

AALBORG UNIVERSITY

MASTER'S THESIS

Tailored Project Management Framework from SCRUM and Lean Practices: Case Study of Two Colombian Companies

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Declaration of Authorship

I, Perttu Villehard PUONTI, declare that this thesis titled, “Tailored Project Management Framework from SCRUM and Lean Practices: Case Study of Two Colombian Companies” and the work presented in it are my own. I confirm that:

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- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
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Signed: Perttu Villehard Puonti

Date: 01.06.2017

“Don’t gain the world and lose your soul; wisdom is better than silver or gold.”

Bob Marley

Aalborg University

Abstract

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Tailored Project Management Framework from SCRUM and Lean Practices: Case Study of Two Colombian Companies

by Perttu Villehard PUONTI

This Thesis is an Agile project management framework tailoring study for two small Colombian companies; Canned Head Studios and Diip. The first company practices software development and the other film production. Furthermore, only the post-production process from Diip is under study which resembles software development process.

In the recent years many different project management methodologies have emerged to support the software development process. Out of all the methodologies, of which there are plenty, Scrum has been the most used by practitioners and most studied by academicians (Theocharis et al., 2015). More recently, the Scrum methodology has received opposition stating that pure Scrum only benefits the quality and requirements of project success, leaving the project cost and time unchanged. It has been proposed that Lean Software Development methodology tailored with Scrum could solve this problem (Uikey and Suman, 2016).

In this study a tailoring method is created based on literature and aided by the case study method to find which project management methodologies tailored together are most suitable to address the project management problems faced at the two case companies. As it turns out, the two most beneficial methodologies are Scrum and Lean Software Development. This finding supports the statements found in literature but also opens some necessary research steps for the future which are discussed in the Discussion Chapter.

Keywords: Agile Project Management, Scrum, Lean Software Development, Project Management Methodology Tailoring

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I give high praise to all the people involved with the case companies. The Colombian entrepreneurial atmosphere, which I was surrounded by for my time at the companies, was exhilarating and it gave me the inspiration to keep writing with a smile on my face. After only hours of my arrival to the office building I felt welcomed and at home. I would like to give special thanks to the founders of Canned Head Studios; Sergio Rodriguez, Juan-David Florez, Julián Martínez, and to the founder of Diip; Oscar Otero. They and the employees were most helpful and cooperative during my stay – I wish I could have stayed longer.

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List of Abbreviations

VSE	Very Small Entity
SME	Small Medium-sized Enterprise
IS	Information System
LSD	Lean Software Development
XP	eXtreme Programming
DSDM	Dynamic Systems Development Method
FDD	Feature-Driven Development
CSF	Critical Success Factor
WIP	Work In Process
K-S	The Kolmogorov Smirnov Test

Dedicated to my parents...

Chapter 1

Introduction

In this chapter the initial problem is presented and analysed, purpose and importance of the study are discussed, and the proposed solution is shortly presented. Furthermore, the scope, assumptions, limitations, and delimitations are given and listed.

1.1 Background to the Problem

This Master's Thesis is a case study of two Colombian companies called Canned Head Studios and Diip. Both companies are situated in the same office building where Canned Head Studios is creating products based on software development and Diip is producing and post-producing films. Canned Head Studios is going through rapid growth and expecting to double its revenue and employee base within two years time. Diip has had a steady growth for the last two years and aims to keep it by tripling its revenue within five years. The product development for both companies is highly project related.

The main challenge for the companies is managing these product development projects. As the companies grow and start accepting more projects yearly, a successful and suitable management of the projects becomes very important (Sohia et al., 2016). The current situation at both companies shows strong signs of not succeeding in achieving the project goals with the three dimensions; cost, time, and requirements (Nicholas and Steyn, 2012). On average one of the aforementioned dimensions is not reached.

Finding suitable project management frameworks and tailoring them for the companies to follow is part of the problem of this thesis. The project management field is currently under turmoil, and it has been for some while after the agile manifesto was introduced by several software engineers in 2001 (Špundaka, 2014). The agile manifesto (see <https://www.agilemanifesto.org>) can be said to be the starting force of multiple different agile project management approaches (Bindera, Aillaudb, and Schillia, 2014). Out of these approaches a project management methodology called Scrum has delivered itself as the methodology most used by practitioners and most researched by academicians compared to the other ones under the umbrella term agile project management (Litchmore, 2016).

