hand, the Product Owner must communicate to the Developers what to work on and in which order (Rubin, 2012). Figure 3.3 shows a visual representation of the Product Owner as a central point.
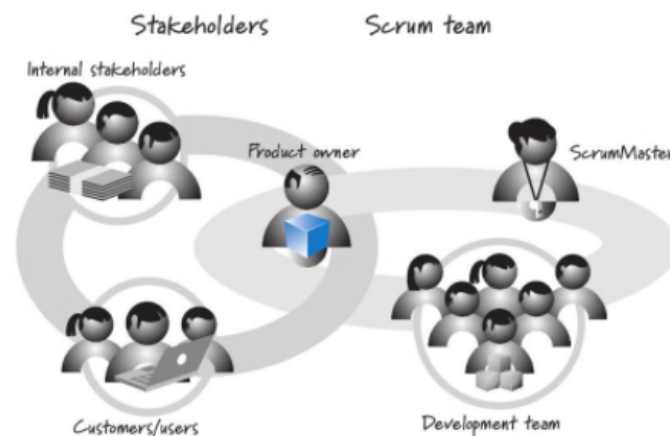
Figure 3.3: Product Owner facing two directions simultaneously (Source: Rubin (2012))

Principal responsibilities

Rubin (2012) lists some responsibilities that the Product Owner has, which are:

- Manage Economics
- Participate in planning
- Groom the Product Backlog
- Collaborate with the Developers
- Collaborate with the stakeholders

Manage economics: The Product Owner ensures that a good return on investment (ROI) is delivered from each sprint. Also, the Product Owner is responsible for prioritising the features in the Product Backlog. When economic conditions change, the priorities are likely to change as well (Rubin, 2012).

Participate in planning: The Product Owner works with the internal stakeholders to position the product correctly in the portfolio. During the Sprint planning, the Product Owner collaborate with the Developers to define a Sprint Goal. This person also provides valuable input that enables the Developers to select a set of Product Backlog items that is realistic for the team to deliver by the end of the Sprint (Rubin, 2012). However, the Product Owner is not a project manager. The Developers are accountable for delivering the product and are therefore responsible for organising themselves. If the Product Owner takes on the responsibility of organising the Developers, then the Developers can then avoid the accountability of delivering the product (Fowler et al., 2019).

Groom the Product Backlog: The grooming of the Product Backlog is overseen by the Product Owner, which is to create, refine, estimate and prioritise the Product Backlog items. The Product Owner does not personally perform all the grooming, but is responsible for making sure that the grooming is done in a way that promotes a smooth flow of delivered value (Rubin, 2012). Failing to include the Scrum Team in this process lead to a lack of commitment from the team, in addition to an increased risk of wrong estimates (Eloranta et al., 2013).

Collaborate with the Developers: The Product Owner is an engaged and committed everyday role which must closely and frequently collaborate with the Developers. The failure to engage can delay essential feedback from client and substantially reduce the value of that feedback when it finally occurs. When using Scrum, the team builds one feature at a time instead of one phase at a time. This means that all activities to create a particular feature are performed during one sprint. Therefore, it is essential to have a constant high level of engagement from the Product Owner. There is far less chance for the Product Owner and Developers to become disconnected with such close interaction on short, timeboxed iterations (Rubin, 2012)

Collaborate with the stakeholders: The Product Owner is the single voice of both internal and external stakeholders. Internal stakeholders can include executive management, program management, marketing and sales. External stakeholders can include customers and partners. It is important for the Product Owner to work closely with the stakeholders to gather input to guide the Developers with a coherent vision.

Product Owner combined with other roles

The same person may act as the Product Owner for more than one Scrum Team if the capacity permits it. It will usually be easier for this person to be the Product Owner of multiple teams on the same project effort, because the work of these teams is likely to be highly related. A person can be both Product Owner and Developer on the same team, but it is considered a bad idea to be both Product Owner and Scrum Master as these two roles counterbalance each other (Rubin, 2012).

Chief Product Owner

One situation where a Product Owner team is frequently created is on very large products. A single person can be Product owner for a couple of Scrum teams. But on very large efforts that require many teams, it can be difficult to have only one Product Owner. One person cannot be the engaged day-to-day Product Owner for more than a few teams (Rubin, 2012). In cases like these, the Product Owner needs to have a hierarchy of Product Owner, as shown in figure 3.4.

The person with the role as Chief Product Owner is *the* Product Owner for the whole product. However, the Chief Product Owner has a team of Product Owners to make sure that the role is correctly filled at each lower level in the hierarchy. When using this approach, one must ensure that the individual team Product Owners remain in power to make the vast majority of the decisions at their level, rather than passing such decisions upwards to the higher levels of the hierarchy (Rubin, 2012).
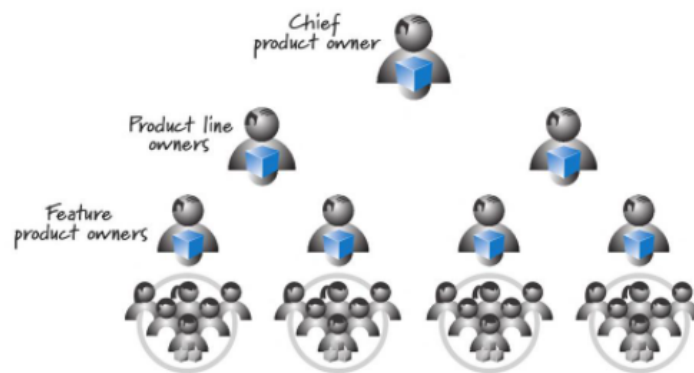
Figure 3.4: Hierarchical Product Owner role (Source: Rubin (2012))

3.1.2 Scrum Master

"A Scrum Master is a master of Scrum in the same way that a Kung Fu master is a master of the art of Kung Fu" (Fowler et al., 2019, p. 53) The Scrum Master is accountable for establishing Scrum as defined in the Scrum Guide by Schwaber and Sutherland (2020). The role of the Scrum Master is to be a teacher, mentor and coach to the Product Owner and the Developers (Fowler et al., 2019). They help everyone, both within the team and the organisation, to understand the theory and practice of Scrum. This role is also accountable for the effectiveness of the Scrum Team. This is done by enabling the Scrum Team to improve its practices, within the Scrum framework. As with the Product Owner, The Scrum Master is not a project manager (Deemer et al., 2010). Scrum Masters are true leaders who serve the Scrum Team and the larger organisation (Schwaber and Sutherland, 2020).

The Scrum Master serves the *Scrum Team* by coaching the team members in self-management and cross-functionality and helping the Scrum Team focus on creating high-value work (Schwaber and Sutherland, 2020) by protecting them from outside interference (Rubin, 2012). According to Rubin (2012) this interference can come in the form of managers who want to redirect the team members in the middle of the sprint or issues originating from other teams. The Scrum Master also cause the removal of impediments to the Scrum Team's progress (Schwaber and Sutherland, 2020). In addition, the Scrum Master serve the Scrum Team by ensuring that all Scrum events take place and are positive, productive, and kept within the time frame (Schwaber and Sutherland, 2020).

The Scrum Master serves the *Product Owner* by helping find techniques for effective Product Goal definition and Product Backlog management and helping the Scrum Team understand the need for clear and concise Product Backlog items. This person helps establish empirical product planning for a complex environment and facilitate stakeholder collaboration as requested or needed (Schwaber and Sutherland, 2020).

The Scrum Master serves the *organisation* by leading, training and coaching the organisation in its Scrum adoption and planning and advising Scrum implementations within the organisation.

Characteristics

A Scrum Master can come from various background (Shringi, 2021). According to Vanderjack (2015), people are

largely defined by their expected behaviour. A former project manager can take the role as Scrum Master, but whether this is a success is highly dependent on the individual and their understanding of the differences between these roles (Deemer et al., 2010). The role as Scrum Master requires a specific mindset to be successful (Deemer et al., 2010), and some important characteristics of a Scrum Master are (Rubin, 2012):

- Knowledgeable
- Questioning
- Patient
- Protective

Knowledgeable: To be effective at process coaching, the Scrum Master must be very knowledgeable about Scrum and its framework (Rubin, 2012). Great Scrum Masters understand the technical environment, which means that the Scrum Masters have the background to engage on behalf of the team when the team members need help. They are also conscious of the team's needs and are active in trying to meet them. They also have an understanding of the political environment, and when they lack the authority to complete a task, they know who to go to (Vanderjack, 2015).

Questioning: The Scrum Masters must teach and coach people to solve their own problems (Fowler et al., 2019). They will use their coaching skills in combination with their process, technical and business knowledge to ask great questions, in the form that make people stop and reflect, and possibly think of better ways of doing things. They prefer to not answer questions directly, as the intention is to help people realise that they have insight to find their own answers (Rubin, 2012).

Patient: Because the Scrum Masters prefer to not give out answers to questions, they must be patient and give teams time to arrive at appropriate answers on their own. Patience can be hard sometimes, especially if the Scrum Master "knows" the answer to the problem. However, Scrum Masters will be arrogant to think that they are smarter than the collective intelligence of the team. It is better to let the team work out the solution on their own rather than propose a solution that the team has not reflected on themselves (Rubin, 2012).

Protective: The Scrum Master should be protective of the team against outside distractions like politics, organisational impediments or people with differing agendas (Rubin, 2012; Vanderjack, 2015). Scrum enlightens many impediments and threats to the Developers's and Product Owner's effectiveness. To have an engaged Scrum Master working energetically to help resolve those impediments and threats is important, or else the Developers or Product Owner will find it difficult to succeed (Deemer et al., 2010). A committed Scrum Master is particularly important for Teams unfamiliar to Scrum in order to develop a sufficient understanding of Scrum roles and Events (Ozierańska et al., 2016).

3.1.3 Developers

The Developers are the people in the Scrum Team that work on the product. They are committed to creating any aspect of a usable Increment each Sprint. The specific skills that are needed by the Developers are often broad and will vary with the area of work (Schwaber and Sutherland, 2020). Many companies are accustomed to

splitting different job roles into specialised, role-specific teams. These teams hand off work when it is function independently of each other and complete. In Scrum, the Developers must do all the work required to produce a part of a working product functionality each Sprint. Therefore, a team is needed that is skilled at all these tasks. Whenever possible, one should create cross-functional teams (Rubin, 2012).

According to the Scrum Guide by Schwaber and Sutherland (2020), the Developers are accountable for:

- Creating a plan for the Sprint, the Sprint Backlog

- Instilling quality by adhering to a Definition of Done

- Adapting their plan each day toward the Sprint Goal

- Holding each other accountable as professionals

Characteristics/Skills

Rubin (2012) mention ten important characteristics of the Development team, which are:

- Self-organising

- Cross-functionally diverse and sufficient

- T-shaped skills

- Musketeer attitude

- High-bandwidth communication

- Transparent communication

- Right-sized

- Focused and committed

- Works at sustainable pace

- Long lived

Self-organising: Self organising teams are composed of individuals that *"take accountability for managing their own workload, shift work among themselves based on need and best fit, and take responsibility for team effectiveness."* (Highsmith, 2009). The Developers self-organise to determine the best way to accomplish the Sprint Goal. No project manager or other manager can tell the team how to do its work (Rubin, 2012). The self-organising team of Developers organise repeatedly to meet new challenges (Cockburn and Highsmith, 2001).

Cross-functionally diverse and sufficient: The Developers should collectively possess all the necessary skills that are relevant to create the product (Fowler et al., 2019). Silo teams composed of people with the same skills can at best do part of the job. Therefore, the silo teams must hand off work to other teams, which represents a large risk of miscommunication and costly mistakes (Rubin, 2012). The Scrum framework strives to eliminate the silos (Fowler et al., 2019). Diversity in teams minimise the number of hand offs. Team diversity with members from different backgrounds and including junior- and senior level personnel on the same team will provide different perspectives for problem solving (Rubin, 2012).

T-shaped skills: Guest (1991) was the first to mention the term "T-Shaped", which is a metaphor used to describe

a person with deep skills in a preferred functional area or discipline as well as broad skills in other functional areas. The goal is to form a team who have the right skills to cover the core speciality areas and have some overlap between these skills to provide flexibility to help out if the team experience a bottleneck. To have an environment where people are constantly learning will provide for an opportunity to increase the broad skills of team members (Rubin, 2012).

Musketeer attitude: In the famous book *The Three Musketeers* by Dumas (1844) there is a famous motto saying *"All for one and one for all"*. The Developers must have the same attitude as the Three Musketeers. This attitude reinforces the point that they win as a team and lose as a team. In a well-functioning team, you will not hear anyone say "I got my part done but you did not get yours done. That is why we failed.". In the end, it is everyone's problem if they fail (Rubin, 2012).

High-bandwidth communications: Communication among Developers as well as with the Product Owner and Scrum Master is needed in a high-bandwidth matter, where exchanging of valuable information is done quickly and efficiently with minimal overhead. Both frequency and quality of information sharing is increased with high-bandwidth communications. This results in more frequent opportunities for the Scrum team to inspect and adapt, which leads to better and faster decision making. Time is money, and by accelerating the rate of information sharing the team can maximise its value. The team can avoid expending more resources by going down the wrong path by quickly exploiting emergent opportunities and recognising wasteful situations (Rubin, 2012).

One of the principles behind the Agile Manifesto is "the most efficient and effective method of conveying information to and within a development team is face-to-face conversation." (Beck et al., 2001), which is the preferred method of achieving high-bandwidth communications. It is preferred to have a co-located team to achieve this. Video calls are a great way of achieving the feeling of co-location but is not as good as actually being co-located (Rubin, 2012).

A critical step toward achieving high-bandwidth communication is the cross-functionality of the team members. Such teams have easy access to the people needed to get the job done. They are also less likely to have formal hand offs from one team to another, which improves the communication speed. Another way of achieving high-bandwidth communication is to reduce time spent on ceremonies that adds little to no value (Rubin, 2012).

Transparent communication: In addition to having high-bandwidth communication, the team should also have transparent communication. This provides a clear understanding of what is actually happening. This helps to avoid surprises and build trust among the team members. The team members should communicate in a way that is least likely to surprise one another.

Right-Sized: In Scrum, small teams are favoured. A general rule is to have 5 to 9 people on the Development team. Having too big team can lead to the emergence of individualism, which is destructive for team harmony and agile concepts (Eloranta et al., 2013). It is possible to have too small teams, for example if the team does not have the necessary people to get the work done. A Scrum project does not scale by having a larger team of Developers but by having multiple Scrum teams (Rubin, 2012). Bradner et al. (2003) performed a study where they looked at 109 different teams.

> Compared to members of larger teams, we found that members of smaller teams participated more actively on the team, were more aware of the goals of the team, were better acquainted with other team members' personalities, work roles and willingness to communicate and reported higher levels of rapport. We also found that members of larger teams reported that their teams were more conscientious in coordinating activities such as preparing meeting agendas compared to responses from smaller teams. (Bradner et al., 2003, p. 7)

Focused and committed: Team members must be focused and committed to the Project Goal. The focus comes from engaging, concentrating on and devoting attention to the Project Goal. It is far easier for a person to stay focused and committed if that person only works on one product at a time.

An argument against working on multiple projects is that switching between tasks (across projects) is considered to be waste, as working in multiple teams causes more interruptions and re-orientation back to work takes time Ikonen et al. (2010). It is hard to find concrete numbers on the waste; A study by McCollum and Sherman (1991) found that working on two simultaneous projects is optimal. From here, practitioners claim that there is a steady decline in effective hours when adding more than two projects (Wheelwright and Clark, 1992). van Solingen et al. (1998) found that it costs an average of fifteen minutes to get back to focus on the task when interrupted. Other studies has found that the work performed following interruptions is of lower quality (Parnin and DeLine, 2010), is more time-consuming and have a higher risk of errors (Eyrolle and Cellier, 2000). This is especially true when the complexity high (Stettina and Smit, 2016).

Works at a sustainable pace over time: One of the principle of the Agile Manifesto is to work at a sustainable pace Beck et al. (2001). This typically means to plan for a 40-hour week, which is achieved through the Sprint Planning where the Developers only take on as much work as they think they can complete in a 40 hour week (Rubin, 2012). A case study performed by Mann and Maurer (2005) found that introducing Scrum to an existing software development organisation lead to a decrease in overtime, *"allowing the developers to work at a more sustainable pace while at the same time the qualitative results indicate that there was an increase in customer satisfaction."* (Mann and Maurer, 2005, p. 1).

Long-lived: Teams should be kept together as long as it is economically sensible to do so. Katz (1982) show in his research that long-lived teams are more productive than groups that are newly formed. Newly formed teams with people who have never worked together will most likely go through phases such as forming, norming, storming and performing before becoming highly functional teams (Tuckman, 1965). This is both time and cost consuming. Once the team is well-functioning, it is a real business asset. Members now know how to work together and have earned each other's trust. In addition, the team has gathered important historical information, such as velocity and shared estimating history. If the team is dissolved or the composition is significantly changed, then this information will no longer have the same value (Rubin, 2012).

3.2 Scrum Artefacts

The artefacts of Scrum represent the work or value produced, and are designed to maximise the transparency of key information. Each artefact has a commitment that ensures that it provides the information needed to enhance the transparency and focus, such that progress can be measured (Schwaber and Sutherland, 2020):

- For the Product Backlog it is the Product Goal
- For the Sprint Backlog it is the Sprint Goal
- For the Increment it is the Definition of Done

3.2.1 Product Backlog

Scrum always prioritise the most valuable work first in a project. Using input from the Scrum Team and stakeholders, the Product Owner is responsible for determining and managing the sequence of work and communicating it in the form a prioritised list known as the Product Backlog (Rubin, 2012). The Scrum Guide describes the Product Backlog as an ordered list of requirements that are needed to improve the product (Schwaber and Sutherland, 2020). It expresses the Product Owner's vision for the product and holds all the things that can be done to achieve the Product Goal (Shringi, 2021). The ordered list of requirements in the Product Backlog are usually referred to as Product Backlog Items or User Stories (Zahraoui and Janati Idrissi, 2015). The Product Backlog is the only source of work for the developers and exists as long as the product does (Fowler et al., 2019; Shringi, 2021).

According to Vanderjack (2015), the three following descriptions should be included in a Product Backlog item:

- *As a*. Describes who is asking for the work to be done. The intention is to make the creator focus on their perspective and serves a clue to who to ask if the Product Backlog item is needed for consultation.
- *I want*. Makes the Item creator to explicitly state what they have in mind.
- *So that*. Describes the qualitative or quantitative reason for the Item in terms of value-addition to the business.

Bill Wake's INVEST acronym presents criteria used to describe well-formed Product Backlog items (Wake, 2003):

- *Independent:* Each Item can be implemented by the team independently of other stories.
- *Negotiable:* Methods by which the end-goal is achieved should be negotiable between the Product Owner and Scrum Team.
- *Valuable:* Each Item adds something valuable to the customer.
- *Estimable:* There must be enough information to properly size each Item
- *Small:* The Items should be small enough to be completed within a Sprint
- *Testable:* The Scrum Team need a clear and precise way to verify whether or not an Item has been completed.

The Product Backlog is a constantly evolving artefact (Rubin, 2012). This means that the Product Owner adds, deletes and revise the Items as the Scrum Team's understanding of the product grows, or as the business conditions change. In addition, the Product Owner ensures that the Product Backlog Items are correctly sequenced using factors such as cost, knowledge, risk and value (Rubin, 2012). The Product Backlog items, problems or whatever

the team is going to work on is thus ordered in the Product Backlog by what the Scrum Team values most (Shringi, 2021). A common pitfall with Scrum implementation is a disorganised Product Backlog, as this can lead to lack of product vision and too big requirements (Eloranta et al., 2013).

Ryan Ripley explains that the Product Backlog supports short-term, mid-term and long-term visions. The short-term vision correlates to the minimum viable product, and the Product Owner must be ruthless about what is needed. Producing value to the customer in order to receive feedback as early as possible is the highest priority. The sooner the team can validate with the customer that the team is on the right path, the more they can protect the investment. Taking too long to get a minimum viable product to the customer puts the team at a huge risk (Shringi, 2021). Ripley further explains that there is no guarantee that a product backlog item will be completed.

Estimation of Product Backlog Items

The activity of creating, refining, estimating and prioritising items is called grooming. To be able to properly determine an Item's priority, it is important to know its cost (Rubin, 2012). However, the Scrum Guide does not dictate size measure to use, and it is therefore up to each Scrum Team to decide how they will estimate size. The normal practice is to use relative sizing. Here, the consideration is the relative size of an item compared to other items instead of the absolute value (Rubin, 2012).

The two most common size measurements are *Story Points* and *Perfect Hours*. According to (Cohn, 2016), *"Story points are a unit of measure for expressing an estimate of the overall effort that will be required to fully implement a product backlog item or any other piece of work"*. For a story to properly represent the amount of effort required, everything that can affect the effort must be included in the estimation. This could for instance be risk, uncertainty, complexity, the share amount or anything else involved in the Definition of Done (Cohn, 2016). On the other hand, perfect hours represents the amount of hours it should take to complete the story under ideal conditions for an average team member (Sutherland and Altman, 2009). In general, perfect hours are easier to estimate for teams unfamiliar with Scrum (Cohn, 2005).

To estimate each items size, most Scrum Teams use an estimation technique called *Poker Planning* (Zahraoui and Janati Idrissi, 2015). The method was proposed by Grenning (2002) and later made popular by Cohn (2005). It is a team-based exercise commonly used for estimating the relative effort required to deliver specific features or functionality. Planning Poker can be used for both Story Points and Perfect Hours (Martinelli and Milosevic, 2016). In general, Scrum effort estimation typically comprises three steps (Zahraoui and Janati Idrissi, 2015):

- Comparison of Items for the purpose of establishing their relative size
- Conversion of the size estimates to lead times based on assumed team productivity
- Re-estimation of lead time based on actual productivity once this becomes known

The story points/perfect hours are used to calculate a Teams *velocity* during the Sprint Planning, which is the total amount of work accomplished during a Sprint (Mahnic and Zabkar, 2012). Ideally, the deviation between estimated and actual size would be zero across the items. In real life however, deviations are to be expected. That said, deviation is not entirely negative. The deviations, especially the bigger ones, provides valuable measurement

of actual data to be discussed. Thus, tracking and comparing the actual and estimated item size and overall Sprint velocity can *"guide Development Teams to accurately evaluate process effectiveness and trigger improvement cycles in regard to Scope management, planning and estimation, risk management, impediments and resource utilisation"* (Chaudhuri and Chaudhuri, 2011, p. 1).

3.2.2 Sprint Backlog

A Product Backlog incorporate weeks or months worth of work, which cannot be completed within one sprint (Rubin, 2012). The team perform a *Sprint Planning Meeting* to determine what work to accomplish in the next Sprint (Schwaber and Sutherland, 2020). The meeting is an event which marks the beginning of a new sprint. Here, the Scrum team meet, negotiate, and agree on the scope of the work to be done during the Sprint (Fowler et al., 2019). The scope is meant to satisfy the *Sprint Goal*, which is an overall statement about the fundamental purpose of the Sprint. During the Sprint Planning Meeting, the team reviews and breaks down high-priority Product Backlog Items into a set of tasks (Rubin, 2012). The implementation of each tasks is then planned in detail. Together, the selected tasks and the plan for implementing them makes up the *Sprint Backlog* (Fowler et al., 2019). The tasks themselves are further describes as *Sprint Backlog Items* (Marcal et al., 2007). The Sprint Backlog is a temporary artefact, as it it exists as long as its Sprint lasts (Fowler et al., 2019).

One important aspect of the Sprint Backlog is that it represents a realistic amount of work which the team can accomplish at a sustainable pace (Rubin, 2012). To ensure this, the the team uses past experience to assess how much work they can accomplish (Dalton, 2019). It should also be highly visible to give a real-time picture of the work that the Developers have planned and detailed enough for the team to be able to inspect and measure progress in the Daily Scrum (Schwaber and Sutherland, 2020). The team is not necessarily committed to a specific Sprint Backlog Items, as they are viewed as helpful measurements to achieve the Sprint Goal (Shringi, 2021).

Fundamentally, the Sprint Backlog should remain relatively fixed. However, this is not to say that the list cannot be changed (Fowler et al., 2019). The Development Team may add, change or delete Items as they see fit when changes occur or when more of the business problem is understood. Even though the content of the Sprint Backlog can be adjusted during the Sprint, requirements should not be changed if it endangers the Sprint Goal (Mahalakshmi and Sundararajan, 2013).

The Scrum Board

The Scrum Board, also known as the *Kanban board*, is a common way of visualising the Spring Backlog (Fowler et al., 2019). The Kanban Board is a simple concept which divides the Sprint Backlog Items into three columns: "To do", "In Progress" and "Done". Thus, the Scrum Board represents a complete picture of what has been finished, what is being worked on, and what has yet to be started (Fowler et al., 2019). There is no standard definition of Kanban and its specific practices (Corona and Pani, 2012). It is therefore not uncommon to divide the "In Progress" column into sub-categories to give a more accurate status representation, as seen in figure 3.5.
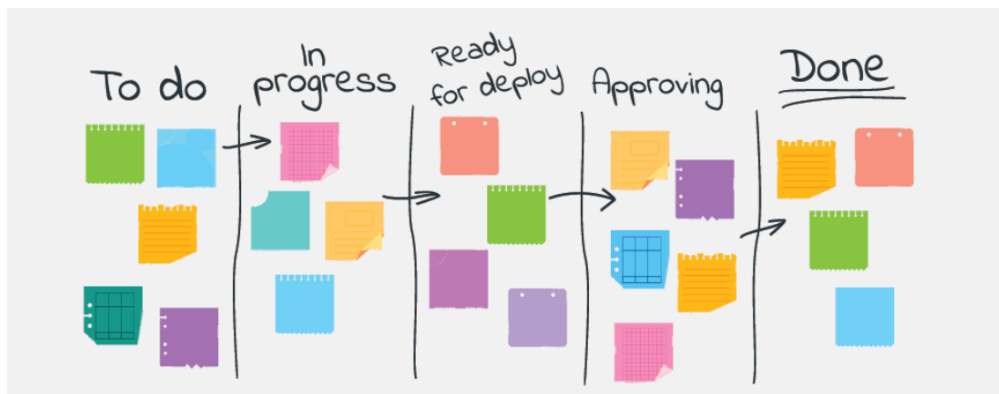
Figure 3.5: Kanban Board (Source: Wilson (2020))

3.2.3 Increment

The Sprint Increment is defined as *"the difference between the product at the end of the sprint when all necessary work has been completed, and the product at the beginning of that sprint before any Sprint work has been done"* (Fowler et al., 2019, p. 63). The Scrum guide further describes an Increment as a concrete stepping stone towards the Product Goal (Schwaber and Sutherland, 2020). Each Increment is a part of the final product, and provides transparency to the Product Owner and stakeholder at the end of each Sprint (Deemer et al., 2010). The Increment must be usable for the end user in order to provide value. An Increment can be delivered at any point during a Sprint, and a Sprint can produce multiple Increments.

An Increment is born when a Product Backlog Item meets the *Definition of Done* (Schwaber and Sutherland, 2020), which is a mutually agreed list of criteria that adds verifiable or demonstrable value (Silva et al., 2017). It is formally written, and describes the state of an Increment when all required quality measures are met. The Definition of Done ensures transparency, as every team member have a shared understanding of what it means for work to be complete. Additionally, it guides the Development Team in selecting the amount of Product Backlog Items for the upcoming Sprint (Davis, 2013). Following, it is helpful to secure quality and limit scope. A clear Definition of Done leads to less amount of rework, and it helps to eliminate doubt during estimation sessions of Product Backlog items (Albero Pomar et al., 2014). The Definition of Done can further be extended to the Sprint Backlog Items and Sprint Event to clearly define when each ceremony is complete (Dalton, 2019). Studies of multi-level definition of done has reported to yield great results in performance and removal of impediments (Davis, 2013).

3.3 Scrum Events

The events in Scrum consists of the Sprint, Sprint Planning, Daily Scrum, Sprint Review and Retrospective. Each event is a formal opportunity to inspect and adapt the Scrum artefacts, specifically designed to enable the transparency required. Failure to operate any of the events as prescribed results in loss of opportunities to inspect and adapt. The events are used to create regularity and to minimise the need for meetings that are not defined in Scrum. To reduce complexity, it is optimal to hold all events at the same time and place (Schwaber and Sutherland, 2020).

3.3.1 The Sprint

The Sprint is where ideas are turned into value, and the Sprint is commonly referred to as the heartbeat of Scrum (Keith, 2010). The Sprint includes Sprint Planning, Daily Scrums, Sprint Review and Sprint Retrospective (Schwaber and Sutherland, 2020). All the work necessary to achieve the Product Goal happens during Sprints. Following, the main purpose of a Sprint is to produce a done increment of product (Schwaber and Sutherland, 2020). In many ways, Sprints are like mini projects themselves with an overall goal and defined scope (Keith, 2010). The Scrum Guide lists some rules and guidelines to be aware of during the course of a Sprint (Schwaber and Sutherland, 2020):

- No changes are made that would endanger the Sprint Goal

- Quality does not decrease

- The Product Backlog is refined as needed

- Scope may be clarified and renegotiated with the Product Owner as more is learned

By splitting project into smaller iterations, Sprints accumulate empirical data over project performance and process control. It functions as a measurement device, which in turn leads to several important rules for its execution. For instance, the Sprint duration is time-boxed (Rubin, 2012). As shown in figure 3.6, Sprints are continuous and contiguous, meaning there is no time where work can be done without being tracked (Fowler et al., 2019).
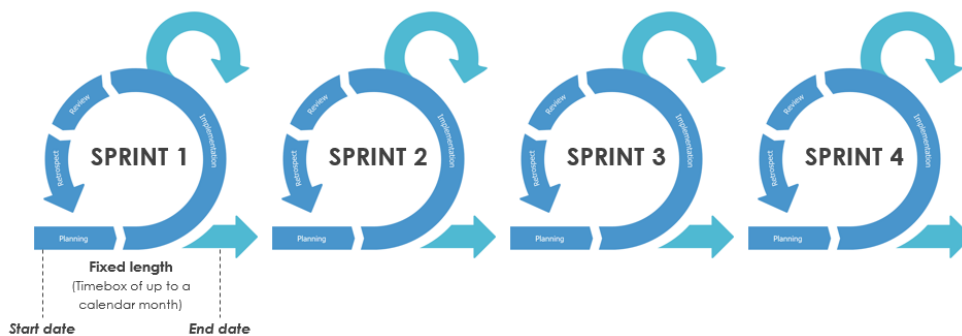
Figure 3.6: Sprint (Source: Visual Paradigm (nd))

Sprint Duration

One common challenge, especially for Teams unfamiliar with Scrum, is to determine a fitting Sprint duration (Akif and Majeed, 2012; Eloranta et al., 2013). When the horizon of a Sprint is too long the Sprint Goal may become invalid and complexity and risk may for management overhead increase (Schwaber and Sutherland, 2020; Eloranta et al., 2013). Contradictory, a too short duration can make it difficult to address all the Scrum Events while completing the Sprint Backlog (Streule et al., 2016). Shorter Sprints are often preferred, especially for new teams, as it does generate a higher number of learning cycles (Keith, 2010). A Sprint typically last between one and four weeks (Keith, 2010). The standard length is two weeks, and it is ultimately decided by the Scrum Master (Morandini et al., 2021).

The Sprint duration is generally influenced by the frequency of customer feedback, the Team's experience with Scrum, the ability to plan the entire Sprint, the Sprint intensity and the timer overhead for planning and reviews (Keith, 2010, p. 65). Through trial and error, it normally takes a Team three to four Sprint to learn what duration suits them (Deemer et al., 2010). A common mistake is to think of Sprints as deadlines for getting work done. A Sprint is a tool used to measure productivity, and should never be extended, regardless if whether the Sprint Backlog is completed or not (Fowler et al., 2019).

3.3.2 Sprint Planning

Every Sprint is initiated by an event called the *Sprint Planning Meeting*, during which the work to be done is agreed on by all parties. A Sprint Goal is set, the scope of the Sprint Backlog is agreed on, and a plan for creating the Product Backlog Items is formed (Fowler et al., 2019). The Scrum Team may also invite other people to attend the Sprint Planning Meeting to provide advice. The event helps to create focus for the Development Team by forcing prioritisation of Product Backlog items (Rubin, 2012). Sprint planning is time-framed to a maximum of eight hours for a one-month sprint. The event is usually shorter for shorter sprints (Schwaber and Sutherland, 2020). Sprint planning addresses these topics (Schwaber and Sutherland, 2020):

Topic One: Why is this sprint valuable?

The Product Owner proposes how the value and utility of the product could increase in the current Sprint. Then, the whole Scrum Team collaborates to define a Sprint Goal that communicates to the stakeholders why the Sprint is valuable (Schwaber and Sutherland, 2020).

Topic Two: What can be Done in this Sprint?

The Developers select items from the Product Backlog to include in the current Sprint, through discussions with the Product Owner. During this process, the Scrum Team may refine these items. This increase the understanding and confidence towards the Product Goal (Schwaber and Sutherland, 2020).

It can be challenging to estimate the duration of work and how much can be completed within a Sprint, especially for new teams unfamiliar with Scrum (Lacey, 2012). However, it is important in regard to the theory of Empirical Process Control (Fowler et al., 2019). The Definition of Done and estimation of the Product Backlog item's size are key elements in predicting a Team's velocity. These are challenging factors that often requires a learning period to get right. Consequently, a period of over and under estimating is expected during the first initial Sprints for new a team, unfamiliar with Scrum (Albero Pomar et al., 2014). The more the Developers know about their past performance, their upcoming capacity, and their Definition of Done, the more correctly they will be able to forecast the Sprint (Schwaber and Sutherland, 2020). In general, Scrum identifies historical Sprint velocities as the most reliable forecast of future outcomes (Cohn, 2005).

Fluctuation in velocity are nevertheless expected to a certain degree. For instance, a high rate of work in progress caused by too big Sprint Backlog Items, can cause at least two problems (Griffiths, 2012; Cohn, 2005). First, a switch in context in known to decrease performance (Albero Pomar et al., 2014). Second, it can lead to having unfinished tasks at the end of the Sprint which will not be added to the Sprint's velocity as they have not met the

Definition of Done and therefore not delivered value (Kniberg, 2015). Other factors that can influence velocity may be team dynamics (Cohn, 2010) and hidden complexity (Schwaber, 2004).

Topic Three: How will the chosen work be done?

For every Product Backlog item that is selected, the Developers plan the work necessary to create an Increment that meets the Definition of Done. This is often done by decomposing Product Backlog items into smaller items of work, typically lasting one day or less. It is at the sole discretion of the Developers how the items are decomposed. No one else can tell them how to turn the Product Backlog items into Increments of value (Schwaber and Sutherland, 2020).

3.3.3 Daily Scrum

The Daily Scrum is a daily meeting where the Development Team inspect the status of their work and adapt their plan for getting it done (Fowler et al., 2019). It is set to last 15-minutes where the team members take turn in answering the following three questions (Mahalakshmi and Sundararajan, 2013):

- What did they do since the last meeting?
- What do they plan to do till the next meeting?
- Are there any obstacles in their way?

By doing this, the Daily Scrum makes sure that the Development team understands the status of the work of each developer, and to work out how to provide help if necessary (Fowler et al., 2019). Following, it is an opportunity to synchronise their work (Deemer et al., 2010). The event is primarily for the Developers, however, the Product Owner and Scrum Master may join if they are actively working on Sprint Backlog Items (Schwaber and Sutherland, 2020).

Daily Scrums improve communication between team members, identify impediments, promote quick decision-making, and may as a result eliminate the need for other meetings (Schwaber and Sutherland, 2020). A common dysfunction is that teams use the Daily Scrum to *solve* problems (Rubin, 2012). This can take hours and is especially common for teams unfamiliar with Scrum. The short duration emphasise that the meeting is for *exposing* problems. To prevent taking up unnecessary time, addressing the issues should be done by the people directly involved in the solution after the Daily Scrum (Fowler et al., 2019). Additionally, the Developers can fail to take responsibility in addressing the issues they encounter. Often, it is regarded as the Scrum Master responsibility to solve problems. This is not the case however, and the team should only ask the Scrum Master for help if they are incapable of solving the problem themselves. The Daily Scrum is not the only time the Developers can adjust their plan. They often meet throughout the day for more detailed discussions about the plan for the rest of the Sprint.

3.3.4 Sprint Review

The Sprint Review is held towards the end of the Sprint and its purpose is to inspect the Sprint's outcome and determine future adaptations (Schwaber and Sutherland, 2020). Following, it is an important meeting for the Product Owners, as it helps fulfil their responsibility to deliver value (Fowler et al., 2019). The Product Owner is

therefore the primary beneficiary of this meeting. The value of the outcome is examined by the Product Owner and then used to stimulate ideas about how to increase value further. Stakeholders and customers can be invited to participate in the meeting to receive feedback on the product (Fowler et al., 2019). The Scrum Team and stakeholders review the Sprint, what has been accomplished and what has changed in their environment. Based on this information, the attendees collaborate on what the next step is. The Product Backlog may also be adjusted in order to meet new opportunities (Schwaber and Sutherland, 2020). In general, the most important element of the Sprint Review is an in-depth conversation between the Developers and the Product Owner (Deemer et al., 2010). It should be avoided to limit the Sprint Review to a presentation, as it is a working session between the attendees. The Sprint Review is the second to last event of the Sprint and for a one-month sprint, the event is timeboxed to a maximum of four hours. The event is usually shorter for shorter sprints (Schwaber and Sutherland, 2020).

Many Scrum teams focus solely on the Product Backlog Items that are completed during the Sprint and ignore the Items that are not completed (Falco, nd; Van Ruler, 2014). By doing this, the systematic issues that prevent the team from accomplishing its goals is never addressed (Falco, nd), and stakeholders are in the dark about how much effort is required to achieve the organisation's goals (Van Ruler, 2014). Therefore, the Product Owner should explain which Items are completed and the reason for why the other Items are not finished. Sprint Reviews can be a valuable opportunity to identify and clear up roadblocks beyond the team's control (Falco, nd). For instance, the roadblocks can be identified by comparing the actual and estimated size of the Product Backlog Items.

Adding new requirements is very common and the Product Backlog should therefore be transparent for everyone in order to achieve stakeholder satisfaction and project complexity control (Alsalemi and Yeoh, 2015). Requirement traceability is used to track the relationship among every requirement. A study by Alsalemi and Yeoh (2015) showed that historical data of the requirements can help to obtain a smooth flow of a project and provide a basis for predicting Product Backlog change.

3.3.5 Sprint Retrospective

The final event of the Sprint is the Sprint Retrospective meeting. Like all other events, the event provides transparency and possibilities to adapt (Fowler et al., 2019). Whereas the Sprint Review focus on *product* progression, the Retrospective is an opportunity to inspect and adapt the *process* (Rubin, 2012; Deemer et al., 2010). The purpose of the Sprint Retrospective is to plan ways to improve process quality and effectiveness (Schwaber and Sutherland, 2020). It does so by inspecting how the last Sprint went with regards to elements such as:

- Individuals
- Interactions
- Processes
- Tools
- Their Definition of Done

The team identifies assumptions that led the astray and explore their origins. Discussions about what went well during the Sprint, what problems were encountered and how these problems were or were not solved are held

(Schwaber and Sutherland, 2020). Done correctly, the Sprint Retrospective could yield the most beneficial impact out of all the Scrum Events (Fowler et al., 2019; Keith, 2010). It aligns with the Agile Manifesto, which states that *"at regular intervals, the team reflects on how to become more effective then tunes and adjust its behaviour accordingly"* (Beck et al., 2001). Empirical observations has demonstrated that Retrospectives helps team to maintain the sustainable pace (Wang and Vidgen, 2007, p. 815), take gradual steps to change and improve (Wang and Vidgen, 2007, p. 816), and resolve communication issues (Hummel et al., 2015). In contrast, failure to perform Retrospective has resulted in difficulties in creating improvements and a lack of knowledge sharing (Barata and Coyle, 2016).

The format of the Retrospective is quite simple. The Scrum Team gathers together to discuss the element mentioned above. The meeting can last from half an hour to three hours, depending on the Sprint Length (Keith, 2010). During the event, the following three questions are raised to each participant (Fowler et al., 2019):

- What should we stop doing?
- What should we start doing?
- What is working well that we should continue to do?

The purpose of this event is to identify changes in the way the Scrum team works. The proposed changes are then broken down to specific *action items* (Keith, 2010). The improvements with the most impact are addressed as soon as possible, and may even be added to the next Sprint (Schwaber and Sutherland, 2020). The action items does not necessarily have to be large, as continuous small improvement will have great effect in the long term (Keith, 2010). However, the greatest benefits from Retrospective usually comes from topics difficult to address (Fowler et al., 2019)

3.4 Scrum Implementation: Case Studies

This section will present case studies of how Scrum has been implemented in new industries. The purpose is to identify if some elements of the framework are exclusively suitable to the software industry. In addition, it provides valuable knowledge of how previous non-software environments has implemented Scrum. As a result, the challenges and lessons learned from these cases will be valuable for the ultimate suggestion to how Scrum can be implemented in the company. This section will first go through three case studies in detail, before combining and presenting the challenges and lesson learned from the three cases along with other identified case studies.

While a lot of research has been focused on the implementation, optimisation and development of Scrum within the software domain, the application of agile methods in other areas is relatively new (Oprins et al., 2019). Consequently, it is a subject scarcely investigated and explored in the scientific research. What other domains can learn from agile management is highly unaddressed, and there is a lack of empirical evidence on the subject. Oprins et al. (2019) addressed this gap and studied the application of agile management practices in other domains. Along with their findings, the literature research revealed a number of case studies and reports, which describes successful implementation of Scrum in construction (Streule et al., 2016; Zender and de Soto, 2020), sales (van Solingen et al., 2011; Steenberg, 2016), education (Vogelzang et al., 2019; Jurado-Navas and Munoz-Luna, 2017; Hicks and

Foster, 2010), manufacturing (Denning, 2012; Sommer et al., 2013), marketing (DeFauw, 2012), volunteer work (Sutherland et al., 2009), research (Senabre, 2019) and finance (Sutherland and Altman, 2009).

These case studies provide valuable insight to the implementation of Scrum in previously unexplored domains. The results are encouraging. In all cases, the implementation resulted in some combination of higher transparency, better communication, better collaboration, faster project development, higher morale, removal of impediments and an overall greater understanding of their working process. Furthermore, the Kanban board proved to be a welcomed addition.

3.4.1 Scrum in Sales

The effects of applying Scrum in the sales department of an IT company was studied by van Solingen et al. (2011) studied. At the time, Scrum was the preferred process for the software development department, and the company was investigating Scrum as an additional line of service. The idea was to provide training and consulting in Scrum. The sales team were responsible for selling Scrum consulting service and software projects to its customers. It was therefore believed that the sales team should experience and learn Scrum thoroughly to improve their sales numbers. Hence, the initial interest to adopt Scrum in sales came forward from a motivation to understand Scrum. Improving anything else was regarded as a bonus.

Prior to the implementation, the sales team worked individually. Little or no information about clients was shared between the account managers, and there was no communication about goals and sales methods. Consequently, each individual had developed its own sales process of which only the outcome would be shared: the number of deals made and the size of those deals (van Solingen et al., 2011). The team had one performance indicator: the number of deals closed. However, the overall results of the sales unit got neglected by its team members, as there was no cohesive sales process in place.

The consensus was that whether a deal was made was inherently random, and the account managers were sceptical when the opportunity to apply Scrum was first discussed. According to the account managers, the sales results were much more unpredictable than software development, and they felt that only the customer had control over the outcome.

The sales team did not have any system in place to predict how their processes affected the end result prior to the implementation of Scrum. There was an attempt to track the number of phone calls made per day. However, to what extent these resulted in actual sales were unknown (van Solingen et al., 2011). In general, there was no known relationship between specific tasks and final sales results. Without that knowledge, it became impossible for the account managers to "work smarter". The only way to improve sales results was to work harder, and even then, the end result fluctuated to a large degree. Consequently, the account managers morale was low. They felt that their time and effort had little impact on the end result, and that the final decision of the client determined whether they did a good job or not. In addition, the sales team lacked frequent reflection and improvement on their sales process. Their focus was on the daily routine, and only success stories were shared as a learning platform for the other team members. Such activities occurred on an ad-hoc basis, so it did not provide the team regular opportunities to learn and improve.

Implementation

At first, the company decided to form a pilot team to implement Scrum. With some help from Scrum consultant, the team decided to start with (van Solingen et al., 2011):

- Weekly sprints on Monday with a Sprint Retrospective and Sprint Planning on the same day
- Quarterly focus on sales targets (13 sprints till release)
- Weekly inspection and adaption: learning by doing, and receiving advice from the internal Scrum consultants/coaches
- Daily stand-up at 9:30 am in front of the Scrum board.
- A Scrum board with burn-up for order intake

The approach of doing Scrum in sales evolved rapidly during the first weeks, and the Scrum board was continuously adapted. However, the sales team lacked discipline in the Scrum roles and the Scrum Master was often out of office in the beginning. Consequently, the sales team was not self-motivated and did not initiate the daily stand-up among themselves. Even when the Scrum Master was present, the daily stand-up tended to start late and proceed the 15-minute landmark. In addition, there was no real improvement cycle. During the retrospective meetings, the team failed to critically reflect the sales process. Most impediments identified were beyond the team's control, thus the sales team was never to blame for the poor results. Additionally, the team failed to follow up smaller improvement areas identified during the retrospectives in the next sprints.