Scrum is a project management methodology created for software development. In the Scrum method the organization is split into small cross-functional and self-organizing teams, the work is similarly split into small pieces or tasks which are prioritized, the release plan of a product is optimized to short iterations which all provide a working product for the customer who is highly involved with the project, and the development process is reviewed after every iteration. (Kniberg and Skarin, 2010)

The principles presented in the agile manifesto are well suitable for software development type projects and following them provides benefits over traditional project management (Kalermo and Rissanen, 2002). Therefore, it can be argued that choosing an agile methodology for the case companies would be most beneficial.

The case companies have both shown concerns with the budget overruns mainly caused by cheap prices driven by the competition. The scrum methodology has its focus on flexibility and studies indicate that there is no benefit from scrum from the project cost side (Suetin et al., 2016). An other interesting agile project management methodology which could aid in solving this problem at the case companies is called Lean project management. This methodology has recently started to gain popularity by both practitioners and academicians hence it is based on Agile principles but it also adds Lean principles to its methodology which in some cases surpasses Scrum in project success (Uikey and Suman, 2016).

Lean Software Development¹ is mostly a set of tools which help to uncover the ideology behind lean thinking. The ideology consists of eliminating waste, amplifying learning, deciding just in time, delivering fast, empowering the team, building trust and honesty, and seeing the whole. (Poppendieck and Poppendieck, 2003)

The initial question is whether Scrum supported by Lean can help the case companies better manage their projects. The results of this could also help the academia by supporting the research of a tailored agile methodology which is currently emerging as a research field and has been happening within organizations that practice agile methodologies (Woods, 2010).

1.2 Problem Definition

The system in question is a high level process for managing projects. Such a system is used for conducting successful projects that reach the given goal. A project goal is three dimensional with cost, requirements, and time, where acceptable values need to be achieved in all dimensions in order to meet the project goal (Nicholas and Steyn, 2012). A project management process exists for managing people, tasks, budget, schedule, quality, and scope of a project with the main purpose, in this case, to create a product for a client (Project Management Institute, 2013).

There are two companies in which a new project management framework is to be created. Both companies have 3-5 employees working on single projects simultaneously, relatively simple product development processes in place, and projects that last around 1 month each.

Canned Head Studios has some previous knowledge about agile project management methodologies which helps the cooperation with the researcher towards this thesis and allows for a higher understanding on the purpose of the thesis from their side. The other company, Diip, does not have prior knowledge on agile project management which restricts the level of complexity of the framework. Furthermore, some constraints might be expected within the cooperation from the employees. It is important to reach acceptance from most of the company workers, especially from the management side.

In the project management process the project manager has to maintain a steady phase of the project so that the goal is achieved while the project team members concentrate mainly on their individual and changing tasks and try to succeed in them as well as possible. One important interface which is used by both the project

¹Lean Software Development, Lean Project Management, and Lean are all used interchangeably in this thesis

manager and the project team is a task managing software which in the case of the case companies is the same, called ASANA.

A simplified current product development process flow following the waterfall model for Canned Head Studios and Diip is shown in Figure 1.1. This is the process that should be better addressed with new agile project management methodologies.

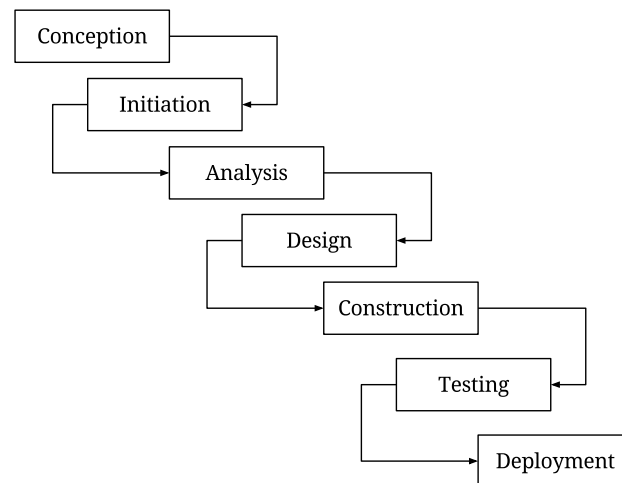


FIGURE 1.1: Simplified development process for both Diip and Canned Head Studios, adopted from a typical waterfall software development life cycle (Bassil, 2012)