The lack of critical reflection and altering actions jeopardised the adoption Scrum, and it started to slowly deteriorate. Realising their mistake, the Scrum consultants decided to make a fresh start. They reflected together with the sales team on how to better adapt and continue to learn through Scrum. Going forward, they would perform a root-cause analysis for the biggest impediment identified during the retrospectives. The team would eliminate it by defining concrete actions and list them as normal tasks, with the highest priority, on the backlog for the next sprint. This allowed the team to eliminate one major impediment after another. From here, the sales team started to understand how Scrum could help them improve. As a result, the morale and commitment to Scrum grew. The team realised that one improvement area would make the current sprint better than the previous one, and that nothing had a greater impact on the future sales than continuously improving their sales process.

Lessons learned

There are many lessons to learn from this pilot. Firstly, the pilot showed the importance of commitment to Scrum as a framework for it to work efficiently. The Scrum Masters role is key in that regard, as underestimating its impact could harm the outcome of Scrum implementation. Furthermore, the pilot displayed other important lessons. For instance, it showed that root-cause analysis can be very helpful in dealing with impediments. Focus is a key value of Scrum and making corrective actions for one impediment the highest priority helped the team to progress. As the corrective actions was proposed and implemented by the team, it gave the members a feeling of control and influence, thus improving motivation and commitment to scrum. As mentioned, customers behaviour was regarded as unpredictable and out of reach prior to the pilot. However, Scrum improved the understanding of customers'

needs through empirical monitoring and process adjustments. Steenberg (2016) found similar results in his study of Agile methods in sales. His study revealed how agile methods, when used to survey customers' needs, provided invaluable feedback that could be used to improve client focus and to give sales teams insight into how their behaviour positively or negatively impacted clients, thus enabling the teams to quickly make changes and become more effective. (Oprins et al., 2019)

The Scrum pilot was in the end regarded as a success, and the management decided to implement Scrum throughout the sales department. Following the introduction of Scrum, the company revenue doubled. According to the company's director, at least 50% of the revenue increase should be credited the adoption of Scrum. In addition, the company reports a higher morale among its employees. The teams are more focused, and they have learned to control the sales process with frequent inspections and reflections.

3.4.2 Scrum in Construction

The way in which construction projects are managed has not changed significantly in the last decades; however, stakeholders, materials, competition, and user requirements are continuously changing (Streule et al., 2016). This lack of change has created a gap between the current managerial view on how construction projects are managed and how they could be conducted to increase efficiency. With this in mind, Streule et al. (2016) investigated the implementation of Scrum in the construction industry. Their goal was to see what the industry could learn from using framework from other domains. More specifically, they wanted to find out what adaptions were needed, how Scrum could improve the design phase and where Scrum, or parts of it, could be used by the design and planning departments of construction companies. To answer these research questions, Scrum was implemented in the design phase of an ongoing project consisting of three four-story multi-family buildings for the Swiss market. Streule et al. (2016)

Implementation

The implementation of Scrum included almost all artefacts and events (Figure 3.7). The Development team consisted of seven individuals with different area of expertise: Architecture, Building Physics, Civil Engineering, Interior Design and Cost Estimation. In general, the team's prior knowledge to Scrum was very low.

Contrary to a normal Scrum team where the Product Owner creates the Product Backlog, the architects from the Development Team and the Scrum Master were the ones doing it in this case. This arrangement was necessary due to the Product Owners other commitments at the time. Every member of the Development Team, in addition to the Scrum Master, were required to participate in the Scrum Events. Furthermore, they were required to attend in the Scrum Review and Planning with the Product Owner (Streule et al., 2016).

Scrum Team			Scrum Events					Scrum Artifact			
Product Owner	Development Team	Scrum Master	Sprint	Sprint Planning	Daily Scrum	Sprint Review	Sprint Retrospective	Product Backlog	Sprint Backlog	Planning Poker	Increment
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	*	✓

*Added after implementation of Scrum (from Sprint number five)

Figure 3.7: Scrum Implementation (Streule et al., 2016)

At first, the sprint duration was fixed to five working days. However, after four weeks it was not enough time to address all the Scrum Events while doing the required work. Additionally, the workload during the first four Sprints was entirely based on the experience from the Development Team, without any systematic or empirical approach. Adjustments were therefore made before Sprint number five. Going forward, the Sprint duration would be increased to two weeks and planning poker was to be implemented. These adjustments helped to determine the effort of each item and allowed a more realistic time frame. Furthermore, the team used virtual Kanban board to keep track on what was important during each Sprint.

Results

The case study evaluated the results from the Scrum implementation by grading the Daily Scrums, interviewing the Scrum Team, and conducting a critical analysis of the Product Backlog. All Daily Scrums were recorded and systematically analysed using a template. During the case study, the overall score of the Daily Scrum increased from a 2.5 (very poor), to a 4.3 (satisfactory-good). In addition, the participants were asked after eight weeks to rate a number of questions regarding the added value from various Scrum Events or Artefacts to the design process. The rating varied in a scale from 1.0 (does not add any value) to 5.0 (does provide a lot of value). The results are presented in table 3.1.

Scrum Framework	Grading
Daily Scrum	3.9
Sprint Planning	3.5
Sprint Review	3.5
Sprint Retrospective	3.0
Attendance necessity, Daily Scrum	4.0
Attendance necessity, Sprint Review	4.4

Table 3.1: Evaluation of Scrum Framework (Streule et al., 2016)

At the end of the study, all participants wanted to continue using Scrum as they were convinced that it was more efficient than the traditional approach they had used over years of practice. The team mentioned higher transparency, better communication and collaboration, better information flow and faster project development as added benefits from Scrum. Furthermore, the many meetings enabled the single member to see the point of view of the other members and thereby improving their knowledge to the overall process and support the concept of cross-functional teams. The team also appreciated the Kanban board as it proved to be a useful tool for keeping track for the project development. Contradictory, there were some disadvantages reported from the team members. The participants addressed missing knowledge of Scrum and lack of clear project leadership as well as unclear duties and responsibilities at the beginning. However, these disadvantages deteriorated as the Scrum knowledge grew.

Lessons Learned

There are some valuable lessons to be learned from the case study conducted by Streule et al. (2016). Firstly, the initial lack of clarity in Scrum roles and artefacts shows that it is important to thoroughly understand Scrum before implementation. Furthermore, the study proved that experience is not enough to determine the duration of known tasks. It is therefore recommended to take enough time to create, inspect, update and adapt the Product

Backlog with Items and tasks before every Sprint Planning. Planning poker, or similar tools, can be helpful in that regard. Moreover, it showed that no significant adjustment to the Scrum framework were necessary for it to work in an industry in which the participants had little to no prior experience with Scrum. This correlates with the findings from the other studies. This case is also an example of how Scrum needs time to be adjusted to its specific environment before the real benefits starts to show. By following regular Scrum recommendations and agile implementation success factors, the team succeeded in implementing Scrum without too much issue.

3.4.3 Scrum in Venture Capital

Sutherland and Altman (2009) studied the implementation of Scrum in Venture Capital company in 2007. The company in question was founded in 2006 and provided hands-on operational value to each portfolio company. Additionally, the company invested in promising software companies and took seats on their board. Their ultimate goal was to achieve significantly high investments returns (Sutherland and Altman, 2009). The company consisted of a core team of thirteen and had an investment portfolio of six software companies. The company participating in the study is anonymous and is therefore called OpenView Venture Partners. The company's mission is to gather, create, store and disseminate best practises and expertise for the benefit of OpenView Venture Partners, its prospects, portfolio companies, and its community and provide high impact execution assistance to the portfolio companies (Sutherland and Altman, 2009).

Prior to the Scrum implementation, the team members often worked above 50 hours per week to fulfil the high demands of their portfolio companies. To reduce the amount of overtime, the company's CEO decided to adapt Scrum as he saw principles and ideas that could be applied to make the company more productive, efficient and self-managed. Furthermore, the team members worked as individuals and the communication between them was limited.

Implementation

The employees had prior knowledge of Scrum through one of the clients, who provided agile project management tools. However, most of the team members though agile ideas and principles were only relevant to software development. Therefore, Scrum was never considered for an internal consumption. Through an initiative from the CEO, the team members completed a Scrum Master Certification course as an introduction to Scrum prior to its implementation.

From here, Sutherland and Altman (2009) describes two phases of the Scrum adaption.

- Phase 1 - Getting Started with Scrum
- Phase 2 - Scaling up Scrum

Two cross functional Scrum Teams with their own designated Scrum Master was formed in Phase 1, and the Sprint duration was set to one week. After the initial formation, Sutherland and Altman (2009) decided to focus on one team in particular. In this case, they studied the value-add team, called the OpenView Labs team, who consisted of four individuals which were responsible for adding operational value to their clients. The individuals had their own

working projects, so the Product Backlog was a collection of each team members individual projects in progress.

The team decided to implement the regular Sprint Events and artefacts, in exception of the Sprint Review. The company CEO was the Chief Product Owner. However, the team members functioned as the effective Products Owners for the portfolio company they worked on. The Stories were sized in perfect hours, as most stories included time-based activities. The initial velocity was estimated to be 20 perfect hours per member, giving the Team a starting velocity of 80. Moreover, unplanned stories were tracked separately. During the start-up phase, the team struggled with defining the duration of the various Sprint Backlog Items. Additionally, the definition of done lacked a general standard and was therefore often unclear for each Item.

Phase 1 - Getting Started with Scrum

Within months, the affects from the Scrum implementation started to show. The team was self-managed, and the internal communication and transparency increased from virtually zero to a significant level. As a result, the team members were able to identify projects of low value. About 30% of the projects was eliminated to make room for more high value projects. Initially, the velocity stayed relative flat and the team took on too many stories. However, this was fixed within a few months, and the overall productivity were increased by successfully removing impediments such as lack of clarity, lack of communication and low value work. The clarity grew by breaking projects into smaller Items. By removing impediments, the team members were less overwhelmed with working on 10-20 projects simultaneously.

An additional benefit was reduction in stress levels. Furthermore, the collaboration between the team members started to increase. However, the team members were still working mainly as individuals at this stage, even though collaboration was welcomed. The main difference after the implementation was the working hours. By using Scrum, the Company's founding partner and CEO Scott Maxwell discovered that the peak of production was in less than 40 hours per week. From here, he instructed the team to work fewer hours and not work during weekends to create a sustainable pace. The idea was to work fewer hours with higher effectiveness and focus to increase the overall productivity.

The initial implementation produced some challenges as well. The Daily Scrum could take up to 45 minutes. The project stakeholders consisted of the portfolio companies and OpenViews representatives, and the communication between these stakeholders and the Scrum team was poor. As a result, it was unclear how the stories fitted together for any given portfolio company. Not all team members were thrilled with the new structure, and one member preferred to work as an individual. For him, existence of the Scrum Master and team transparency started to become a source of conflict. However, he was not alone to be sceptical of Scrum. Most team members were unsure if Scrum made sense for their company. While they embraced some aspect of the framework, the consensus was that they should stop the implementation at this point. In general, it became increasingly difficult for the Team Members to both be Products Owners and Developers. Another problem was that the ability to take large projects and breaking them into smaller stories created a temptation to take on too many projects at the time. Consequently, they rarely completed the Sprint Backlog and struggled to follow Maxwell's instruction to work less hours.

Phase 2 - Scaling Up

Even though most team members wanted to stop further implementation of Scrum, the people in charge decided to push through it. However, some experimentation and changes were made in the next phase. As the team had grown from four - to six - to ultimately nine members, it had become too large to be efficient. As a result, the team split into two groups. Additionally, the team experimented with two-weeks Sprint without much luck due to less focus and a growing number of unplanned stories. The team therefore decided to stick with the one-week Sprint.

During this phase, the team also experimented with sizing in Story points. This was however unsuccessful, and the team went back to perfect hours. The reason for this was that many stories were small enough to be tasks, and many stories were time-based. For example *"a one hour call to discuss marketing plan"*. Moreover, it is difficult to use velocity in perfect hours as the sole gauge of improved output productivity. Therefore, velocity estimation was a combination of perfect hours, a few other metric and conservative assumptions. Unfortunately, the other metrics are not specified in the case study.

In addition, the team successfully managed to reduce the duration of the Daily Scrums down to 15 minutes. The weekly Retrospective continued to produce impediments. To manage them, the team created an Impediment Backlog for new and unfinished impediments. As impediments were removed, the transparency within the Labs team and between the portfolio company Products Owner grew.

Some adjustment to the team was made as well. One of the OpenView's senior point people replaced the CEO as the Product Owner. This meant that the Scrum Team could now focus on only being a Developer. Moreover, The Product Backlog was divided, and each portfolio company now had its own Backlog. The Backlogs were discussed in conjunction during an Investment committee meeting, where priorities were reviewed, and stories clarified. This new arrangement accomplished clearer Product Backlog items, and less communication needed between the Labs team and the portfolio companies.

The initial issues with the Definition of Done was also fixed. Firstly, they established a common definition for all Product Backlog items. The Product Backlog item was defined as done when the deliverable was posted to a Central Desktop, and all stakeholders were notified. Secondly, to increase clarity, the next step in the project was specified so that then next person knew what had been done and what remained to be done in the project. The changes meant that at the beginning of each week, every team member knew exactly what they needed to do and why. This allowed them to focus on execution of tasks to a great degree. Following, almost every single Sprint Backlog was completed in time.

When historical velocities were compared, the team learned that the more they took on beyond the previous Sprint's velocity, the less they managed to get done. Following, the Team started to follow up Maxwell's instruction to work less hours. The team were more disciplined, thus late nights and weekends were no longer an issue. Altogether, the velocity increased with 40-70 % from January 2008 to October 2008. By including size reduction in Product Backlog items due to removal of impediments, Sutherland and Altman (2009) estimates 80-100 % improvement in productivity during the same time period. As a result, the company CEO claimed that the output in terms of value had increased by a minimum of 150 %.

However, the up-scaling of Scrum fabricated some challenges. Despite clearer Product Backlog items and increased collaboration, the team members still lacked a good understand of the big picture and worked mainly as individuals. Additionally, one team member decided to leave the team as he was too much of an individualist to work in a Scrum Team.

Results

Due to the implementation of Scrum, the team managed to produce higher quality, more Product Backlog items and more value while working less and require less outside management. Additional benefits are higher collaboration, transparency and morale among the team members. As a result, integrating new team members has become easier and more effective. However, the team members still reported some issues regarding their understanding of Product Backlog items and the bigger picture. To address this problem, the team implemented a weekly Sprint Review between the portfolio company point people and the Labs team. Here, the results of Sprint stories were discussed. The goal was to remove impediments and help the team to get a sharper understanding of next Sprint's goal and Product Backlog items in a ddition to improving the cooperation, communication and collaboration between team members.

Lessons Learned

OpenView went through some reoccurring challenges with Scrum implementation. In such case, OpenView's experiences highlights that continuous adjustment and learning is often needed to precisely predict the duration of Product Backlog items tasks. In addition, the study shows that the Definition of Done is hard to get right at first try. Moreover, the case demonstrated that one can create space for unplanned work and still successfully implement Scrum.

Furthermore, OpenView case underlines the importance of commitment to Scrum for it to reach its full potential. The study also highlighted that the framework is not for everyone. For Scrum to work, you must have trust, commitment, accountability and attention to results as a team. However, some very capable people are individualists. For them, Scrum can be harmful and kill their productivity and drive. Careful selection and monitoring of team members is therefore important, as inclusion of strong individualists can hurt the overall productivity and work environment. Additionally, the study showcased that Scrum could reduce the period of integration for new team members. This is a valuable lesson learned that can be used by companies who have a high turnover in employees.

Additionally, the study from the Venture Capital group showed that Scrum can be implemented in a multi-project environment with a continuous evolving Product Backlog. Similar results have been found in the software industry (Stettina and Smit, 2016). One particular helpful action in handling multiple projects simultaneously, was to include a guide for the next step in the definition of done. It also demonstrated that all Scrum elements should be implemented. At the end of the study, the group was in the process of implementing a Sprint Review to improve the transparency and understanding of the Product Backlog Items. Furthermore, it demonstrated that sizing in perfect hours is suitable for time-based Product Backlog items, and that higher transparency can result in a better distribution of resources.

Moreover, the study showed that Scrum is very good at revealing areas in which a team must improve. Sutherland and Altman (2009) also highlighted that removal of impediments without doing root cause analysis can lead to extra work. By neglecting the root cause analysis, impediments come back in the same or modified form until the root cause is handled. Another lesson learned is that challenges can emerge when you are focusing on one single area at the time. Therefore, it is desirable to keep a wide focus and consider the whole process in mind when dealing with impediments.

3.4.4 Challenges Across the Case Studies

The case studies from other industries who have tried to implement Scrum has revealed some interesting reoccurring challenges, which are related to:

- Resistance to Agile Methods
- Not Implementing the Whole Framework
- Product Backlog items
- Scrum Knowledge
- Events

Resistance to Agile Methods

Many teams are initially unconvinced of Scrum, and feel that it is not relevant for them and thus cannot improve their process (Jurado-Navas and Munoz-Luna, 2017; Sutherland et al., 2009; Sutherland and Altman, 2009; van Solingen et al., 2011; Zender and de Soto, 2020). This is not surprising, as scepticism towards agile methods is mentioned as a common challenge in section 2.2.1. Following, it takes some time before the team is won over, and the Scrum Master plays an important role in convincing the team. Often, the positive effects from the Daily Scrum, Sprint Review and Retrospective is needed for the team to fully grasps the potential benefits from Scrum.

Not Implementing the Whole Framework

In contrary to the Scrum Guide's recommendation (Schwaber and Sutherland, 2020), some teams decide not to implement Scrum as a whole (Sutherland and Altman, 2009; Senabre, 2019). In one particular case, both the Retrospective and Daily Scrum is neglected. As a result, the implementation is impeded and the study concludes that *"additional scrum practices (such as regular "standups" in short periods, or retrospective meetings) could improve the adaption of APM principles and practices adapted to research activity"* (Senabre, 2019, p. 24).

Product Backlog items

As described by Lacey (2012), sizing, the Definition of Done and determining the team's velocity are typical challenges for teams new to Scrum. Following, these challenges are recurring issues in multiple of the identified cases (Sutherland and Altman, 2009; DeFauw, 2012; Streule et al., 2016; Vogelzang et al., 2019). A direct consequence can be unfinished Sprint Backlogs, which in turn has a negative effect on staff morale. Sizing based on experience proves to be particularly inaccurate (Vogelzang et al., 2019; Streule et al., 2016). Planning poker (Streule et al., 2016; Vogelzang et al., 2019) and splitting the Product Backlog Items into smaller objects (DeFauw, 2012) turn

out to be helpful corrective actions. In addition, each Sprint provides the Scrum team with valuable knowledge and experience. The initial problems with sizing and the Definition of Done therefore decreases progressively with time, as predicted in the Scrum Guide (Schwaber and Sutherland, 2020).

In addition, some cases follows teams in a multi-project environment. One particular challenge from this environment is indistinct Product Backlog items (Sutherland and Altman, 2009). The team members struggle to understand how the Product Backlog items and increments fits together. One solution to this problem is to include a specification of the next step in the Definition of Done. By doing so, the team gets a better understanding of the Product Backlog items and more clarity in the Sprint Backlog (Sutherland and Altman, 2009).

Scrum Knowledge

One common challenge in implementing agile methods is the lack of prior knowledge. This is also relevant in multiple of the case studies (Sutherland et al., 2009; Senabre, 2019; Streule et al., 2016). The consequence of the lack of prior knowledge, is a lack of clarity and understanding in the different roles, artefacts and events during the initial Sprints. To mitigate this risk, some teams decides to have a deeper introduction to Scrum prior to its implementation (Jurado-Navas and Munoz-Luna, 2017; van Solingen et al., 2011; Zender and de Soto, 2020; Vogelzang et al., 2019). In one particular case, the Scrum team completes a certification course (Sutherland and Altman, 2009).

Events

Many teams struggled with completing the Scrum Events in a timely manner (Streule et al., 2016; Vogelzang et al., 2019; DeFauw, 2012; Sutherland and Altman, 2009). The Daily Scrum is in particular subject to lingering, and some teams struggle to set a fitting Sprint length. However, challenges connected to the Events are not limited to their duration. The Retrospective takes time to be beneficial, as trust, cooperation and openness to conflict among team members is needed to be established (Jurado-Navas and Munoz-Luna, 2017). One team fails to sufficiently reflect over their own performances during the Retrospective meetings, which jeopardised the adoption of Scrum (van Solingen et al., 2011). This is solved by doing root-cause analysis and making the corrective actions the highest priorities in the upcoming sprint. As with the challenges with the Product Backlog items, the execution of the Scrum Events gets better with time.

3.4.5 Lessons Learned

There are many lessons learned across the case studies. Interestingly enough, most of these correlates with the success factors and challenges presented in section 2.2.2. The identified lessons learned from the cases are the following:

- Scrum is Flexible
- Scrum Needs Time to Adapt
- No Size Fits All
- Scrum Can Work in a Multi-Project Environment

- Implement the Whole Framework

- Sizing in Perfect Hours and Planning Poker

- Root-Cause Analysis in the Retrospective

- Commitment to Scrum is Vital

Scrum is Flexible

The main lessons learned from these cases are that the Scrum framework can be adopted in wide range of domains outside of software development, without significant modifications needed (Streule et al., 2016; Sutherland et al., 2009; Sutherland and Altman, 2009; van Solingen et al., 2011; Vogelzang et al., 2019). After all, Scrum is designed to guide teams to continuous process improvement through value prioritisation, reflection, customer behaviour and needs, self-steering, teamwork and joint task definitions: all invaluable to any discipline or industry (van Solingen et al., 2011). The case studies showcased that very little of the Scrum framework is exclusive to software development. As a result, the success factors for agile and Scrum adoption described in section 2.2.2 is valid for non-software implementation.

Scrum Needs Time to Adapt

Due to initial issues, the implementation of Scrum can be divided into two phases. The first phase can be described as a learning period, where the team spend time to learn Scrum and understand the process (Jurado-Navas and Munoz-Luna, 2017; Vogelzang et al., 2019; Streule et al., 2016; Sutherland et al., 2009; Sutherland and Altman, 2009; Senabre, 2019; van Solingen et al., 2011). The second phase is then initiated by making suitable adjustments to the Sprint length, sizing unit, Definition of Done, grooming activity or any other Scrum element. The Scrum Masters plays an important part during the transition to the second phase, and it is often from this point forward the benefits from Scrum becomes clear. Thus, getting a good understanding of the Scrum framework prior to implementation can help to shorten the initial learning phase. The cases also display how inclusion of one corrective action with the highest priority in each Sprint Backlog is beneficial, especially for new teams unconvinced of Scrum. Following, root-cause analysis demonstrates great value during the Retrospective meetings.

No Size Fits All

In Scrum, there is no size fits all, and it is hard to get right at the first try. Following, a period of adjusting the frameworks elements to its environment is needed for it to work at maximum capacity. This aligns with one of the success factor highlighted in section 2.2.2, which is that a pilot team used to gather insight increases the chance of a successful large scale implementation.

Scrum Works Can Work in a Multi-Project Environment

Additionally, the study from the Venture Capital group showed that Scrum can be implemented in a multi-project environment with a continuous evolving Product Backlog (Sutherland and Altman, 2009). One particular helpful action in handling multiple projects simultaneously, is to include a guide for the next step in the definition of done. The case demonstrates that one can create space for unplanned work and still successfully implement Scrum.

Implement the Whole Framework

One common mistake with agile implementation is to skip practices or ignoring core elements (Dikert et al., 2016; Ozierańska et al., 2016). This is especially relevant in one case, where they leave out both the Retrospective and the Daily Scrum (Senabre, 2019). In this case, the success of the implementation can be described as moderate, and the researches concludes that leaving out these core elements impeded the adoption of the framework. In addition, the Venture Capital Group was in the process of including the Sprint Review in their practices to improve transparency in the Product Backlog Items when their study ended.

Sizing in perfect hours

Another lesson learned is that sizing in perfect hours is most suitable for environment with a majority of time-based Product Backlog items (Sutherland and Altman, 2009). This also proves to be easier to understand and more familiar to the newly established Scrum Teams. In addition, the cases highlights that estimating known tasks based on experience is inaccurate (Streule et al., 2016; Vogelzang et al., 2019).

Root-Cause Analysis in the Retrospective Events

The lack of critical reflection and altering actions can jeopardise the adoption Scrum, as showcased in the Sales case (van Solingen et al., 2011). In addition, the Venture Capital Group concludes that leaving out the root-cause analysis lead to the same problems reoccurring in a different form (Sutherland and Altman, 2009). Similar results has been found in other studies (Zender and de Soto, 2020; Vogelzang et al., 2019) and root-cause analysis should therefore be a part of the retrospective events when implementing Scrum.

Commitment to Scrum is vital

The pilot from the Sales team highlighted that the importance of commitment to Scrum for it to work efficiently. In addition, the Venture Capital Group showcases that Scrum is not suited for strong individuals. This correlates with one of the success factors in Dikert et al. (2016) study which states that including engaged people increases the probability of a successful implementation of agile methods.

4 Method

A method is a procedure, a means of solving problems and arriving at new knowledge. Any means that serves this purpose is part of the arsenal of methods (Hellevik, 1999). This chapter will introduce the methodological approaches used in this study, which involves research method, interview process, presentation of case, credibility and limitations.

4.1 Research Method

In method theory, it is common to differentiate between quantitative and qualitative research. The greatest difference between the two is presented in table 4.1 (Jacobsen, 2015):

Table 4.1: Quantitative and Qualitative research

Quantitative	Qualitative
Questionnaire with rigid question and answer options.	Personal interview or conversation
A method to analyse statistics. Will not provide nuances or reflection.	Retrieval of data more open and informal. Does not restrict the correspondent's answers.
Useful for investigating root-causes or synergies.	Provide an opportunity to develop a deeper understanding.

A qualitative approach with semi-structured interviews is used in this study. The interviews can best be described as a conversation between the interviewed objects and the researcher, where the researcher steers the topics of the conversation. The purpose of the interviews is to establish the background to why the Company can benefit from implementing Scrum, and to establish which factors can impede or promote the implementation of Scrum. Furthermore, the interviews provides useful information for the employees' attitude towards a potential Scrum implementation. Questions such as; how will the team look, how can it improve the current practices, what will need to be in place, and what will be the biggest challenges is addressed.

Eisenhardt (1989) describes how one can apply cases to develop theories in research. By using an iterative process, his descriptions serves as a guide for design and execution of studies. Table 4.2 shows the iterative research process used in this study. During this study, the steps are revisited several times to allow adjustments to the theory content, solution, discussion and conclusion.

Table 4.2: Iterative Process

Step	Research Process	Correlated Section
1	Problem Statement	Introduction
2	Literature Research	Theory
3	Identify current challenges and propose Scrum solution	Results
4	Analyse proposed solution	Discussion
5	Conclusion	Conclusion

4.1.1 Case Description

Eisenhardt (1989) emphasise that the case selection is crucial, as it lays the foundation for the theory to be developed. The case chosen for this thesis is an Oil & Gas Company who provides well intervention services for several clients through long-term contracts. In this study, interviews are used to portray how Scrum can be implemented in the company by first mapping out what the current practice is and which challenges are faced, then proposing a solution of how Scrum can be implemented to the company. According to Eisenhardt (1989), it is important to be well prepared and have a narrow focus area before one proceeds to the literature research phase. Without having a narrow focus, it is difficult to determine what literature is relevant for the case study. The focus of this study is to research how to implement agile methods to a well intervention company.

4.1.2 Literature Research

The literature research is performed between January and May 2021. The literature studies gathers previous research on the subject. This includes the framework itself, but also regular pitfalls and success factors for Scrum implementation. In addition, the literature review include a comprehensive research of Scrum implementation in domains outside software development. This is highly relevant, as it is important to establish what Scrum elements are and are not suitable for other domains. In general, it is time-consuming to find such cases, as the topic is scarcely described in the literature. Most of the sources used is obtained from Google Scholar, Science Direct or Oria. The purpose of the literature review is to establish sufficient knowledge of differences between traditional methods and Scrum, Scrum success factors and pitfalls and the implementation of Scrum in domains outside software development.

4.2 Interviews - collecting empirical data

Eisenhardt (1989) highlights two key benefits with interviewing several respondents. First, it increases the creative potential as the respondents often have complementary knowledge and insight. This provides the empirical data with multiple layers, and therefore increases the probability to discover new, relevant perspectives and insights in the data set. Second, a higher amount of interviewed objects increases the validity in the data set.

4.2.1 The Interview Process

The interviews are held between March and May 2021. The subjects are notified that the interviews will be anonymous. The interviews are performed after the qualitative method in a semi-structured matter. The purpose of a semi-structured interview is to ask open question to find the interviewed object's experience and knowledge in the subject. From here, the conversation between the interviewer and the interviewee might diverge in order to pursue the topic in more detail (Britten, 2006). Each interview is conducted over Teams and recorded for transcription. Ideally, these interviews would be held with one subject at the time to reduce the risk of conformity. However, the Covid pandemic has made it difficult due to practical reasons. The duration of the interviews is set to one hour. In relation to research question 1, it is vital that the interviewed subjects has complementary knowledge and experience. Following, interview participants are chosen from different roles and departments. Their combined insight gives a wide perspective in relation to current challenges and Scrum opportunities.

In total, four interviews are performed with a duration of approximately one hour. Six people with different background are interviewed. It is important to interview different roles to gather several points of view. The interview subjects are anonymous, but each interview subject's role is listed below:

1. Customer Service Leader 1
2. Customer Service Leader 2
3. Operations Supervisor 1, wireline
4. Operations Supervisor 2, logging & intervention
5. Operations Supervisor 3, logging & intervention
6. Operations Supervisor 4, wireline

The first interview addresses the current practice of planning well intervention services. Three Operations Supervisors are interviewed, and the guide for this interview is included in appendix A.1. As more is learned, a second interview is conducted with a Customer Service Leader, addressing the same topics as the first interview. The interview guide, in appendix A.2, is adjusted based on the information from the first interview. This time, the client has higher focus. The two last interviews are conducted in order to propose a solution to how Scrum can be implemented in the company. A presentation is made, and the interview subjects provides valuable input on what will work and what can be challenging.

4.2.2 Data Analysis

The analysis of the interviews follows Eisenhardt (1989) guide for case study analysis.

Entering the Field

Eisenhardt (1989) explains that it is important to frequently overlap between collection and analysis of data. He argues that the overlap provides opportunities to make adjustment in the collection of data. This has been very important in this case. Initially, it is important to understand the Service Execution Model and its limitation. In addition to the interviews, weekly communication with the supervisor at the company is held throughout the study. Between each meeting, new areas are investigated and important questions are noted down for the next meeting.

Case Analysis

According to Eisenhardt (1989), it is during this process that the researcher becomes familiar with the data and starts to generate a theory. Following, this process forces the researcher to look past the initial impressions and look through the evidence from multiple perspectives. This enables to researcher to discover patterns before he/she starts to generalise across the data input. The transcribed interviews and retrieved data from the Service Execution Model is reviewed multiple times for comparison. This allows an overview with challenges in the current practice to be established. These results are presented in section 5.

Comparison Between Retrieved Data and Existing Literature

After the data set is analysed, a comparison between the findings and the excising literature on the subject is conducted in accordance to (Eisenhardt, 1989) recommendations. When comparing, it is vital to ask the following question; *What does it resemble, what does it mean and why?*, as this helps to develop a theory. It is important to include contradicting literature to the theory section for two reasons. First, the credibility is harmed if conflicting theory is ignored. Second, contradicting theory can represent an opportunity, as it forces the researchers to be creative and create a complete solution (Eisenhardt, 1989). By combining the findings and the existing literature a suggested solution to how Scrum can be implemented is developed. These results are presented in section 6. From here, the suggestion is compared to the theoretical foundation the solution is based on in section 7.

4.2.3 Validity

In statistics, validity is defined as the degree of agreement between the claimed measurement and the real world (Louangrath, 2013, p. 1). Following, it is important to gather data from multiple sources to secure high validity (Aberdeen, 2013). Aberdeen (2013) further divide validity into *internal* and *external* validity. The internal validity describes to which extent the claimed findings are valid for the case and issue examined. The internal validity is in this case based on existing theory and input from multiple perspectives provided by the interviewed objects.

It would have been beneficial to both observe the current practice and have more interviews with employees to increase the validity of the current challenges. Due to the pandemic, observations of the current process could not be made. The company was restricted to work from home, which means that observing normal conditions was not possible. All information gathering has gone through teams meetings and email. Therefore, the time to develop a good understanding of the current practice has been longer than optimal. This ultimately slowed down the initial process of understanding the case, which is needed to ask relevant and useful questions during interviews. Consequently, there has not been sufficient time to perform as many interviews as wanted. To increase the validity, the results are sent to key people in the company to validate that the information has not been misinterpreted.

The internal validity of the overall problem statement and research question 2 are not particularly harmed, as these are heavily based on existing theory. The literature is carefully selected to enable a thoughtful and nuanced suggestion to Scrum implementation. Ideally, the study would include more empirical evidence of Scrum implementation in domains outside of software development, and especially in the Oil & Gas sector. This topic is however not described and investigated to a large degree in the current literature. Nevertheless, the findings from case studies in new industries highlights that very little of the Scrum framework is exclusive to the software development community. Following, the internal validity of the suggested solution and problem statement can be regarded has high.

The external validity is very narrow, as the results are based on a specific environment. The suggested solution might be transferable to other Well Service companies. However, the suggestion is based on a very specific roles and process, so a significant external validity is unlikely. At most, the study can function as an inspiration for implementation of agile methods in the Oil & Gas sector.

Other factors that might have influenced the validity is the execution of the interviews. As mention earlier, interview subjects would ideally be interviewed one at a time. Interviewing multiple people at once can lead to conformity and loss of information. In addition, the period the interviews are conducted in might had an influence as well. The Covid 19 pandemic has brought temporary changes to the company, especially in terms of meeting culture. The pandemic has reduced the capacity at oil platforms/production ships, and following increased the unpredictability in the planning process. Despite of this, the study reflects the normal situation at the company to a high degree. Nevertheless, further research would be necessary to reveal additional nuances and to confirm the findings.

4.2.4 Reliability

Reliability refers to what extent a study can yield the same result if it is to be repeated (Aberdeen, 2013). Normally, it is difficult to satisfy reliability requirements in qualitative interviews (Long and Johnson, 2000). Brinkmann and Kvale (2015) points out that the qualitative interview is not:

1. scientific, but only reflects common sense
2. quantitative, but only qualitative.
3. objective, but subjective.
4. scientific hypothesis testing, but only explorative.
5. a scientific method, because it is too person dependent.
6. trustworthy, but biased.
7. reliable, because it rests on leading questions.
8. intersubjective, because different readers find different meanings.
9. valid, as it relies on subjective impressions.
10. generalizable, because there are too few subjects.

The semi-structured interviews are particularly hard to repeat, as the conversation easily could have taken another direction. Furthermore, the study is influenced on how the recipient perceived the questions, which is not necessarily repeatable and dependent on the person. However, attempts to prevent misinterpretation by asking follow up questions and explain any ambiguity are made. To increase the reliability, the interviews are recorded to reduce the risk of misinterpretation from our part. The weekly supervisor meetings are on the other hand not recorded. The data from these meetings are notes and summaries written directly after the meetings. The summaries are then sent to the participants and the supervisor for feedback, in case misinterpretations have been made.

4.2.5 Limitation: Observation

According to Baker (2006), the value of observation is that *"it permits researchers to study people in their native environment in order to understand "things" from their perspective"*(Baker, 2006, p. 1). A combination of qualitative interviews and observation as method can provide a deeper understanding of the case, and can help the researcher see the case from different points of view (Johannessen, 2010). A combination of methods is called triangulation and the combination of observation and interview have a complementary effect on each other (Denzin

and Lincoln, 2011). Getting to know the studied case and the interview subjects through observation lays a good foundation for the interviews (Fangen, 2010).

Initiating the study with observations would be a preferred method for understanding the case. However, the company was restricted to work from home due to the pandemic. Therefore, it was not possible to use observation as a method to gather information. The equivocality and uncertainty was high in the beginning of the project.

Equivocality, which means ambiguity, occurs when multiple and conflicting interpretations about a situation exists (Weick, 1979; Daft and Macintosh, 1981). *"High equivocality means confusion and lack of understanding."* (Daft and Lengel, 1986, p. 3) It means that asking a yes-no question is not feasible because participants are not certain about what questions to ask (Daft and Lengel, 1986). Uncertainty can be defined as "the difference between the amount of information required to perform the task and the amount of information already possessed by the organisation" (Galbraith, 1977). High uncertainty requires a large number of questions to be asked and more information to be acquired to learn the answers and reduce the uncertainty (Daft and Lengel, 1986).

According to Daft and Lengel (1986), the simplest form of personal information processing is direct contact. When a problem occurs, Person A can contact Person B for a brief discussion, to quickly resolve the issue (Galbraith, 1977). Daft and Lengel (1986) defines information richness as *"the ability of information to change understanding within a time interval"* (Daft and Lengel, 1986, p. 7). Direct contact often uses rich media which reduces equivocality and uncertainty through discussions and exchange of viewpoints and new data. Rich media, in example face-to-face meetings, is preferred for reducing ambiguity and reaching a common interpretation because it provides immediate feedback so that interpretation can be checked immediately (Daft and Lengel, 1986).

Therefore, the use of observation and physical presence with the company could have reduced the amount of equivocality and uncertainty substantially in the initial phase of the project. However, this was not possible due to the pandemic, and information has therefore been gathered through weekly video meetings and formal interviews.

5 Current Practice of Planning and Execution of Well Intervention Services

This chapter presents an introduction to the company, key roles involved in the planning and follow up on well intervention services, and the Service Execution Model that is utilised for planning and execution of well intervention services. Then, the challenges related to planning and follow up of well interventions is presented.

5.1 Introduction

The company provides well intervention services for several clients through long-term contracts. The service is divided into two product lines, Wireline and Logging & Intervention. The two services combined provides well intervention services as a total supplier. The company perform services internationally, and the Service Execution Model is used in both Norway and for example the UK.

The well intervention service is an operation[1] executed offshore on a rig. This operation is also referred to as a job. A campaign is a series of jobs executed in a sequential order. Each job has a initiating phase, a planning phase, executing phase and finally a closing phase. A job is planned as a project, and the complexity of the surroundings makes that two similar jobs will not necessarily have the same solution. Even though delivering services for clients is an on-going activity that never ends, each service is unique. This means that the delivery of services is an operational process[2], and each service is a project.

> "We are not a production company, so the product we deliver is a service, and the service is as different
> as the different customer representatives you have to deal with." (Operations Supervisor 4)

Wireline

The wireline service provides equipment and personnel for wireline jobs out on rigs. The service uses a mechanical or electromechanical wireline for attaching and conveying tools down in the well to perform operations like intervening or pipe recovery. When the client orders a wireline service to a rig, the specific rig has a predefined package of equipment. Equipment and personnel are typically out on rig for a longer period.

Logging & Intervention

The logging & intervention service provides equipment and personnel to perform jobs with the tools that are attached to the wireline cable. When the client orders a logging & intervention service, the client typically has a problem that needs to be solved with these tools. The equipment needed for these jobs are more customised and job specific, there are less predefined equipment packages. When executing a job, equipment is combined into a toolstring. The toolstring is attached to the wireline cable and conveyed into the well to perform the operation that the client needs. Before shipping the equipment offshore, a stringcheck is performed to ensure that the equipment on the toolstring will work together and that equipment is not forgotten.

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[1]Operation: an activity that is planned to achieve something (Cambridge Dictionary, nd)

[2]Operational process: an on-going endeavour undertaken to create a repetitive product or result (ISIXSIGMA, nd)

5.2 Roles

There are several people involved in one operation. Multiple people from a workshop maintains and prepare the equipment needed for the operation and offshore personnel, for example crew leaders and field engineers, execute the operation offshore. Personnel coordinators and financial controllers are involved, to mention a few. However, the main people involved in the entire process, from initiation to closing, are the Customer Service Leader and the Operations Supervisor. In addition, the Operations Manager and the newly established role as One Team Coordinator is presented.

5.2.1 Customer Service Leader

The Customer Service Leader (CSL) is responsible for customer service support for clients with focus on planning, job preparation and expert help during execution and evaluation. The Customer Service Leader is also responsible for being the focal point in all relations with assigned accounts and responsible for contracts with regards to Sales, Account management and Marketing. The Customer Service Leader work towards one client and sits in-house at the client office. The position includes daily status meetings with the clients, and is the main focal point between the client and the company. They are responsible for finding solutions to the client an securing operations for the company. An overview of all the responsibilities and accountabilities for the Customer Service Leader can be found in appendix A.3.

Purpose of position:

- Secure best possible customer service contact, support and solutions driven service
- Achieve customer satisfaction through safe, efficient and innovative project planning, preparation, execution and evaluation
- Develop and secure long-term customer relationships
- Verify compliance with statutory, clients and corporate norms, policies and requirements

5.2.2 Operations Supervisor

The Operations Supervisor (OS) is responsible for planning and follow up of operations towards client and Customer Service Leader to ensure that the operations are performed in a safe and efficient manner. The objective for this role is to ensure an effective, professional and qualitative planning and follow-up support to enable flawless and efficient services through the Customer Service Leaders to the clients. The Operations Supervisor plan and follow up jobs independently most of the time, and have several jobs going at the same time. The Operations Supervisor belongs to either the Wireline or the Logging & Intervention department and work with a close collaboration with one or multiple Customer Service Leaders. An overview of all the responsibilities and accountabilities for the Operations Supervisor can be found in appendix A.4.

5.2.3 Operations Manager

Each product line has a Operations Manager, one for Wireline and one for Logging & Intervention. The Operations Manager has personnel responsibilities for the Operations Supervisors, and is overall responsible for the service

performance of either Wireline or Logging & Intervention service. The objective of the position is to ensure flawless planning and execution of service delivery and to coordinate and optimise the utilisation of the Operations Supervisors. This person quality checks the on-going operations and is not involved in any detail-planning. An overview of all the responsibilities and accountabilities for the Customer Service Leader can be found in appendix A.5.

5.2.4 One Team Coordinator

Recently (May 2021), a new role has been established in conjunction with a long-term contract with one of the clients. The purpose of this role is to coordinate all the jobs that are performed for that client. The Customer Service Leader is caught in single projects, so this coordinator will have the total overview and ensure efficient work flow between the client and company. The client has defined some of the work tasks that are included in this role, which can be found in appendix A.6.

5.3 Service Execution Model

The Service Execution Model is the model used for planning and execution of operations in the company. The model is divided into four phases, as shown in figure 5.1. The first phase is contractual and only happens once for long-term contracts. Phase 2-4 are job-specific and are repeated within the long-term contract. The Customer Service Leader and the Operations Supervisor are the key roles throughout this process.

1 Contractual	2 Plan & Prepare	3 Perform service	4 Close-out
1A Contract handover	**2A** Identify requirements	**3A** Pre job	**4A** Post job
1B Contract setup	**2B** Plan job	**3B** Perform job	**4B** Invoice
1C Business risk	**2C** Prepare job	**3C** Post operations	**4C** Close job
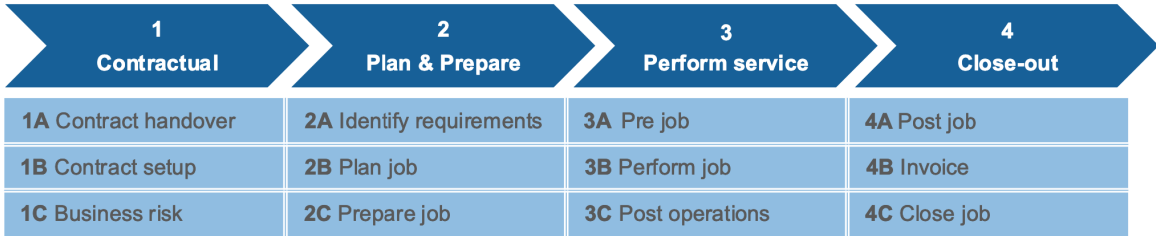
Figure 5.1: Overview of the four phases of the Service Execution Model

5.3.1 First phase: Contractual

The first phase of the Service Execution Model is the contractual part of the project. In the UK, there is a contract for each job, which means that the phase is repeated for every job. However, in Norway, they usually have long-term contracts with clients that proceed over a time frame. This means that the first phase of the Service Execution Model is only performed once for each contract. Within the long-term contract, the Customer Service Leader works to secure operations for the company. Phase *"1C Business risk"* is repeated when the Customer Service Leader secures an operations. This is to make sure that upcoming work is covered by the contract. Normally, only the Customer Service Leader is involved during this phase. However, it can be beneficial to include to Operations Supervisor as support when proposing to the client, especially for complex and high-profile operations.