The main components for the project management process are; people involved from the case companies, clients involved, product development process, and the project management process itself. The product development process is to be kept as unchanged as possible hence the implementation does not aim to fit the process with an agile project management process but rather the agile project management process is to be tailored to be used with the existing product development process.

An ideal system in this case is where the the current development process is not changed dramatically but instead the supporting project management processes should be well defined and well suited for the companies' needs. The goal of the new project management framework would be to allow the companies to grow and at same time deliver products through projects with higher success rates.

Furthermore, another problem arises from the problem of bettering the project management process' at the companies; to developed such a framework that can deliver these requested benefits. The creation of a suitable, easily implementable, and beneficial project management framework is the widest problem faced by this study.

1.3 Purpose of the Study

There are two sides for looking at the purpose of this study. One purpose is to aid the two case companies by developing a framework for project management from both Scrum and Lean project management methodologies and implementing it in hopes from them to increase their project success' where goals are not met in budget and schedule (see Appendix B).

The other purpose is to provide valuable research on the area crossing both Scrum and Lean project management. Moreover, this Master's thesis tries to shed

light on how similar these two methodologies are, how well they work together as a tailored framework, and could this framework be implemented successfully based on literature.

An extra purpose for this study is to give insights on conducting case studies with Colombian companies. This might be a rising interest hence Colombia is gaining international interest from businesses because of its economical, regulatory, and political advances in recent years (DoingBusiness.org, 2013).

1.4 Importance of the Study

The study is important because the research area under the combination of Scrum and Lean is highly polarized. Lean claims to be alone and Scrum claims to be alone. Scrum has been acknowledged as the most used Agile project management methodology but Lean Project Management is on the rise with many studies showing its superiority against scrum (Wang, Conboy, and Cawley, 2012). This study will have a neutral view on both of these methodologies and find whether they are actually interconnected already. Further, there is some research done on the combination of these two but it is not sufficient and requires more case studies in order to get wind under its wings. Moreover, a successful implementation has been proven difficult by many articles and tailoring a methodology from different methodologies seems to be a growing subject (Campanelli and Parreiras, 2015).

The Lean approach toward product development is still lacking a set of understandable guidelines for the practitioners in day to day use of the framework. Furthermore, there is lack of understanding on how Lean should be implemented. Finally, there is a need for benefits regarding the use of lean practices on this area (Al-Baik and Miller, 2015). All of these needs are answered, on some level, in this thesis.

1.5 Proposed Solution

The proposed solution which culminates this thesis is a set of tools and practices selected from both Scrum and Lean methodologies which together create the tailored frameworks. These are shown in Table 1.1.

For a more detailed view on the solution see Chapter 6.

1.6 Scope of Study

The scoping of this study balances on two things; what suits best for the companies and what is most interesting from the academical side. As a background for the companies; they develop their products with sort iterations (approx. 1 month) and the current project management method which is seen as unsatisfactory is roughly based on the waterfall model.

In Figure 1.2 are shown two types of Models; System Models and Process Models. System models are involved with how the product architecture is drawn and approached upon. For this study it is chosen not to study this part of the development but instead study the development process itself. This is purely a decision made by the researcher.

Because the companies already base their processes on the waterfall model and which is seen as an insufficient methodology, the development models are chosen

TABLE 1.1: The proposed tools and practices which together create the two frameworks for Canned Head Studios and Diip

Methodology	Tool / Practice	Company
Lean	Continuous Improvement	Canned & Diip
	Kanban	
	Just-in-Time	
Scrum	Product Owner	Canned & Diip
	Scrum Culture	
	Sprint Planning	
	Sprint Backlog	
	Scrum Core Team	
	Scrum Team	Only Canned
	Scrum Master	
	Daily Scrum	
	Sprint Review	
	Sprint Retrospective	

for inspection. Out of the development models there are mainly two different types of approaches; ones that focus on the process of coding software and ones that focus on the project management process. The project management process methods are chosen for further inspection because this is where the researcher has previous knowledge, where the most benefits can be achieved for the companies, and where there is most interest currently on the academical side.