5.3.2 Second phase: Plan & Prepare

Figure 5.2 gives an overview over the *"Plan & Prepare"* phase of the Service Execution Model. The responsible person for each sub-phase is given in parenthesis, where WS=Workshop Supervisor and LC=Logistics Coordinator. As figure 5.2 shows, the Customer Service Leader has most of the responsibility in this phase, followed by the Operations Supervisor. The workshop supervisor is responsible for the preparation of the ordered equipment and the logistics coordinator is responsible for shipping preparation and load out. These activities are performed in the workshop. The Customer Service Leader attends DOP meetings with the client, that is making the program, and brief meetings with client management.
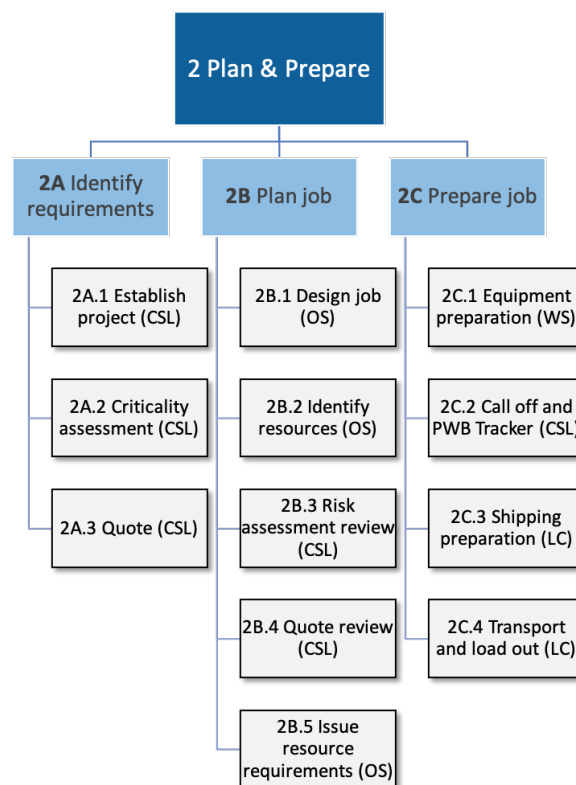
Figure 5.2: Overview of the planning and preparation phase of the execution model.

In general, the planning phase is a dynamic process due to a high degree of changes. The visibility in the portfolio of operations is limited, and two weeks is described as far into the future. Some clients hand out 90-days plans. These are however increasingly uncertain and are susceptible to multiple changes throughout its duration.

> *"A two weeks perspective is very long in our business." (One Team Leader 1)*

The planning phase can be divided into two categories, where one part of the planning is towards the client with drawings and simulations, and the other part is mobilising personnel and equipment. During the planning phase, the two different product lines work closely together.

> *"We are a bit organised in different silos, but we get sort of melted together during the planning and execution phases." (Operations Supervisor 1)*

2A Identify requirements

When the need for a well intervention service emerges, the client has a brief meeting with management to get approval of the job. Then, the client has a start up meeting where information about the well and a summary of the information is provided to the Customer Service Leader and any possible competitors. The Customer Service Leader has access to the client's Sharepoint so they can read their activity program whenever the client has uploaded information, and has access to the history of the well, 5 years back in time, to see what has happened and what has been done. The Customer Service Leader start to look into details and make a proposal to the client about what can be done and at what cost. For complicated wells or operations, the Operations Supervisor and Customer Service Leader have internal discussions before proposing to client.

Once it has been established that a current contract is in place, the terms and conditions have been agreed and all operations parameters have been accepted, the project is established in the appropriate system. The Customer Service Leader tries to gather as much information about the job as possible, and distributes it to the Operations Supervisor. Things can easily go wrong if the client has not provided sufficient information about the job, and the Operations Supervisor will need to make assumptions based on experience when planning the job. However, the initial well information provided by the client is in most cases very accurate, as inaccurate information will also have negative consequences for them. The overall impression is that the client understands that the Operations Supervisor needs sufficient information to make good plans.

2B Plan job

During the planning phase, the Customer Service Leader is closely involved with the client and have daily status meetings. If any new information gets brought up, it will be immediately communicated to the company and the Operations Supervisor. This arrangement means that the Operations Supervisor does not have daily contact with the client. However, the Operations Supervisor can communicate directly with the client during risk meeting, "development of program" meetings or meetings where specific technical knowledge is needed.

When the job is landed, the Customer Service Leader sends an order to the Operations Supervisor with the relevant information. From here, the Operations Supervisor starts planning and produce drawings of the equipment needed for the job which is then simulated. There is some back and forth communication between the Customer Service Leader and Operations Supervisor until the client is happy with the foundation of the job. The duration of the planning phase typically varies from one day to one week, depending on the size and complexity of the job. However, longer duration occasionally happen.

The Operations Supervisors have daily meetings with a workshop coordinator to coordinate the equipment. The workshop coordinator receives all information and distributes the equipment accordingly. Before there were multiple workshop coordinators, but due to restructuring, there is one coordinator and the rest concentrates on their work in the workshop. The Operations Supervisors coordinate with each other to mobilise equipment, and communicates the information to the Customer Service Leader.

2C Prepare job

After the plan is set, an equipment order is sent down to the workshop. From here, the workshop personnel will perform necessary maintenance and other preparations. When the preparation of the equipment is done, the whole equipment setup is tested through a string-check before shipping offshore. The string-check is an error detecting precaution to discover if there are missing parts or if the equipment does not fit together. Due to changes or rush mobilisations, the planned equipment might not be available anymore when the shipment date approaches.

5.3.3 Third phase: Perform service

The third phase, where the service is performed, happens offshore. The Operations supervisor is responsible for most of the pre-job phase. Crew leader, field engineer and operator are responsible for performing the job and the post operations, where the Operations Supervisor is held accountable. The Customer Service Leader is informed throughout this phase. An overview over the *"Perform service"* phase is shown in figure 5.3.
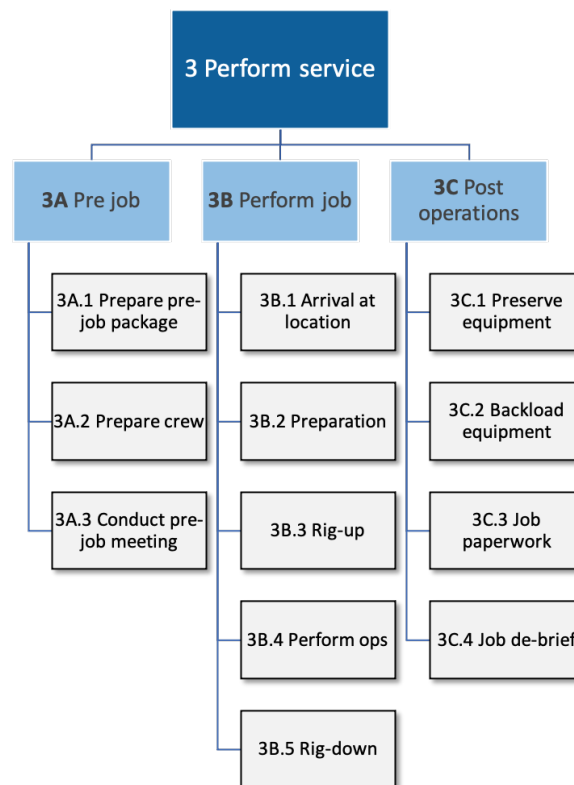
Figure 5.3: Overview of the performing phase of the execution model.

5.3.4 Fourth phase: Close out

Figure 5.4 gives an overview over the *"Close out"* phase of the Service Execution Model. The responsible person for each subphase is given in parenthesis, where FC=Financial Controller. The Operations Supervisor, together with the Workshop Manager, are responsible for the post job phase. This involves ensuring that equipment returns to base and prepared for maintenance, and report any lessons learned from the operation. The Customer Service Leader is responsible for closing the job towards the customer by invoicing and completing the paperwork.
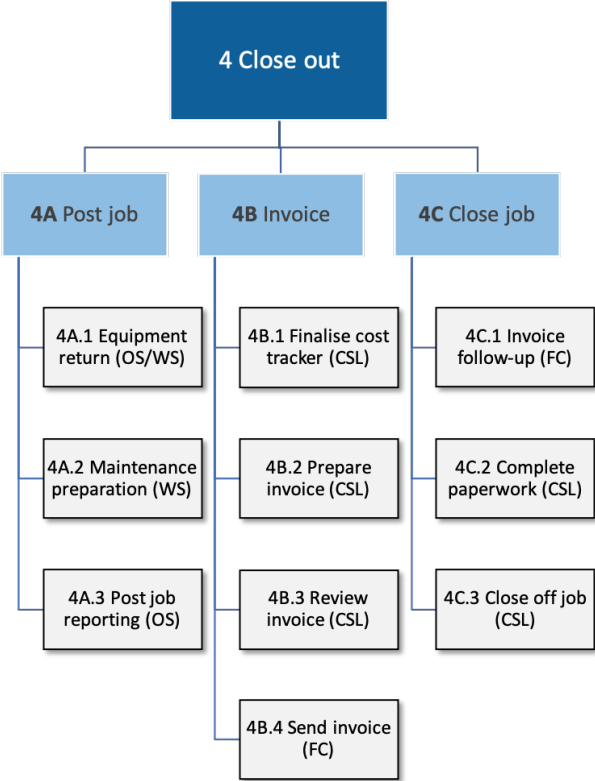
Figure 5.4: Overview of the closing phase of the execution model.

5.4 Challenges

In this section, the results from the qualitative interviews in terms of challenges related to today's practice will be presented in relation to research question 1. During these interviews, several challenges of both external and internal influence control is brought up. The most significant challenge is the complexity of the environment. The company provides well intervention services to multiple clients, and external factors such as conditions in the well, weather conditions and external delays out on rig are highly unpredictable. Projects appears in a short notice and rush mobilisations are common. This results in rapid changes of plans. Handling changes is a big part of the everyday life for the Operations Supervisors and Customer Service Leaders. Twelve different challenges have been discovered through interviews and divided in to three categories; scope change, interdependencies between projects, and organisation. These are presented in table 5.1.

Table 5.1: Challenges

Category	Challenge
Scope change	• Uncertainty
	• New information late in the process
	• Extra and corrective shipments
Interdependencies between projects	• Visibility
	• Shifting in schedule
	• Activity levels
	• Client coordination
	• Rush mobilisations
	• Resources
Organisation	• Varying workload
	• Meetings
	• Process improvement

5.4.1 Scope change

The interview subjects describe that a significant part of their job is to handle scope changes. A job is rarely planned and executed without scope changes. The main reason for scope change is uncertainty and situations that could not be planned in advance. Another reason for scope changes is new information from client late in the process. Interview subjects point out that new information from client late in the process happens occasionally and varies depending on the client, but scope change mostly happens due to unpredictable situations. Scope changes will in some situations lead to extra and corrective shipments of equipment. The three underlying challenges related to scope change are; uncertainty, new information late in the process, and extra and corrective shipments.

Uncertainty

Operational and unpredictable challenges in the execution phase can lead to scope changes. For instance, equipment can fail during testing or execution, and the well condition can change in short notice. There can be high temperatures and high pressure which makes the job challenging to perform. There can also be debris in the well that obstructs access to the desired point in the well. When this happen, additional equipment is needed to perform the job and a small job can turn out to be a longer and more complex job at very short notice. Therefore, the people involved in planning have to be dynamic, adapt to different situations and mobilise quickly.

> ”Well conditions can be quite unpredictable, you do not always know the conditions before you have tried.” (Operations Supervisor 2)

New information late in the process

Sometimes, the Operations Supervisors do not have all the necessary information needed to plan the operation. The Customer Service Leader will provide as much information as possible from the client initially. The earlier the information is provided, the better it is for the people planning and preparing the equipment. When the information is missing, the Operations Supervisors will need to plan based on experience until more information is provided.

However, the Operations Supervisors try to have as much relevant information as possible before starting on a job.

> *"It happens very often, at least it feels like it happens very often, that important information turns up at a late stage the planning process. Maybe the equipment already has been ordered, but there is some information you are missing. You have to get started with the planning to get the equipment out on time." (Operations Supervisor 3)*

In addition, the client will sometimes have an opinion about what equipment is needed for the operation. If this opinion comes at a late stage, additional equipment might have to be sent offshore. Scope change during a job can lead to additional equipment being shipped offshore or unused equipment which potentially could have been used for another operation.

Extra and corrective shipments

In addition to the main mobilisation of equipment, extra shipments occurs on a regular basis. When additional equipment is needed after the main mobilisation, this is sent on an extra shipment. These shipments are more resource-insensitive than regular shipments, and can affect several projects due to the high interdependence. Following, they are considered a waste.

There are several reasons for why extra shipments may be necessary. Appendix A.7 presents these reasons. The most common reason for extra shipments was *"Change in Operation - Additional Order from Client"*. These additional orders are typically a result of changes in scope or well conditions. The situations that causes extra shipments are often unpredictable, and are therefore not discovered before the job has started. Other reasons can be lack of information from the client. Experienced Customer Service Leaders can in some situations ask the right questions to the client to clarify the information, but otherwise it is mostly beyond the company's control.

The second most common reason for extra shipments in 2020 was due to *"Equipment Malfunction Offshore"*, which means that equipment failed during execution. Combined with extra shipments due to *"Equipment Faults Discovered Offshore"*, which is when equipment fails during testing before execution, this category represents 28% of the extra and corrective shipments in 2020. This category is unpredictable and causes extra work in terms of finding equipment to replace the faulty equipment and sending the equipment offshore.

A sub-category of the extra shipments is the corrective shipments. A corrective shipment is an extra shipment, where additional equipment is sent because of for example faulty planning or faulty equipment. In general, corrective shipments are considered the most wasteful as valuable time and effort has been spent on unsuited equipment. Due to the limited resource availability, this could have been valuable for other projects.

Corrective shipments might occur as a result of human mistakes. For instance, *"Missing in order from Operations Supervisor"* was the second most common reason for corrective shipments in 2020. A missing order might be caused by small details, for example a small piece of equipment forgotten during the planning, preparation or mobilisation phase. These missing orders typically occurs when activity is high or when time is of the essence. Following, rush planning are particularly susceptible to corrective shipments. Other reasons for corrective shipments can be that the preferred equipment was not available when the main mobilisation took place, and is thus

sent later as a corrective shipment.

5.4.2 Interdependencies between projects

Other challenges are related to the fact that each project is not isolated from its environment. There are multiple ongoing jobs which share the same resources. In addition to plans shifting, rush mobilisations will cause for plans to change or shift even further. This affects the resource availability for each project. This category can therefore be divided into; visibility, shifting in schedule, activity levels, client coordination, rush mobilisations and resources.

Visibility

Normally, the company is informed about a job one month in advance, and have approximately six weeks visibility about upcoming jobs. Some clients operate with long term plans such as a 90-day plan. However, some jobs appear at short notice. The Operations Supervisors considers two weeks to be far into the future, due to scope changes and shifting in plans. With such short visibility it is hard to make solid long-term plans.

> "We are experiencing short notice jobs quite often, but not necessarily 24-48 hours, but stuff that is not included in the plan. When a valve in the well starts leaking, then we need to go out and fix it. Stuff like that is common, the client could not know this in advance. For the most part, it is the jobs that suddenly appears that are challenging." (Operations Supervisor 1)

Shifting in schedule

Shifting in the schedule of upcoming jobs is common. As an example, the mentioned 90-day plan can contain for example ten upcoming jobs. However, these jobs are frequently shifted. The 90-day plan from the client is therefore referred to as a "90-second plan" by one interview subject, due to the constant changes in plans. Shipment dates are moved back and forth by both the client and the Operations Supervisors.

> "The planning is dynamic and the schedule gets pushed around. This is where the interaction between the Customer Service Leader and Operations Supervisor comes in." (Operations Supervisor 1)

Activity levels

The company measures activity levels in mandays, which is a measure of the number of offshore personnel working on operations each day.

$$1\,person \times 1\,day = 1\,manday$$

If ten people are offshore for ten days, then this equals 100 mandays. Activity levels are highly fluctuating, and it is nearly impossible to predict the number of mandays in the upcoming month due to scope change, plans shifting and jobs appearing at short notice. The number of mandays can be twice as high one month as it was the previous month. The activity level affects the resource availability, which amplifies the fact that the projects are not isolated from their environment.

Client coordination

One challenge that the company faces is that they have multiple clients, and these clients do not coordinate with each other. The client requests a service, and the company delivers the service. This means that there are periods with low activity, and high-activity where multiple clients need well intervention services at the same time. The organisation cannot simply decide when to execute operations in order to optimise resources, because they need to stay competitive and deliver high value customer service to the clients.

In this relation, the newly established role of the One Team Coordinator is discussed during the interviews. This role will have a greater overview over the upcoming jobs from one specific client, and might be able to coordinate the jobs from this client to gain a better distribution of activity. This can then lead to a more optimised distribution of resources. Regarding this, two of the Operations Supervisors agree that a better coordination between the Customer Service Leaders who work with the clients would make things easier, and increase the predictability in their workday.

> *"Sometimes a lot of similar operations can stack up. If we manage to coordinate them, and spread them out more evenly over time, then we could gain more from our equipment. When having a coordinator with a greater overview of ongoing jobs, then things can become easier. The Customer Service Leaders are very focused on their single operations." (Operations Supervisor 1)*

> *"If there was a better coordination between our Customer Service Leaders in relation to operation, then it would be possible to increase the predictability in our workday. You would certainly never achieve 100% predictability, but there is much room to improve." (Operations Supervisor 2)*

Rush mobilisations

Another challenge is the rush mobilisations. These are urgent, demanding, and typically high-profile operations caused by unforeseeable events. Due to their urgency, they demand shipment during the same day or within the next few days. This affects the upcoming jobs. When there is an activity peak, one job coming in from the sideline can almost overturn everything. Both ongoing and new jobs can cause rush mobilisations.

> *"An example is a planned campaign for four wells, where equipment is sent out for those four wells. Suddenly the client comes in with two additional wells, and a rush mobilisation is required. In addition, a situation occurs in the first well which was not planned. Then the plan needs to be changed daily, and more equipment is rush mobilised. The equipment originally planned for the four wells must stay on board the rig, and additional equipment must be sent out to cover the unplanned part. When the situation is handled, the additional equipment is sent back. Then suddenly a new situation occurs, and so on. Changes occur all the time, and the additional equipment needed to handle unpredictable situations could have been used for other jobs." (Customer Service Leader 1)*

Planning a rush mobilisation often includes taking equipment or personnel from other planned and prepared operations. The workshop and the Operations Supervisor are highly affected by rush mobilisations as they require extra work and have consequences to other planned jobs. When planning jobs on such short notice, it is easy to

forget small pieces of equipment.

Resources

One significant contributor to the high complexity is the limited amount of equipment and offshore personnel, as this creates a high interdependence between the projects. The level of activity is varying, and therefore the availability of equipment and offshore personnel is varying. As equipment and personnel are limited resources, a change in one project can force changes in multiple other projects, and thus corrective and extra shipments. This uncertainty makes is difficult to maintain, prepare and coordinate the resources in an optimal matter. Coordinating equipment and personnel is described as a daily firefighting, and prioritisation of which jobs get the equipment is done by looking at contract conditions and profit.

1. Personnel

Not all offshore personnel are trained in all types of equipment. Following, finding the right crew for the operation can be a time-consuming task. In periods with peak of activity, shifting in plans can cause for different personnel being sent out than originally planned. As an example, eight engineers might be trained to perform a job with a specialised equipment. If the client shifts the date of the job and there is high activity, these engineers may have to be sent out on other jobs.

2. Equipment

In the Logging & Intervention department, there are no standard equipment packages used for operations. The operation requires a certain type of tools, to solve the challenge in the well. A significant amount of time is spent on assembling a equipment package with the right equipment for the job. It is not uncommon that tools become unavailable close to the shipment date due to external influence, and this can cause a number of issues. A typical situation is that an operation is planned with a tool that is ideal for the job, but when the shipment date arrives, the tool is no longer available because it was sent elsewhere. As a consequence, a less suitable tool might be used, or the ideal tool is sent on a corrective shipment when available. *"Lack of equipment available at main mobilisation"* was the most common reason for corrective shipments in 2020, as shown in appendix A.7.

> *"When the shipping date approaches, you may not have the initial equipment you planned for, and then you have to change the plan." (Operations Supervisor 3)*

The Customer Service Leader can potentially establish a project for a client that is not feasible because of lack of equipment. When there is a peak in activity, it can be challenging to get the required equipment and personnel. As a result, a Customer Service Leader can land a job in which there is no available equipment, or they could create a short period with an excessive need for a specific equipment and/or personnel. This can in turn lead to changes in several operations, extra and/or corrective shipments, postponements of jobs and economical sanctions.

> *"We get updated by the Operations Supervisor, if for instance there is a possibility that maybe we cannot deliver the equipment on time." (Customer Service Leader 1)*

5.4.3 Organisation

The previous two categories are characterised by unpredictability and matters that are beyond the company's control. This category contains challenges that are more controllable within the organisation. The category contains challenges related to; workload, meetings and process improvement.

Varying workload

The activity levels are fluctuating, and therefore the company has employees to cover the average activity level rather than the periods with peaks in activity. This means that during periods with high activity, people have a high workload. Especially the Operations Supervisors can have many projects at the same time. As mentioned, the activity level can be twice as high one month as it was the previous month. For the Operations Supervisors who are following up all the activity offshore, this means that workload increases accordingly. One of the Customer Service Leaders mention that an increase in the capacity of the Operations Supervisors could possibly increase performance.

> "...We are kind of overloaded in terms of time, both in terms of jobs we are working on and that we sit in meetings most of the day." (Operations Supervisor 2)

Clients might request information or input on a job that is "far" into the future, and from the client perspective this is only fair. However, the Operations Supervisor might have more urgent matters to handle on other jobs. This can cause interruptions and disturbance for the Operations Supervisors. Following, the Operations Supervisor describes their days as unstructured, where they jump from one job to another. In addition, one Operations Supervisor might work with several Customer Service Leaders, which can enhance this challenge. When asked if it would be more effective to relate to fewer Customer Service Leaders, one Operations Supervisor answers:

> "Yes, because then we could have a meeting on Monday where we discussed what was relevant for the upcoming week and plan accordingly." (Operations Supervisor 2)

Meetings

Both the Customer Service Leader and Operations Supervisor spend a lot of their time in meetings. Whereas this is regarded as necessary for the Customer Service Leader, some Operations Supervisor express concern about the meeting culture, especially too many passive participants is described as a reoccurring issue.

> "We spend a lot of time in meetings, in which there are many participants. If that is a good thing or not, I'm not really sure." (Operations Supervisor 3)

Process improvement

The process of planning and follow up on operations is rarely inspected for potential improvements by the Operations Supervisors. Sometimes reflections are made after jobs, but not in a structured, systematic way. The Operations Supervisors are busy with multiple on-going projects, with little time to stop and reflect between projects. The word "firefighting" has been used on multiple occasions during the interviews. This also affects the quality of

post-job meetings. The way of working is to some degree a result of many years of experience and things falling into place in the end. The Service Execution Model does have a "lessons learned" activity within the framework, but the potential of this activity is not fully exploited.

> *"We have a way to go with post-job meetings, sharing information and transfer experience." (Operations Supervisor 1)*

> *"We have worked this way for many years now, where things eventually sort themselves out in one way or another. However, not everything we do is a result of a carefully thought out philosophy." (Operations Supervisor 2)*

6   Implementation of Scrum Framework

This section will combine input from the interviewed objects and Scrum Theory to suggest how Scrum can be implemented in the Company. In correlation with the success factors for agile implementation, the suggestion is to start with a pilot with one test-team. The idea is to use this team to gather insight and allow the Company to adjust the framework to their environment before a potential large-scale implementation across the Company. In addition, Scrum will not be implemented at a project level. Since the company work on multiple projects simultaneously and due to the frequency of Scrum events, Scrum would not be suitable at a project level as it would lead to management overhead.

Instead, the suggestion is to implement Scrum to the operational process of delivering services. This implies having a Product Backlog consisting of multiple projects, similar to the case of the Venture Capital Group. Implementing Scrum to the operational process also means that current Service Execution Model will make up most of the base for the different artefacts. The familiarity also means that the roles and responsibilities to the Operations Supervisor and Customer Service Leader will stay relatively intact.

6.1   Scrum Team

One recurring challenge from both the case studies and the literature is the lack of Scrum knowledge prior to its implementation. Consequently, the lack of clarity in the different roles, artefacts and events impedes the initial Sprints too some degree. The Venture Capital Group solves this by completing a Scrum course. It is therefore recommended that this team also completes a Scrum course prior to the implementation. The intention behind this suggestion is that it will speed up the initial learning period, so that the team will more quickly reach the full benefits of Scrum. It will also help them to understand the agile principles and thus help them to perform the Scrum events in accordance to their intended purpose.

6.1.1   Product Owner

The role of the Product Owner and the Customer Service Leader are similar in terms of responsibility. A comparison of the two roles are shown in table 6.1. When choosing a person to take the role as Product Owner, it is natural to choose a Customer Service Leader. The Customer Service Leader has the appropriate business and domain knowledge to perform the role, and has a close relationship with both stakeholders and the Operations Supervisors. A person can be both Product Owner and Developer on the same team. The Customer Service Leader from the Development team can therefore act as Product Owner, as well as a member of the Development team.

Table 6.1: Comparison of Product Owner and Customer Service Leader in terms of responsibility.

Responsibilities	Product Owner	Customer Service Leader
Manage Economics	• Maximise value of product • Prioritise features according to economic conditions	• Achieve increased sales over budget • Project performance measures (KPIs)
Participate in planning	• Collaborate with internal stakeholders to position product correctly in portfolio • Collaborate with Developers to define a Sprint Goal	• Commercial aspects related to planning, preparation, execution and evaluation • Communicate project information from client to Operations Supervisor
Groom the Product Backlog	• Create, refine, estimate and prioritise Product Backlog items	• Obtaining and sharing short-and long-term activity forecasting
Collaborate with the Developers	• Constant high-level collaboration with Developers • Develop and explicitly communicate Product Goal • Create and clearly communicate Product Backlog items	• Collaborate with Operations Supervisor on project • Connector between client and Operations Supervisor
Collaborate with the stakeholders	• Single voice of both internal and external stakeholders • Work closely with stakeholders to gather input Developers	• Participate in company's strategy and budgeting process • Develop and secure long-term customer relationships • Customer satisfaction and development • Day-to-day contact with client for support and improved value creating through proactive solution proposals

6.1.2 Scrum Master

The Scrum Master has the responsibility of protecting the Developers from outside interference such as issues originating from other teams, and is therefore an important role in the Scrum team. There are no obvious roles in the company that have the same responsibilities as the Scrum Master, but a Scrum Master can come from various backgrounds. The important factors are that the person chosen for this role have a passion for Scrum and understands the framework, to ensure that Scrum is implemented and adapted correctly. It is also important that the person understands the technical environment that the Developers work in, and are conscious of the needs that the teams have. The Scrum Master should be chosen based on the expected behaviour of this person, which is to be knowledgeable, questioning, patient and protective. The Scrum Master is not a manager of the team, but a servant.

To ensure a sufficient understanding of the technical environment, it is recommended to choose a person from the organisation for the role as Scrum Master. A person from the IT-department is familiar with the technical

environment and might also be familiar with Agile/Scrum. An IT-person can assist with moving impediments related to technical issues such as IT problems. This person is also familiar with the organisation, and knows who to contact to help remove impediments that are beyond the team's control. Therefore, this person contributes to ensuring a smooth process for the Developers and Product Owner. Other solutions are to choose a person from other departments to ensure technical understanding, or employ a consultant with expertise in the field of Scrum.

6.1.3 Developers

The Service Execution Model shows that the key people involved in an operation is the Customer Service Leader and the Operations Supervisor. The Customer Service Leader is in charge of the client side of the operation, and gathers information which is communicated to the Operations Supervisor. The Operations Supervisor is in charge of the planning of the operation internally. Equipment needed for the information is planned and plans are sent to the workshop for preparation. Offshore personnel is mobilised and informed about the operation. During execution, The Operations Supervisor is in charge of following up the operation offshore, and makes sure that problems are solved. Combined, the Customer Service Leader and the Operations Supervisor can plan and follow up operations. Through meetings and interviews with the company, this is considered to be the best combination for a Scrum team:

- One Customer Service Leader
- One Operations Supervisor from Wireline
- One Operations Supervisor from Logging & Intervention

6.2 Artifacts

The Scrum artefacts are designed to maximise the transparency of key information and is therefore a vital part of the Scrum framework. Following, the suggestion attempts to adjust and describe the content of the artefacts if Scrum were to be implemented in the Company.

6.2.1 Product Backlog

The Customer Service Leader as Product Owner has the responsibility to add new jobs into the Product Backlog and determine the sequence of work. The Product Backlog is the sole source of work for the Operations Supervisors and Customer Service Leader. When work is postponed, rush mobilisations appear or other changes occur, this will be added to the Product Backlog and prioritised accordingly.

This is similar to how they work today; the Customer Service Leader gathers information from the client and distributes it to the Operations Supervisors. The difference from today is that the Operations Supervisors will only work with one Customer Service Leader, and therefore mainly work on the operations that the Customer Service Leader has secured. In order to secure enough workload for the team, the Operations Supervisors might have to work on jobs that are secured by other Customer Service Leaders, but this will have to go through the Customer Service Leader as Product Owner. The solution to use the Product Backlog as a collection of operations, is similar to how the Venture Capital Group used the Product Backlog. In the Venture Capital Group, the Product Backlog

consisted of a collection of individual projects. The projects that the Customer Service Leader and Operations Supervisors will work on are team efforts.

Product Backlog Items

The Scrum Guide describes the Product Backlog as an ordered list of requirements. Each requested operation can be considered as a requirement; the client needs this service performed or needs this problem to be solved. Compared to conventional Scrum teams, this team will not use Scrum to incrementally work towards a solution. To deliver a service, the team must go through the Service Execution Model from phase 1 to phase 4. They are still following the linear execution model. Ideally, the team would go through the Service Execution model from phase 1 to phase 4 for one operation within one sprint. However, this is not possible due to varying length and complexity of operations, multiple on-going operations and interdependence between operations. The Product Backlog Item must therefore be divided into smaller items.

Based on this, it is suggested to use the sub-phases in the Service Execution Model as a reference point when defining the Product Backlog Items. Figure 5.2 on page 49 shows the Plan & Prepare phase of the Service Execution Model. *"2B Plan Job"* is an example of a Product Backlog Item, which includes designing the job, identifying resources, risk assessment review, and issuing resource requirements. In this example, the planning of an operation takes between one day and one week, and therefore fits within the sprint. The length of the sub-phases might vary or expand due to changes. If sub-phases has a longer duration than one sprint's length, the Product Backlog items can be further broken down into sub-sub-phases. This approach makes it easier for the Developers to transition to Scrum, as it adds familiarity. Implementing Scrum is an empirical process, with constant learning and adaptations. By trial and error, the Product Backlog items can be adjusted and improved as more is learned during the implementation.

6.2.2 Sprint Backlog

When asking whether the Operations Supervisors know on Monday what work they will do on Friday, one interview subject answered:

> *"You had planned to set aside Friday to clean up the mailbox, but then you might be left to plan an entire job instead, or a full mobilisation. But yes, ... to some extent you know what to do on Friday, but the day will never be quite as you had planned." (Operations Supervisor 1)*

The Sprint Backlog will be used according to the Scrum Guide as a way to structure the work week and will be created by the Operations Supervisor and Customer Service Leader. It will be based on current and most urgent jobs. Initially, it will be challenging to estimate the duration of the Sprint Backlog Items due to the unpredictable and highly volatile environment. With time, as showed in the case studies, this process will become easier as you continue to complete Sprints. Nevertheless, it is difficult to estimate the duration of unknown rush mobilisations and other sudden changes in resources or external environment. Good monitoring and reporting over time will give the team valuable information on how much time is spent on the unpredictable tasks during the week. This information will allow them to adjust the time set aside to unforeseeable events and to work at a sustainable pace.

A lesson learned from the case studies is the importance of having small enough Items. The Service Execution Model has already divided each sub-phase in multiple defined tasks. Following, the tasks described in Service Execution Model will be the reference point for the Sprint Backlog Items and together make up the Sprint Backlog. One lesson learned from the implementation of Scrum in Sales is that commitment to Scrum is important. The sales team fails to commit and follow up the small improvement measures, and as a result, the whole implementation is jeopardised. Their solution is to include corrective actions in the Sprint Backlog and give them high priority. After all, Scrum is designed to guide teams to continuous process improvement. Because of this, it is recommended to include concrete corrective actions in the Sprint Backlog and make them the highest priority.

6.2.3 Increments

According to Scrum theory, an increment is born when the Product Backlog Items meets their Definition of Done. Following, one increment will be the completion of one sub-phase. This definition of increment enables the Scrum Team to gather phase specific data and experience on each sub-phase. The focus during the Sprint Review will therefore be narrowed down to specific sub-phase and their tasks, instead of reviewing entire projects. The narrow focus will be helpful for identifying smaller and more obscure impediments and obstacles. In addition, the suggested increments serve as check points where it is natural to seek customer feedback to ensure that the project remains on track. This may in turn reduce the number of extra shipment presented in section A.7.

Since the Scrum Team works on several projects simultaneously, the proposed definition implies that the Scrum Team will deliver multiple increments each sprint. Additionally, smaller projects could be completed entirely during one Sprint. This situation is similar to the one described in the Venture Capital Group, who produced multiple user stories across a number of projects during each Sprint. The high rate of change and unpredictability indicates that the Development Team often will jump back to previous phases.

Definition of Done

The literature highlights that the Definition of Done can be extended to the Sprint Backlog Items and Sprint Event. The studies of multi-level Definition of Done reported several benefits, such as less amount of rework, removal of impediments, performance and a more precise estimation of User Stories. Furthermore, as seen in the Venture Capital case, it can be helpful to include instructions for the next step in the Definition of Done while dealing with multiple projects. Following, including operation specific instructions or information for the next sub-phase can help to reduce the cost of context switch described in section 3.1.3. With this in mind, it is recommended to include these elements in the Definition of Done. The Definition of Done might be troublesome to get right at the first try. Compared to today's practices, a good definition might reduce the time spent on jumping between tasks. Following, each sub-phase should have a set of clearly defined requirements that needs to be accomplished before initiating the next sub-phase.

6.3 Events

In Scrum, each event is a formal opportunity to inspect and adapt the Scrum artefacts, and they are specifically designed to enable the transparency required. In order to not lose any opportunity for inspection and adaption,

it is therefore recommended to include all Scrum events. As a by-the-book implementation is often not feasible, attempts to suit the organisation's needs are made by adjusting the Sprint Review. By including all Scrum events, the suggestion mitigate one common root-cause for challenges with agile implementation: ignoring core elements.

6.3.1 The Sprint

The interviews have made it clear that changes occur frequently, and that a two-week perspective is a long time in their business. Interview subjects describe that they would have difficulties with planning a week's worth of work due to the frequency of changes. It is therefore suggested to set the Sprint duration to one week. Following, it is suggested to keep the Sprint Event's as short as possible to reduce the risk of management overhead. The Kanban board proved to be a welcomed addition in the case studies as it helped to improve transparency. It is therefore suggested to use a Kanban board to keep track of the Items during the Sprint.

6.3.2 Sprint Planning

The Sprint planning will be set at each Monday. In this meeting, the Product Owner and the Scrum Team will discuss the relevant projects for the upcoming week. To make the transition to Scrum less complicated, and make the items small enough, it is suggested that the Sprint Backlog Items is based on the tasks described in the Service Execution Model.

In terms of sizing, both the literature and the implementation cases clearly highlighted that experience based sizing is very inaccurate, especially for teams new to Scrum. Because of this, the team can utilise planning poker during the Sprint Planning meeting. Based on the unpredictable nature of their every day life, it is important to leave significant room for change management when estimating the item's size. Risk, uncertainty and complexity must be included in the estimation. In similar fashion to the Venture Capital case, a lot of the tasks described in the Service Executing Model is time based. Because of this similarity, and the fact that time-based sizing is easier to understand for Teams unfamiliar with Scrum, the use of perfect hours as sizing metric is suggested. When planning the Sprint, it is also recommended to leave out room for sudden and urgent events, like the rush mobilisations. Over time, it will be possible to monitor how much time is spent on sudden events during a week and plan accordingly.

The way the Operations Supervisors work today can be a bit unstructured, they jump from one job to another. One Operations Supervisor can imagine that working with one Customer Service Leader, instead of several, would improve predictability. He suggests that the Customer Service Leader and Operations Supervisor could have a Monday meeting where they went through what was relevant for the upcoming week and plan accordingly. This fits the purpose of a Sprint Backlog and the Sprint Planning Meeting.

In general, The Sprint Goal will consist of completing the Sprint Backlog, while removing impediments to improve the process. However, the Sprint Goal will be determined by the Scrum Team during this meeting. One interview expressed concern about the Sprint Planning meeting in regards of determining a Sprint Goal and planning the work week.

"It depends how you look at it, but about 90% of our job consists of dealing with changes. Efficiently, we will not have a Sprint where you work on some specific goal and pre-defined tasks." (Customer Service Leader 2)

6.3.3 Daily Scrum

The Daily Scrum will be performed as recommended in the Scrum Guide, meaning maximum 15 minutes each day. Due to the frequency of changes, this meeting will provide the Development Team a platform to update the Sprint Backlog and discuss progress and impediments. The meeting is for exposing problems, which is beneficial due to the high number of changes the Customer Service leader and Operations Supervisors experience. As the literature expressed, it is important that the challenges are solved after the Daily Scrum. This is however easier said than done, as the Daily Scrum is in particular subject to lingering in the case studies by this reason. This risks is reduced by having the team completing a Scrum course and having an experienced Scrum Master.

According to the communication theory presented in section 3.1.3, it is optimal to have this meeting with collocated team members. However, some minor adjustment is needed. For instance, the Customer Service Leader spend most of the day at the client's office. Following, meeting face to face can be challenging to accomplish, but video conferencing is an adequate substitute. As the workday is unpredictable, it is suggested to have this meeting first thing in the morning.

6.3.4 Sprint Review

The Sprint Review will be the second to last event in the Sprint. Following, it will be performed every Friday. The literature highlighted that the items with the greatest deviation between estimated and actual size functioned as a great starting point for these meetings. It is suggested to follow that advice, at it can quickly reveal great impediments for further inspection. The Sprint's velocity should also be documented and compared with previous Sprints in allegiance with the theory of Empirical Process Control. This will help them determine the Sprint Backlog's scope during the Sprint Planning Meetings. For a one-month Sprint, the event is time-boxed to a maximum of four hours and is usually shorter for shorter sprints. Based on the short Sprint length, a time-frame of maximum 30 minutes is suggested as a starting point.

There are some issues regarding the Sprint Review among the interviewed employees. These issues are primarily connected to the practical execution, and not the idea itself. One of these issue is connected to the lack of reporting tools, which underlines that the Scrum Master must possess a great competence and overview over digital solution:

"You need a tool where you can investigate the planning and reporting done during a sprint if you want be able to draw the necessary experiences and implement positive changes. We are required to report towards the projects we are working. However, due to our systems, this task in very difficult to complete. " (Operations Supervisor 4)

Scrum theory emphasis the importance of cross-functionality. Furthermore, the Venture Capital case underlines that it is important to have a broad perspective during the Sprint Reviews and Retrospectives. By these reasons,

it is suggested to include a workshop coordinator in these meetings. The workshop coordinator will contribute with valuable knowledge and competence, and might help to identify impediments. In addition, it can increase collaboration and understanding between the coordinator and the Scrum team.

> *"They [the workshop] might not have a full understanding of our challenges and vice versa. It is clear that we could gain from better collaboration. Especially now during Covid, as we do not meet psychically. They are very committed to deliver equipment, but they might not understand the importance of different aspect. I do believe that we would benefit from a better communication. (Operations Supervisor 2)"*

Customer Representative

Scrum theory recommends the presence of a customer representative during the Sprint Review. In general, Scrum is used as a framework to develop a specific product or service over a longer period of time. In these environments, it is clear that customer feedback is vital. A long period of time and one specific product does not translate to the Company's situation. In many ways, the product goal or motivation behind Scrum implementation is very similar to some of the case studies. In both the Sales and Venture Capital cases, the motivation behind the implementation is to improve the internal process. Following, none of them has Sprint Reviews with customer representatives. Nevertheless, the client is highly involved through the Customer Service Leader, as they have daily meetings.

The idea of customer representative included in the Sprint Review Meeting received mixed emotions among the employees. One of the interviewed subjects thinks that transparency, openness and honesty can create *"a common ground and an increased understanding of the interactions and shared processes."* However, others identified some immediate issues:

> *"The question is: do we really want a customer representative in these meetings, and what to we gain from it? Due to the nature of our contracts, I fear that we can be penalised if we give the customer more insight, as there is a low threshold for punishments and sanctions. I also fear the team feeling you're trying to create will disappear the moment we tell them that some equipment went to a more profitable job at their competitor. Telling them that will only lead to complaints and most likely sanctions. There is a reason for why we keep our customers at a need-to-know basis and carefully select the information we share beyond that. In an ideal world, we would have more equipment and personnel. If we had that, then this would work no questions asked. However, I wouldn't invite a customer to these meetings today."*

Based on these concerns and the previous success stories, it is suggested to not include a customer representative in these meetings.

6.3.5 Sprint Retrospective

Both the literature and the cases presented in section 3.4 highlighted the importance of the Retrospective meeting for successful Scrum implementation. By comparing Scrum with today's practices, the Retrospective meeting stands out as a big contrast between the current and agile approaches. The feedback from the interviews on this

meeting is in general positive among the company employees. When presented with Scrum Theory and the idea behind Retrospective meetings, some commented:

> *"As of today, there is some shared experience on an ad-hoc basis in the backroom. We do not have an organised platform to share our experiences and discuss areas of improvements. There is no doubt that we currently waste time and effort due to the lack of this mindset." (Operations Supervisor 4)*

The possibility of having regular meetings to reflect on ways of improving the process is discussed with some of the interview subjects. A response to this is a concern that when problem areas are discovered, they are not followed up. The meeting looks good on paper, but the organisation must be willing to implement these changes in order for the meetings to be productive, and the concern from one of the interview subjects is that this willingness is missing.

> *"If you continuously have an opportunity to streamline the process with a fixed team, then I think you could achieve some very positive results. However, I do see some challenges. There is a lack of willingness to change. For example, the issue of double planning has previously been brought to attention without being properly addressed. It does not matter if you have 5 or 15 meetings without the willingness to change." (Customer Service Leader 2)*

With the same reasoning as in the Sprint Review, it is suggested to include a workshop representative, preferably the workshop coordinator to this meeting. A workshop coordinator would provide helpful insight and therefore might prevent implementing corrective actions which does not solve the root-cause. Lastly, a duration of 30 minutes, due to the short Sprints, is suggested as a starting point.

7   Discussion

This purpose of this section is to discuss the results in relation to the existing literature and the research questions provided in section 1. The discussion is divided into three parts. First, it will discuss the findings in relation to research question one: *What are the challenges related the company's current practice of planning and execution of well intervention services?* The identified challenges will be discussed with reference to traditional project management. The purpose is to determine what challenges occur as a result of traditional management, and from here, discuss whether a traditional approach or an agile approach is more suited at project level. The second part of the discussion is in regard to the second research question: *How can Scrum be implemented in the Company, and what issues can inhibit the implementation?* Following, the section will discuss the proposed solution in regard to success factors from previous agile implementations and presenting challenges related to the suggested solution. The last part discusses the overall problem statement: *How can Scrum improve the operational process of planning and execution of well intervention services?*

7.1   Challenges with Current Practice

The Service Execution Model is a traditional model for planning and executing well intervention services, which moves sequentially from one phase to the next when predefined milestones are achieved. The Service Execution Model is designed to be completed in one unique cycle, which assumes that once a phase is completed, it will not be revisited. The phases are executed in different locations. All the work of planning and follow up is executed by the Operations Supervisors and Customer Service Leaders at the Company's or client's office. The preparation phase is executed at the workshop by mechanics and logistics coordinators to mention a few. The execution phase is performed offshore by offshore personnel. Revisiting phases is therefore wasteful, as it causes extra and corrective shipments and logistics between workshop and offshore rig is time consuming. Therefore, a job needs clearly defined phases where each phase is performed as accurate as possible, in order to avoid revisiting previous stages. The goal is to get it right the first time. It is therefore natural to use a traditional model for planning and preparing a job.

By utilising a traditional model, the company reaps the benefits associated with the traditional approach. Key strengths are standardisation and robustness which leads to comparability and repeatability of projects. The fact that the entire project can be scheduled in advance is an important factor, due to the execution happening offshore. When the Service Execution Model defines how specific processes are performed, it is easy for anyone to find information about the project. This means that one Operations Supervisor can take over a job from another Operations Supervisor without any consequences to the project. However, there are some challenges related to the use of a traditional model. These are presented below.

7.1.1   Scope change

The traditional approach assumes that projects are simple, predictable and linear with clear boundaries. However, the interview subjects describe that a significant part of their job is to handle scope changes. Following, one can conclude that this assumption is false. This creates problems for the planning process, as traditional project

management is known to not handle change particularly well.

The goal of the project is often clearly specified by the client, and the company is dependent on information from the client in order to plan the job. Sometimes, new information from the client appears late in the planning process, which causes re-planning. If the main reason for scope changes is due to lack of communication with the client, an agile approach can solve this by simply ensuring frequent contact with the client. However, the Customer Service Leader has daily meetings with the client and provides as much information as possible to the Operations Supervisors to ensure a good foundation for planning of operations. Therefore, it seems that lack of client contact is not necessarily the root-cause for the frequent scope changes. Both the company and the client wish for things to go according to plan.