To add more on the previous points, the companies have described by interviews (see Appendix B for more details) that most improvements should be achieved in reducing the project costs and maintaining the product quality. From the project management process side there is one certified approach for each of these problems; Scrum for quality and Lean for cost reduction. This argument is derived from the fact that Scrum has been proven to increase product quality (Cornelius, 2014) and Lean has been proven to provide project cost reduction (Lei et al., 2017).

The current environment within the companies supports agile-type development under which Scrum is situated (Sohia et al., 2016) and by combining both Lean and Scrum together, it can be argued that such a methodology also falls under the agile umbrella term (Boes and Kämpf, 2014). The agile project management view has been explained in Section 2.1 and it tells that this type of methodology is suitable for the environment at the case companies. This is an other argument for the selected scope.

In Figure 1.2 the final scope of this study is shown; this study is concerned with software engineering development models called Scrum and Lean with the initial understanding relying on Agile theory. Moreover, only the most popular Scrum and Lean practices are chosen for the framework – in total Scrum has 30 practices and Lean 22 Tools, this was considered too wide of a spectrum for this thesis.

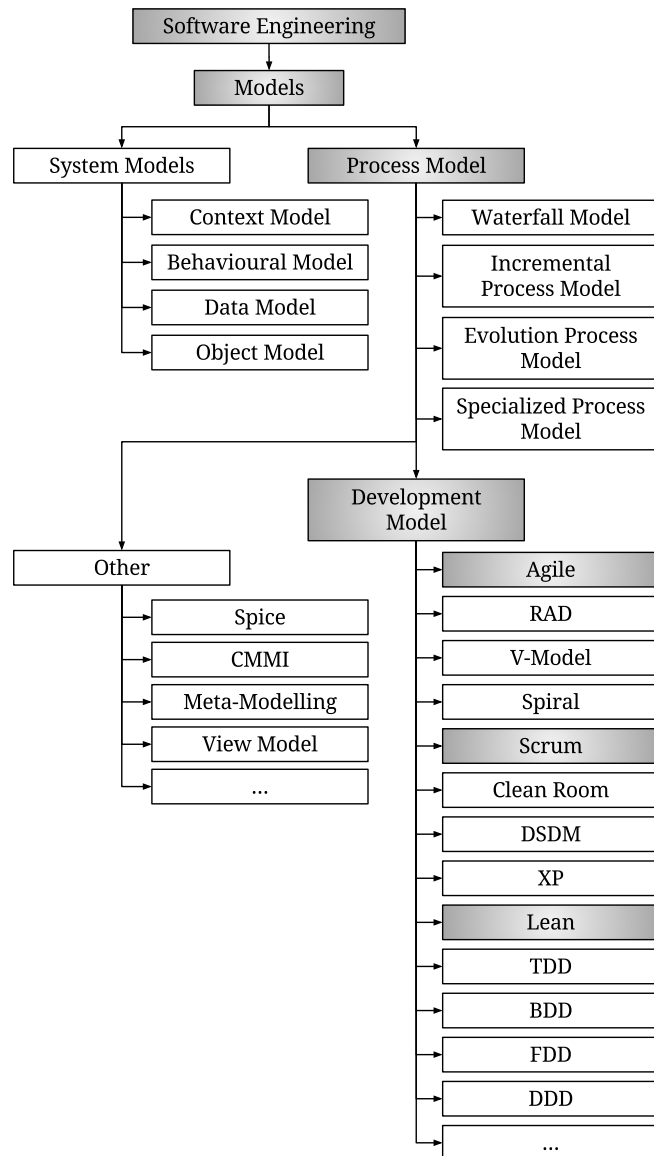


FIGURE 1.2: Models involved with software engineering with the selected models for this study highlighted (Baseer, Reddy, and Bindu, 2015)

1.7 Assumptions

Assumptions are more or less out of the control of the researcher but without making assumptions this study would be irrelevant. The assumptions should be justified and their existence should be explained. (Simon and Goes, 2011)

The assumptions, reasons for making them, and their justifications are shown in Table 1.2.