The main problem is the complexity of the environment. There is a high degree of uncertainty related to a job, and it cannot be assumed that a simple operation will remain simple when the execution starts. It can turn out to be a more complex job than expected; equipment can fail unexpectedly, conditions in the well can create difficulties and other factors such as weather conditions can cause delays. The people involved in planning must therefore adapt to different situations and be dynamic in order to handle these changes. The traditional approach is not designed to handle changes, and neither is the Service Execution Model. The Service Execution Model assumes that the operation will be executed without changes.

However, the actual practice of planning and execution is highly adapted to managing these changes. The people involved in an operation expect changes and are experienced with handling them. This includes Operations Supervisors, the workshop and Customer Service Leaders to mention a few. As mentioned, the Operations Supervisors describe their workday as a constant firefighting, where a significant part of the work done on a job is handling changes. This can lead to stressful situations when the activity levels are high, compared to a more predictable situation with less changes.

The consequence of scope changes is that equipment is moved around between projects, causing changes in other planned operations. In addition, if the scope change occurs when the job has started, additional equipment must be sent out in extra shipments. These extra shipments are considered waste and involves extra work. This means that the company would benefit from reducing the amount of scope changes on a project. However, when the source of the change comes from situations that are unpredictable, it is difficult to see how this can be achieved from an outside perspective.

7.1.2 Interdependencies between projects

Traditional project management assumes that projects are isolated from its environment. The projects in the company are highly interdependent and are not isolated from its environment. There is a short visibility of upcoming jobs and additionally the upcoming jobs are shifted frequently. This leads to highly fluctuating activity levels which are difficult to predict. A contribution to the varying activity level is the fact that the company works with several clients who demand services, and the clients naturally do not coordinate with each other. This makes the distribution of resources unpredictable and hard to foresee.

Each project needs a set of resources in form of offshore personnel with the right training, and a set of equipment. If the project could have its own set of resources, isolated from the environment, it would be easier to plan the project linearly and with less scope changes. However, all projects share the same limited amount of resources. This leads to a significant amount of time spent on finding the correct personnel and equipment for the job. Due to the high interdependence between projects, there is a risk that the planned equipment has been sent elsewhere when the shipment date arrives. The traditional approach to project management cannot handle this type of complexity and dynamics and are focused on delivering according to time and budget constraints rather than delivering business value.

Rush mobilisations are urgent and require shipment the same day or within the next few days. The rush mobilisations are planned and prepared in a short period of time, which increases the risk of errors in the planning and preparation phase. This steal focus from other jobs, in addition to disrupting the planned resource distribution. Equipment is taken from other planned jobs. Following, the complexity and interdependence between rush mobilisations and other planned operations is particular high.

7.1.3 Organisation

Due to the fluctuating activity levels, the Operations Supervisors must be able to increase their capacity accordingly. During high activity periods, the Operations Supervisors will have more work with following up multiple ongoing projects in addition to planning upcoming jobs in collaboration with several Customer Service Leaders simultaneously. Following, they often jump between projects and find themselves frequently interrupted. For the Operations Supervisor, working with multiple Customer Service Leaders implies working with multiple clients, oil fields, well conditions and sub suppliers at the same time. The arrangement excessively increases the complexity in their daily work, which the literature stated increases the cost of context switch and risk of project failure. Working on two projects simultaneously is ideal in terms of efficiency, and each additional project will decrease productivity.

The Operations Supervisors also describe that a lot of time is spent in meetings. The meeting culture has not been investigated in this study. However, due to a traditional Service Execution Model, a high degree of scope changes and a high interdependence between project, it is natural to assume that a significant amount of communication is needed in order to plan and execute these projects.

A weakness with the traditional approach is that it does not emphasise learning. As a result, the traditional Service Execution Model is inefficient in terms of reflection and self-improvement. The Operations Supervisors spend little time on improving work processes. Such activities happen sporadically, as they do not prioritise it. As a result, impediments take a longer time to resolve compared with agile methods. This issue might be reflected in the corrective shipment, where "Missing in order from Operations Supervisor" was the second most common root-cause.

7.1.4 Traditional Approach versus Agile Approach

The benefits of using a traditional model is that everything can be planned and scheduled in one unique cycle. This makes it possible to plan and schedule equipment across projects, the workshop knows what equipment to prepare, and the offshore personnel has a complete equipment package when starting the operation. Moreover, the traditional approach assumes that key members can be moved quickly between projects, because of all the detailed information contained in the traditional model. This is reflected in the Service Execution Model, which is standardised and detailed. This increases the ability for collaboration between projects, as the processes of each project are identical. Therefore, an Operations Supervisor can easily perform tasks for other Operations Supervisors, or for example a Customer Service Leader, due to the amount of information contained in the Service Execution Model.

Even though the traditional approach has some clear benefits in form of standardisation and robustness, the approach has some weaknesses. The company works in a complex environment with high interdependencies between projects, varying activity levels and frequent scope changes. This leads to a high degree of change management, which requires a significant amount of communication between people involved in planning of projects. The agile approach attempts to control and manage complexity, and one could ask if the agile approach is more suited for project management in the company than the traditional approach.

The agile approach focuses on delivering functioning parts of a solution in cycles by having an iterative approach. This implies that the project has a long duration. The duration of the projects in the company are relatively short, and there are several ongoing projects at the same time. Put in perspective, the visibility of upcoming operations is approximately six weeks. As a result, there is a high risk of management overhead if Scrum is to be implemented at project level. For these reasons, a traditional approach is more suitable than an agile approach at *project level*.

7.2 Implementation of Scrum

Today, the traditional Service Execution Model is more suited for planning operations than transitioning to an agile project management approach. However, since there are several ongoing projects at the same time that follow the same life cycle, one can consider the operational process of delivering services to be the "project". Agile methods can be implemented in the operational process, where each service is considered to be a functioning part of the solution and executed with a traditional approach. This way, the benefits from the traditional approach are kept, and the benefits from the agile approach can be gained.

7.2.1 Multi-Project Environment

The case study from the Venture Capital Group shows that Scrum can work in a multi-project environment. This is the most important finding in this study, as it shows that Scrum can be implemented to the operational process of delivering well intervention services. Scrum is commonly used for projects within software or development in general, which typically will have a longer duration. Therefore, one can have multiple Sprints with a length between one week and one month within one project. The projects in this company can typically have a duration of a Sprint, and it is important that the project is executed linearly to the extent it is possible, due to the location of

the different phases. To implement Scrum to the operational process is therefore considered to be a good solution. The robustness and standardisation of the traditional approach, which can be planned and executed in one unique cycle, is kept. The benefits from Scrum are gained. Scrum can be used to improve the Service Execution Model and current practices of planning and follow up of operations.

7.2.2 Pilot Team

One common success factor for agile implementation, presented in section 2.2.2, is to start with a pilot team to gain acceptance and gather insight. In similar matter, the proposed solution consists of a test-team for the same reasons. The pilot is important as it reduces the risk of implementing Scrum. One lesson learned from the case studies is that Scrum needs time to adapt, and that the implementation can in general be divided into two phases. For instance, the implementation of Scrum in the Venture Capital Group is divided into two phases in order to get started and adapt the framework in the first phase and scale up in the second phase. Many impediments emerges in the beginning, which are easy to remove and have a high positive impact on the productivity of the team. Discovery of such impediments will also reduce complications for Scrum implementation across the company if it turns out successful.

7.2.3 Map to Old Way of Working

The solution is similar to the old way of working. For instance, the solution does not include concrete actions to improve the Service Execution Model. This is because grass root level empowerment is an important success factor in implementing Scrum. The intention is to let the team become autonomous and self-organised, as the combined knowledge and experience between them will lead to the most efficient adjustments in the Service Execution Model. In general, there are many similarities between the suggested solution and the current practices.

Product Backlog items

Leaving the Service Execution Model untouched keeps the solution simple and familiar. The sub-phases of the Service Execution Model are considered to be a good starting point for Product Backlog Items, according to Bill Wake's INVEST acronym for good Product Backlog Items:

Table 7.1: INVEST and Sub-phases as Product Backlog Items

	INVEST	**Comments**
	Independent	The items need to be performed in a sequential order. They are dependent on other stories.
✓	**N**egotiable	Methods used to achieve end goal are negotiable.
✓	**V**aluable	Each item brings the team closer to completion.
✓	**E**stimable	There is enough information to size the item
✓	**S**mall	The items are small enough to be completed during a Sprint
✓	**T**estable	It is clear when an item has been completed.

Independent: The Product Backlog items are not independent from each other. They need to be executed sequentially, as they are based on the Service Execution Model. Execution of operation cannot start before the operation

is planned. Further, due to the complex environment and interdependencies in the on-going projects, the Product Backlog item is not necessarily independent from other Product Backlogs.

Negotiable and Valuable: The Developers should be free to decide which methods to use to reach the end goal. The Operations Supervisors and Customer Service Leader follows the Service Execution model when working on a job, which are pre-defined steps. However, the Operations Supervisors describe the planning process as dynamic. Adaptations are made, and the end goal is to satisfy the customer by executing a successful operation. Therefore, the end goal is the main focus and the Developers are free to work as they wish to reach that goal. Each Product Backlog item will add value to the client as it brings the team closer to completion and opens an opportunity for the client to review the item.

Estimable: According to one interview subject, the Operations Supervisors should be able to estimate the length of work tasks, in a "perfect world". It should therefore be possible to estimate the size of the Product Backlog item, under the conditions that no changes occur. However, all the interview subjects have emphasised the fact that changes occur frequently, and a significant part of their job is to handle these changes. Each Product Backlog Item must therefore take these changes into account when estimating the size. The goal is to increase the accuracy of the sizing through learning from each Sprint.

Small: The Product Backlog items should be small enough to be completed during a Sprint. If the sub-phases of the Service Execution Model are too large to fit within a Sprint, they can be further broken down into the sub-sub-phases, for example *"Design job"*. As mentioned, the venture capital Scrum teams used Product Backlog items such as *"one-hour meeting"*. The size and definition of the Product Backlog items are adjusted to fit the team's way of working through learning during the implementation.

Testable: When using the Service Execution Model as items in the Product Backlog, it is easy to know when a item is considered done. However, even though the initial planning of an operation is done, one might have to use more time on planning later in the process due to changes that has occurred. A new Product Backlog item will then be created in order to perform this task.

A common challenge from the case studies is the sizing and Definition of Done in relations to Product Backlog Items. In addition, the case studies highlights that sizing in story points is not suitable for environments with a majority of time based tasks and that sizing based on experience is particularly inaccurate. The consequence from these challenges is typically unfinished Sprint Backlogs and low staff morale. By using perfect hours, planning poker and having familiar Product Backlog Items, the suggestion mitigates some of this risks.

Development team

The roles and responsibilities of the team members have not particularly changed. The team members, consisting of one Customer Service Leader and one Operations Supervisor from each product line, often cooperate today. The proposed team roles and organisation therefore resembles the current structure, which adds familiarity to the solution. Familiarity is important as the literature states that agile transformation shall be kept simple to prevent scepticism and an unwillingness to change. In addition, the suggested teams fulfil many of the important

characteristics of Development teams highlighted in Scrum theory.

Today, the two product lines and the Customer Service Leaders are organised in silos. But as one interview subject mentions, they melt together during the planning and execution phase. Transitioning from silo team to Scrum team is therefore not expected to impact the team members significantly. They collectively possess the required skills to plan and follow up an operation from beginning to end, as a total supplier of well intervention services. In other words, the team is *Cross-functionally diverse and sufficient*.

Each team member has a deep skill within their discipline as either Operations Supervisor or Customer Service Leader. In addition, through interviews it has become clear that they also have a good understanding about their colleagues' way of working. This indicates that the team members have *T-shaped skills*, an overlap between the skills of the team members which provides flexibility to the team. Exchanging of valuable information must be done quickly and efficiently within the team. The Operations Supervisors and Customer Service Leader combined can provide efficient communication both inwards toward the organisation, and outwards toward the client. This ensures *high-bandwidth communication* and easy access to the people needed to get the job done.

The Scrum theory also highlights *Right-sized* as an important characteristics of a Development team. By having only three developers, the suggestion enables the team to achieve multiple benefits such as better communication, collaboration, focus and coordination according to the literature.

Other characteristics, such as *Self-organising* and *Musketeer attitude* are related to personal characteristics and engagement. These characteristics correlates with the success factors from agile implementation, which states that commitment to change and agile mindset is important for large-scale implementation. This is also backed up in the lessons learned from the case studies. For instance, the Venture Capital Group showcases that Scrum is not suited for strong individuals. It is therefore beneficial to include fully engaged, motivated personnel with a sense of team-feeling for the test-team. This will also help to mitigate one of the reoccurring challenges from the case studies, which is resistance to Agile Methods.

Product Owner

The role as Product Owner has many similarities with the Customer Service Leader. Both roles have responsibility to manage economics, participate in planning, obtaining and sharing short- and long-term activity forecasting, and collaboration with Developers and stakeholders. Therefore, a Customer Service Leader will not have to change the current responsibilities in order to take on the role as Product Owner. According to theory, it is possible for a person to have the role as both Product Owner and Developer on the same team. This reduces the complexity of implementing Scrum, as there is no need for an additional Product Owner with the same responsibilities as the Customer Service Leader. In addition, the Customer Service Leader as Developer collaborates with the Operations Supervisors to a higher degree than a Product Owner would in a traditional Scrum team.

7.2.4 Scrum Training and Coaching

Furthermore, the proposed solution emphasises the importance of Scrum training and coaching prior to the pilot. This will help the team to understand the agile principles and speed up the initial implementation phase where the

teams learn Scrum in practise. This is important, as the literature highlighted that the principles in the agile manifesto needs to be understood before agile practices can be performed in correlation with their intended purpose. The implementation of Scrum in Construction is an example where the participants did not understand Scrum sufficiently prior to the implementation. In addition, lack of training and coaching during the implementation can create difficulties in agile transformation. Short Sprints of one-week length and frequent opportunities for coaching will help in that matter.

The Scrum Master knowledge and experience of Scrum is vital, as it is this person's responsibility to coach and guide the team during the pilot. The Scrum Master has the responsibility to serve the Scrum team, the Product Owner, and the organisation by leading, training and coaching.

Following, the solution has clearly stated that the Company should carefully choose this person. A person from IT within the organisation is suggested, as this person might have the technical understanding of the work performed by the team, in addition to being conscious of the team's needs. IT related impediments might be easier to resolve with a person with a background in IT as Scrum Master. In addition, people from IT might have knowledge about agile/Scrum. Due to the importance of Scrum knowledge in the implementation phase, one can also consider an expert on Scrum as Scrum Master, or a combination with both a person from IT and an expert on Scrum in the initial phase.

7.2.5 Customise the Agile Approach Carefully

Another common success factor is to customise the agile approach carefully. As a by-the-book implementation is not 100% feasible, the proposed solution has made suitable adjustment to the framework. The artefacts, team and events are all carefully selected to match both the Company and Scrum recommendations as best as possible. Lessons learned from Scrum implementations outside software is that: Scrum is flexible, Scrum needs time to adjust, no size fits all, and implement the whole framework. The suggested solution implements the whole framework, and no elements are left out. However, the lessons learned shows that Scrum is flexible and is not a framework that is ready to implement as it is. In essence, it needs time to adjust in order to fit the company.

It is suggested to exclude the client from the Sprint Review meeting, and rather try to include a representative from the workshop. One Operations Supervisor believe that they can benefit from a better communication with the workshop. The Operations Supervisors and the workshop might not have a full understanding of each other's challenges. For this reason, including a representative from the workshop in the Sprint Retrospective would also be beneficial. This can increase transparency and increase the cross-functionality of the team. Interview subjects agree that a Sprint Retrospective can produce positive results.

7.2.6 Challenges with Proposed Solution

The implementation of Scrum will not be free from challenges. Compared to the Scrum theory, the suggested solution is not ideal in some areas.

Sprint Planning Meeting

By discussing the relevant operations for the upcoming week, the Sprint Planning Meeting will add more transparency and predictability to the Operational Supervisors compared to today's practices. However, planning the week in detail will most likely be very challenging due to the high number of changes and suddenly appearing rush mobilisations. Following, reaching a situation where the Developers can focus on one item at the time will be challenging, if not impossible, to achieve in real life. Interruptions will continue to occur, but hopefully at a less frequent matter.

Interdependent Items

The Product and Sprint Backlog items will be difficult to estimate, especially during the implementation phase. The case studies reported significant improvement in this area after the completion of some Sprints. However, this might not be the case in this scenario, as it is hard to completely separate the items from internal and external influence. This is mostly a result of the limited resources and high rate of change which significantly increases the interdependencies between the projects. Compared to the INVEST acronym, having interdependent Product Backlog Items is not ideal. Nevertheless, the Items fulfil the other five elements of the acronym and have therefore the potential to be well-formed. Even so, the lack of independent items might jeopardise the purpose of the Sprint Reviews if the interdependence is not improved over time.

Sprint Duration

The literature clearly states that having too short Sprint length increases the risk of management overhead, due to the high frequency of Scrum Events. This is also the case for the Construction team. A Sprint duration of two weeks is ideal according to the literature. On the other hand, the Venture Capital Group demonstrates that it can be difficult to remain focused in a two-week Sprint when the number of unplanned stories stack up. This is highly relevant, as the lack of long term visibility would almost certainly lead to the same conclusion in this scenario.

A Sprint duration of one week might imply some immediate challenges. Today, the team members already spend a lot of time in meetings. Adding these two things together, and the risk of management overhead is relatively high. Furthermore, a lesson learned from the case studies is that it can be difficult to keep the Events short, especially during the initiating phase. These factors underline the importance of having the team completing a Scrum course prior to implementation, as this will help to keep the meetings to the point. In addition, this makes the Scrum Master a key team member as it is the Scrum Master's responsibility to guide the team in accordance to Scrum theory. Hopefully, the risk of management overhead will decrease with time once the team has developed a good understanding of Scrum, as demonstrated in the case studies. Moreover, the team will steadily remove impediments in today's practices. One potential future benefit could be that less time is spent in meetings. This will in turn the reduce the risk of management overhead.

Sprint Review

Even though the Customer Service Leader has daily contact with the client, it would have been ideal to include a client representative in the Sprint Reviews. By not having a client representative, the team loses valuable op-

portunities to improve the interactions and cooperation between them and the client. In addition, the client loses valuable insight to how their decisions influence the planning process. By being more open and sharing, it could have been possible to find new arrangement in which both parties benefited from. This could help to reduce the risk of available information arriving late in the process or postponement of shipments. Therefore, the Company should be looking for ways to include a client representative in their Sprint Reviews. As for now, it is believed that including representative will be more harmful than helpful due to the nature of the contracts and limited resources.

Scrum Team

Scrum favours small teams, as long as the team includes all the necessary people needed to get the work done. The suggested team includes the necessary people to *plan* and *follow up* on operations. The small team of Developers have several benefits in terms of coordination, self-organisation and collaboration. However, the Service Execution Model includes all the phases of an operation, from start to finish. This includes the workshop who are maintaining and preparing the equipment, offshore personnel who are executing the operation and other people as well. This means e.g. that the Operations Supervisor is accountable for the testing of equipment offshore, even though this activity is performed by offshore personnel. If equipment fails, the Operations Supervisor must ensure that the equipment is fixed, or new equipment is mobilised.

This is a weakness in the team, they cannot prepare the equipment or execute the operation. They do however have the responsibility to follow up on these activities, which means that they are dependent on the workshop and the offshore personnel to perform their job in order to progress. Including mechanics from the workshop can be challenging as there are multiple departments involved in maintaining and preparing equipment for operations. To isolate a team of mechanics to solely focus on one team's operation is wasteful. The offshore personnel work on rotational shifts and are only available for the execution of the operations. They will not be able to participate in the Scrum Events such as the Daily Scrum. Additionally, forming a well-functioning team takes time and the Development team is preferably long lived. To include different offshore personnel based on availability and skills will disturb the process of becoming well-functioning and long lived. It is therefore recommended to not include mechanics and offshore personnel to the team initially.

The Sprint Review and Retrospective can benefit from having members from the workshop and the offshore personnel on the team. Scrum theory emphasise the importance of cross-functionality in teams, as a wider perspective can lead to a higher degree of impediment removal. Following, the team should strive to include other participants with separate knowledge to the Sprint Review and Retrospective event.

Urgency of Changes

The biggest uncertainty and risk to the proposed solution is connected to the urgency of changes. The Scrum theory does not exclude the possibility to add items to the Sprint Backlog during the Sprint, but the normal practice is to keep it to the minimum. This will not necessarily be the case in the suggested solution, as the urgency from changes in scope, equipment, personnel and shipment plans most likely would add items to the Sprint Backlog on a regular basis. The urgent and sudden nature of the rush mobilisations is another issue. The rush mobilisations are impossible to predict and of high impact. Following, they represent a major uncertainly compared to regular

Scrum practices. Empirical evidence of Scrum implementation in similar environments is little to no existent. It is therefore hard to judge how this will affect the adoption of Scrum.

Workload

A challenge that has been identified with agile implementations is that the team has too high workload, and that overloaded teams will not be able to change their behaviour and learn new ways of working. Sometimes old commitments are kept and people are forced to commit to firm deadlines which resulted in ignoring the new practice. This can be challenging for the company, as interviews has shown that people are very busy and are overloaded with work. Isolating a pilot team and reducing workload might affect other employees negatively in terms of workload. It can also be difficult to ignore deadlines, as they are not that flexible.

7.3   How Scrum can Improve the Current Practice

One of the main realisation from this study is that one cannot know in advance whether a full-scale Scrum practice is better than today's practices. Whether Scrum will work in the company and which improvements it will bring is difficult to predict, it must be tested in order to find out. However, the case studies of the implementation of Scrum in Sales and in the Venture Capital Group shows that the implementation process itself brings improvements. One can therefore consider testing Scrum on one team as a project for improving work processes. The process of adapting Scrum to the company might reveal hidden problem areas that can be addressed independently of the Scrum framework.

In an ideal world, many of the company's problems could be partially solved by increasing their resources. However, equipment is costly, and the demand for well service is fluctuating. Following, it is difficult to increase the resources without putting the company in a vulnerable position. It is therefore valuable to constantly inspect and improve the process to maximise value. Following, the agile principles of a multi-project Product Backlog and Sprint Planning Meetings provides the team opportunities to look beyond the relevant project in a bigger perspective. From here, it might be easier to plan and improve the coordination of resources.

7.3.1   Team

Both the Sales team and the Venture Capital Group worked individually prior to the Scrum implementation. The Sales team shared little information about clients and there was no communication about goals or sales methods. This is not directly transferable to the company, as they share a common method of planning, the Service Execution Model, and they have a high degree of communication. However, there are other benefits with establishing a Scrum team consisting of one Customer Service Leader and one Operations Supervisor from each product line.

Whereas the traditional approach assumes that team members can be shifted without much problem, Scrum emphasise the importance of long-lived teams. Forming a Development team where the Operations Supervisors work together and only relate to one Customer Service Leader, could be a step in forming highly functional teams. The arrangement of Scrum team would allow the members to go thought the forming, norming, storming and performing phases without having to start over. In the long run, this could make the Scrum teams a real business asset.

Moreover, moving the employees to a fixed Scrum team will help to reduce variables for both the Operations Supervisors and the Customer Service Leader. The silos are eliminated which reduces the number of hand offs between team members. This will help to reduce the complexity that lays the premise for the planning process, which in turn will reduce the cost of context switch.

Incorporating a Scrum team with a Scrum Master will help the team stay focused on their work tasks. The Scrum Master protects the Development team from outside interference. Especially the Operations Supervisors get distracted when they work on multiple operations simultaneously and must switch between tasks frequently. Practitioners claim that working on two simultaneous projects is the most effective, and each additional project beyond that will cause a steady decline in effective hours. By having a team consisting of one Customer Service Leader and one Operations Supervisor from each product line to combined deliver a complete well intervention service, the team can have a narrower focus. The team members go from working mostly independently on operations, to working as a team to complete a job.

As a result, team members can lean on each other to make sure that the work is done and that no team member is overloaded with work. Today, an Operations Supervisor from for example Logging & Intervention can be overloaded with work and have the sole responsibility to complete the work. In a Scrum team, the Operations Supervisor can get help from the other Operations Supervisor and the Customer Service Leader to complete the work and get back on track. It is a team effort to make sure that the individuals on the team complete their work in order to achieve the goal of delivering a service.

7.3.2 Predictability

In contrast to traditional management, Scrum does not assume that projects are simple and predictable. The framework offers great tools and measurements to identify how change can be managed and mitigated. The Scrum implementation in Sales managed to reduce the unpredictability of their work and made it more manageable and predictable. This is one of the key benefits that an implementation of Scrum can help with. Interview subjects have described that most of the work related to a job is change management. In addition, the activity levels are fluctuating, which means that there are periods where the Operations Supervisors must take on a higher workload. The goal is to achieve a work week that feels less overwhelming and busy, and more predictable. By weekly inspecting the work and how it is performed, one might discover factors that are a root-causes of changes that can be controlled.

Planning each week and inspecting the work that is actually done is a step towards a more predictable work week. To implement a Sprint and plan the whole Sprint in advance might be one of the most significant challenges related to Scrum implementation. Two of the interview subjects describe that they know to some degree what they will work on the upcoming week, but because of the unpredictable environment, the week rarely turn out the way they expected. To plan a Sprint and change the plan to reflect the situation is expected to be a time-consuming task, especially in the beginning. But it is also an important task. Practitioners perceive that gathering historical data of how the requirements in the Backlog have changed can help obtain a smooth flow of a project and provide increased predictability in Product Backlog changes.

It is therefore believed that a Scrum implementation can lead to a more predictable work week, where especially Operations Supervisors are less overwhelmed by planning and following up several operations at the same time. This reduces the challenge of varying workload, as the activity-peaks become easier to handle.

7.3.3 Productivity

In addition to an increased predictability, historical data gathering will also lead to increased productivity. A general result from the case studies is that the teams get more done in less time after implementing Scrum. Especially the Venture Capital Group was characterised by overtime and weekend work before implementing Scrum. After the implementation, they work normal weeks while taking on more work. They are less overwhelmed by working on multiple projects simultaneously.

This is achieved through establishing a common definition of all Product Backlog items and specifying the next step of the project so that the next person know what has been done and what remains in the project. As a result, every team member knows exactly what to do and why at the beginning of each week. A 80-100% improvement in productivity was estimated during a 10-month period due to a clear definition of Product Backlog items and impediment removal. The estimation of Product Backlog items' size will become more accurate for every sprint, and Planning Poker has proved to be a good tool for estimation. They discovered that when they are overoptimistic about the amount of work they can finish within one week, they get less done. When they plan their week more accurately and take on less work, they get more done.

The Service Execution Model lays out the steps in the project, so every individual will know what has been done and what remains. However, it is unclear how visible and transparent this information is for other people involved in the operation. Anyhow, it would be beneficial for the team members to know more about what work will be performed the upcoming week. Through learning, the Product Backlog items will become more accurately estimated, and factors such as scope change will be more predictable. It will therefore be easier to plan the week, and the goal is to be in a position where team members can plan their week to cover a manageable amount of work without feeling overwhelmed, but also get more done in less time. A study by Mann and Maurer (2005) found that as the developers worked at a more sustainable pace, there was an increase in client satisfaction.

7.3.4 Transparency

The Kanban board offers a quick overview of the status in different items in the planning process. Today, the Company does not use similar tools to keep track of the work. Today, the Customer Service Leader and Operations Manager work on multiple projects and have overlapping responsibilities in the Service Execution Model. For instance, the Operations Supervisors are accountable for the testing of equipment offshore. This means that the Operations Supervisors potentially will have to follow up this task but are not the ones executing the task. The Kanban board can visualise the different phases of a task to sort out which tasks the team members are actively working on and which tasks are potential efforts.

In addition to the Kanban board, the short and precise questions from the Daily Scrum can help to improve the *Transparent communication* and coordination between the team members. From here, it can reduce the amount

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of interruptions and help the team to become *Focused and committed*. Both the Daily Scrum and Kanban board is therefore a vital elements of the solution, as both transparent communication and focused and committed is highlighted as important characteristics of the Development team in the literature.

7.3.5 Empirical Learning

Scrum emphasise empirical learning. Today, the main reason for change is uncontrollable external factors. However, the framework provides opportunities to make corrective actions in their everyday work life based on empirical data. Scope changes related to operational challenges in the execution phase, and new information late in the planning process are today considered to be unpredictable and beyond the company's control. The interdependence between project is also considered to contain several unpredictable factors.

Today, the Company does not have any system in place to predict how specific tasks in their process affect the end result. The general consensus is that change is inherently random and can happen at any stage and for any reason. As of today, there is little emphasis on working "smarter", and the only way to handle the varying work load is by working harder. This is similar to the case description of the sales team prior to their implementation of Scrum. By using Scrum, the sales team demonstrates that it is possible to understand their process and environment through empirical monitoring and adjustment. This is also possible for the Company. Basing the Product Backlog Items will allow the team to gather historical data over how each sub-phase in the Service Execution Model affects the end results.

In similar matter, the team can over time learn more about what elements are particularly susceptible to influence during the Sprint Reviews by documenting and comparing estimated and actual size of the Backlog Items. The deviations between estimated and actual size of Product Backlog items, especially the bigger deviations, provides valuable measurement of empirical data to be discussed. This can for instance be related to a particular equipment, offshore personnel, oil platform, well conditions, team-related or customer communication impediments. From here, they can perform root-cause analysis and implement corrective actions to reduce the impact of both internal and external influence during the Retrospective meeting. Over time, this will hopefully increase the predictability and the Team's control over the planning process, as it did with the sales team. From here, it might be possible to reduce amount of scope change and interdependence between projects. The difference from today is that this empirical learning is done actively every week by the team in a structured way. The empirical learning from the Scrum implementation in Sales leads to the team's discovery of a way to make unpredictable results more predictable, which leads to a doubling in the company's revenue.

7.3.6 Frequent Inspection

Compared to today's practices, the Retrospective meeting offers frequent opportunities for inspection of their interactions, processes and tools. By continuously asking themselves what they should start, stop or continue doing, the Retrospective enables process improvement and impediment removal to a greater degree than today. The implementation of Scrum in the Venture Capital Group shows that Scrum is very good at revealing areas in which the team must improve.

The nature of the short Sprints allows the team to have frequent inspections of impediments. By having these frequent inspections, one can keep a wide focus, rather than focusing on one single area at the time. Big, corrective actions on an ad-hoc basic might not fix the root-problem. This is a lesson discovered during the implementation of Scrum in the Venture Capital Group. The short Sprints allow the team to make smaller corrective actions and try out new arrangements. In Scrum, changes to the way they work will have far less risk involved, as they can always go back within the next sprint. This way, the team can gradually break down the root-causes behind the impediments. Following, the frequent inspections provided by Scrum will guide the team to continuous process improvement.

For instance, frequent inspection can improve their current meeting culture which was described as sub-optimal and with many passive participants. This arrangements means that the Operations Supervisors spend a lot of time in meetings. The attributes of the Retrospective will allow them to look closer into the current meeting culture and try out new arrangements for improvements. This can in turn free up valuable time for the Operations Supervisors. In addition, the literature states that the frequent inspection from the Retrospective meeting can help the team to work in a sustainable pace and take gradual steps to change and improvement. The Retrospective can therefore lead to the Company being more able to manage the varying workload.

One concern that one interview subject has, is that impediment removal can be difficult due to lack of willingness to change within the organisation. This is very similar to the case described in section 3.4.1. Here, the sales team struggles to extract the potential benefits from the Retrospective meeting and fails to follow up the corrective actions. Their solution to include a root-cause analysis for the biggest impediment identified during the retrospectives proves to be very helpful. From this point, the sales defines concrete actions and list them as normal tasks, with the highest priority, on the backlog for the next sprint. Having only one, or a few, improvement area to focus on proves to yield great results. The corrective actions do not have to be large, as continuous small improvements will have great effect in the long run. Another helpful action from the Venture Capital case, is to include an Impediment Backlog when the impediments stacked up. Based on the lessons learned from these cases, including root-cause analysis and Impediment Backlog to the Retrospective meetings is suggested.

7.3.7 A Potential Way Forward

If the Scrum pilot is successful, then the Company should consider implementing Scrum across the Company. Following, a potential solution to how this could look, and what benefit it could provide is therefore briefly discussed in this section.

One weakness with the proposed solution is that it does not necessarily improve the Scrum team's understanding of the bigger picture. This issue is difficult to solve in a small test-team. For the long run, it would be preferable to introduce the One Team Coordinators as comprehensive Product Owners for their client. From here, you could introduce a hierarchy-based Scrum, where the One Team Coordinators, Workshop Coordinators and Operations Managers forms a portfolio team with a Chief Product Owner. The purpose of this team would be to optimise the portfolio and coordination of resources. As each One Team Coordinator represent one customer and multiple teams, there is much to suggest that the overall coordination of resources could improve with such an arrangement.

In this scenario, each Customer Service Leader would need to communicate with their Product Owner before making a formal commitment. As the One Team Coordinators has knowledge and overview of both their and other clients upcoming jobs, this person should be in a better position to give the final answer. As a result, the risk of creating periods with excessive needs for a certain type of equipment or offshore competence could be reduced.

A portfolio-based team should be able to add potential upcoming jobs in the coordination assessments in a greater scale compared to today. As a result, this structure should increase the Company's control over the coordination of resources. If this was to happen, then the planning and execution teams should in turn be less susceptible to external influence. This would in turn reduce the complexity of the Product and Sprint Backlog Items. Moreover, it would be easier to gather data of their projects across the company. Monitoring what type of equipment and competence they typically need, especially regarding rush mobilisations, will be valuable for the company for two reasons. First, they could make corrective actions to reduce the impact of changes and/or rush mobilisations. Second, the historical data could be used when investing in new equipment and when training/hiring personnel.

A simple illustration of this hierarchy is presented in Figure 7.1. Due to limitations, this Study has not researched a hierarchy based Scrum to a great extent. Following, it would be advisable to research existing theory of Scrum of Scrums before introducing such a solution to the company. However, this arrangement should not change the details in the proposed solution in a significant matter.
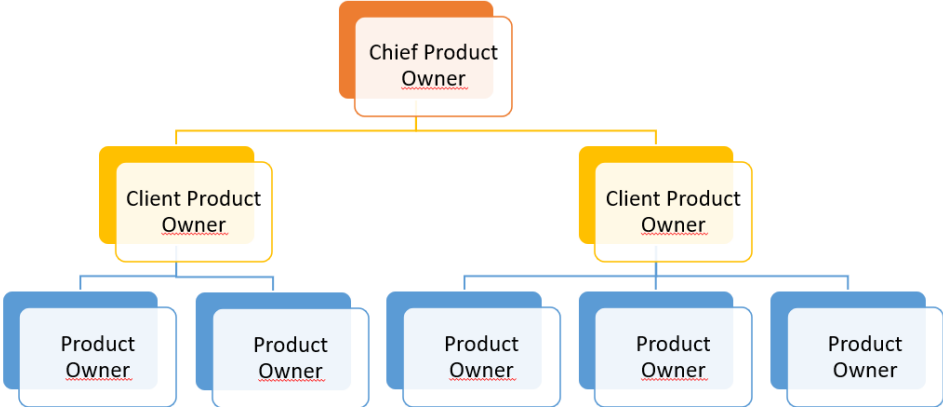

Figure 7.1: Hierarchy Based Scrum

8   Conclusion

Research Question 1: What are the challenges related to the company's current practice of planning and execution of well intervention services?

The challenges related to the company's current practice can be divided into three categories: scope change, interdependencies between projects, and organisation. The main reason for scope change is the complex and unpredictable environment of the project. Uncontrollable factors such as well conditions or equipment malfunction are sources of change. Projects are highly interdependent, and all projects share the same resources. Multiple clients require services, which means that activity levels are varying, and activity-peaks creates challenges with resource availability. Rush mobilisations appear at short notice, and require intensive planning in addition to taking planned and prepared equipment from other operations. Challenges within the organisation are related to the varying level of activity, which leads to periods with high work load for the Operations Supervisors. In addition, a lot of time is spent in meetings, and the work process is rarely inspected by the Operations Supervisors.

The company uses a traditional model for planning and execution of well intervention services. This has some benefits in terms of standardisation and robustness. The whole operation can be planned in one cycle and people can switch between projects. However, a traditional model cannot handle the degree of scope change and interdependence between projects that the company is facing. This leads to a high degree of change management.

Research Question 2: How can Scrum be implemented, and what issues can inhibit the implementation?

The findings from this study has highlighted that Scrum can be implemented to the operational process, and be used as a framework to empirically improve the traditional model used today. A test-team, consisting of all the necessary people involved in planning and follow up of operations, will adapt the Scrum framework to the company and remove Scrum related impediments in order to find out if a large-scale implementation is feasible. The old way of working has not been changed significantly, roles and artefacts are similar in content. The change comes with the introduction of Sprints and related events. In addition, the Scrum Master will have an important role in the implementation and should be chosen carefully.

The suggested solution does however come with some challenges. Due to a high frequency of changes, Sprint Planning might be challenging. Interdependencies between projects means that the team does not have a isolated set of resources needed to perform the work, and will be affected by changes in other projects. In addition, the team does not include all the necessary people needed to get the job done which means that team members are dependent on other people in order to progress. The client is not included directly in the Scrum process. The company has multiple clients, and increased insight might lead to sanctions. Changes such as rush mobilisations are urgent and cannot be ignored, which adds an element of uncertainty to the success of the Scrum implementation. Finally, high workload and firm deadlines challenges the implementation of Scrum as overloaded teams will not be able to change their behaviour and learn new ways of working.

Problem Statement: How can Scrum improve the operational process of planning and execution of well intervention services?

The empirical theory strongly suggest that Scrum can improve the planning and execution of well intervention services. Transitioning to an agile approach should reduce some of the challenges related to their current approach. Compared to today's practice, the Scrum framework provides an opportunity for empirical learning which improves the planning and execution process continuously. This leads to slow and steady removal of impediments instead of bigger corrective actions which might not work on a ad-hoc basis. There is less risk in trying out new arrangements due to the small scale of the team. Implementing a cross-functional Scrum team can lead to higher focus and less distractions in terms of switching between projects. Silos are removed, and completing the tasks related to an operation is now a team effort. The number of hand offs, complexity and cost of context switch are therefore reduced.

By incorporating weekly Sprints, the team will have to plan the upcoming week. Each Sprint will provide empirical learning and historical data-gathering on what is planned and what is actually achieved. Frequent inspections of the current process will lead to a steady removal of impediments. This may increase the predictability, productivity and transparency in the team's workdays. Elements in the process that are particularly susceptible to change can be identified. This can lead to a reduction in complexity and interdependence in the planning process. The historical data will also help the team identify mitigation action to reduce the impact of change. Other Scrum implementations have led to team members feeling less overwhelmed by taking on several projects at the same time. Due to the fluctuating level of activity, this is considered to be a desired result for the company. To conclude, the empirical learning that Scrum provides can lead to a more predictable work week, a reduction in scope change and interdependence, as well as improving internal challenges related to the organisation.

Further Research

This thesis suggests a way of implementing the framework of Scrum to the company with a pilot team. The next step would be to perform the pilot. Findings from other studies has made it clear that it takes time to adapt Scrum to a company, and the best way to find a solution is through trial and error.

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A Appendix

A.1 Interview Guide 1

This interview was conducted in Norwegian, therefore the questions are in Norwegian. In addition to these questions, follow up questions were prepared.

1. Hvordan foregår planleggingsprossessen?

2. Hvordan ser hendelsesforløpet/tidslinjen ut i planleggingen av en vanlig jobb?

3. Hovr involvert er klienten i planleggingen?

4. Hvordan er teamsammensetningen for en jobb? Hvilke roller har ulike medlemmer?

5. Hvor ofte har dere statusmøter på planleggingen?

6. I hvor stor grad påvirker et prosjekt andre prosjekter?

7. Må det gjøres antagelser under planleggingen?

8. Hvilken informasjon er standardisert/fast for alle jobber?

9. Hva er det som oftest må planlegges på ny?

10. Hvilke type endringer kan dukke opp under planlegging og utførelse?

11. Hvilken informasjon får dere av klienten når dere får vite om en jobb?

A.2 Interview Guide 2

In addition to these questions, follow up questions were prepared.

1. Can you tell us how you work?

2. What can you tell us about the client's planning process?

3. How do you obtain the necessary information about a job?

4. To which extent do you experience that the client comes with new and relevant information closely to the execution of the job?

5. To which extent do you experience that the client makes use of assumptions in the information they share with you?

6. How involved are you in the clients planning process?

7. To which extent would you say one project affects other projects?

8. What effects do you think would come from an increased cooperation and communication between the client and the OS?

9. What type of meetings do you participate in?

10. To which extent does the client change the project scope?

11. What are the practical differences for you between a rush mobilisation and a regular job?

12. What would make your job easier?

A.3   Responsibilities/Accountabilities Customer Service Leader

- Responsible for all commercial aspects related to planning, preparation execution and evaluation

- Responsible for day-to-day contact with client for support and improved value creating through proactive solution proposals

- Responsible for achieving increased sales above budget

- Responsible for managing and developing local customer relationships

- Responsible for obtaining and sharing short- and long-term activity forecasting

- Responsible for client contact to ensure correct risk assessments and SEM compliance

- Responsible for facilitating contract reviews

- Responsible for experience transfer and lessons learned, including correct reports and Synergy closure

- Responsible for HSEQ compliance

- Responsible for providing input within his/her area of responsibility to other sections/departments as and when required, including tendering process and contract execution

- Responsible for the implementation and follow-up of performance measures (KPI's) within area of responsibility

- Participate in company's strategy and budgeting processes

- Customer satisfaction and development

- Personal performance according to PBC

- Overall project performance according to defined KPI

- Synergy reporting and expediting

- Take personal responsibility for HSE and Quality

- Follow defined rules and procedures

A.4 Responsibilities/Accountabilities Operations Supervisor

- Ensure compliance with statutory, clients and corporate norms, policies and requirements

- Responsible for providing internal and external advice, guidance and support regarding technical questions, projects and job planning

- Detail plan and prepare offshore operations

- Coordinate all stakeholders for service delivery (onshore base / support, offshore resources)

- Conduct mobilisation meetings and de-briefs with offshore crew.

- Job specific Risk Assessment and SEM compliance

- Responsible and leading role in support of offshore operations, follow up offshore job execution

- Inform and / or consult Customer Service Leader on operational matters pre-, during and post job

- Maintain full cost control and finalise tracker

- Responsible for monitoring the quality and effectiveness of the service and recommend changes as and when required

- Evaluate and optimise use of existing and potential new technologies

- Strive to Standardise and achieve "Best Practice"

- Synergy reporting and expediting

- Responsible for Wireline product line 24/7 support

- Document and close job, ensuring any applicable "Lessons learned" are captured

- Personnel responsible for Offshore personnel within his/her department

- Responsible for competence requirements, close current gaps, and drive targeted competence development for Offshore personnel

- Undertake and execute ordering and allocation of required equipment for the offshore operations

- Manage and optimise both personnel and equipment resources

- Hands on quality check of delivery outside standard delivery

A.5 Responsibilities/Accountabilities Operations Manager

- Accountable for product line performance

- Optimising profitability

- Drive operations through SEM (Service Execution Model)

- Participate in long term strategy/development of the product line

- Evaluate and optimise use of existing and potential new technologies

- Strive to standardise and achieve "Best Practise"

- Manage and optimise both personnel and equipment resources

- Responsible for competence requirements, close current gaps, and drive targeted competence development for product line personnel

- Responsible for product line 24/7 support

- Responsible for monitoring the quality and effectiveness of the service and recommend changes as and when required

A.6 Responsibilities/Accountabilities One Team Coordinator

- Daily follow up of the Work

- Secure availability of qualified personnel and equipment

- Identify and follow up long lead critical items, equipment and personnel needs

- Initiating equipment and personnel mobilisation, subject to client approval

- Clients's planning and execution process

- Identifying and suggesting optimal methods and tools

- Identify potential improvements

- Drive experience sharing with special focus on safety and efficiency gains

- Participation in relevant meetings

- Preparing operational programs (or parts thereof) and Job reports

- Identifying areas where new or alternative technology, can lead to more cost-efficient operations

- Ensure that experience and expertise from other parts of company's organisation are utilised

- Monitoring of operational plans and daily reports for liaison between client and company's organisation

- Providing in-house technical assistance with respect to operational considerations and calculations

- Active co-ordination of service quality monitoring in conjunction with client

- Screening and quality check all invoices from company before delivery to client

- Participating in studies and projects to improve efficiency and service quality

- Leveraging experience sharing within the One Team partners/Alliance

A.7 Extra and corrective shipments in 2020

Table A.1 gives an overview of the reasons for extra shipments in 2020. In addition it shows the percentage of extra shipments that were corrective shipments.

Table A.1: Reasons for extra shipments in 2020

Reason for shipment	Quantity	Percent	% Corrective
Change in Operation - Additional Order from Client	87	18,1%	0%
Equipment Malfunction Offshore	80	16,6%	16,3%
Other	64	13,3%	23,4%
Supply Consumables	62	12,9%	1,6%
Equipment Faults Discovered Offshore	55	11,4%	60%
Lack of equipment available at main mobilisation	46	9,6%	89,1%
Missing in Order from Operations Supervisor	39	8,1%	97,4%
Exchange of equipment due to planned maintenance	20	4,2%	5%
Missing from Workshop	18	3,7%	94,4%
Operating Error	7	1,5%	100%
Missing in Order from Client	2	0,4%	0%
Missing in Order from Customer Service Leader	1	0,2%	1%
Total	481	100%	34,7%