1.8 Limitations

Limitations are involved with every study. These limit the study without researcher's control and affect the results and conclusions from the study. (Simon and Goes, 2011)

TABLE 1.2: List of assumptions made in this study

Assumption	Reason	Justification
Interviewed and questionnaire subjects speak the truth	The data is mainly based on these two	The names of the subjects are kept anonymous and the atmosphere is kept trustworthy
Subjects understand the questionnaire questions	See previous reason	Researcher is present with each of the subjects while they fill the questionnaire
The case companies represent other companies within the same fields	As a case study the results should be generalizable	The products, methods, organizations, and processes of the case companies are similar to others respectfully
Data gathered from observations is not influenced by the researcher's presence	Data is also gathered from observations for a deeper understanding of the cause-and-effect relation	Researcher spends time at the company on daily basis to eliminate peculiarity and normalize presence

The limitations of this study are listed here:

- Overall time of conducting the study is approx. 5 months
- The subjects / employees of the companies are not allocated any extra time outside of normal work – the interviews and questionnaires are conducted within tight time frames and when ever the subjects have time
- The researcher can only study the people at the two case companies – both are situated in Bogotá, Colombia
- There exists a language barrier between some of the subjects and the researcher, hence not all information can be transferred
- The general language at the two case companies is Spanish which means that the researcher only gets a limited understanding from observations

A case study in itself is a limitation because it limits the conclusions that can be made of the causal relations studied (this is further explained in Chapter 4).

1.9 Delimitations

The delimitations of a study come from the selected scope and the decision made for conducting the study i.e. the study plan. One of the first and main delimitations is the chosen problem statement (Simon and Goes, 2011). Finally, the delimitations are created from decisions made during this study. There are two delimitations:

- Only Scrum and Lean methodology are studied from the Agile project management methodologies
- The study is only interested in project success affected by Lean and Scrum methodologies

The reason not to consider other project management methodologies is because there have been studies that between different agile methodologies the project success is arguably the same (Litchmore, 2016). But also studies which suggest a good cooperation between Scrum and Lean (Wang, Conboy, and Cawley, 2012). This lead is being followed and therefore the scope is set for these two methodologies.

Chapter 2

Literature Review

The purpose of this chapter is to review and present the current literature used in the making of this study.

2.1 Agile Project Management

Agile project management¹ has its core in short iterations, where a development project is separated into small parts, each of them when finished being a release and generating a usable product for a client. An other backbone for agile project management is the intimate functioning of a team, where the emphasis is on face-to-face communication (Nicholas and Steyn, 2012). Merriam-Webster dictionary defines the word agile in two ways (Merriam-Webster, 2017):

“marked by ready ability to move with quick easy grace” & “having a quick resourceful and adaptable character”

The agile character of agile project management is necessary for projects where there is a possibility for a change in the product specifications. This is especially true in companies doing Information Systems (IS) development which both the case companies are involved with respectfully (Abrahamsson et al., 2002). There are multiple different existing methodologies that fall under the spectrum of Agile project management e.g. Scrum and Lean Development.

2.1.1 Umbrella Term: Agile

Agile project management is an umbrella term which covers many methodologies that have their roots in the agile software development manifesto, currently most of them are also categorized to be used for software development. The most popular agile project management methodologies are: Scrum, Lean Software Development (LSD), Extreme Programming (XP), Crystal, Dynamic Systems Development Method (DSDM), and Feature-Driven Development (FDD). (VersionOne, Inc., 2017)

2.1.2 Agile Software Development Manifesto

In 2001 a group of people, unsatisfied to the traditional project management practices, published a manifesto stating a need for a new frontier in project management called agile project management. The manifesto is as follows (Beck et al., 2001):

¹Agile project management, Agile software development, and Agile are used interchangeably in this thesis

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions over processes and tools.

Working software over comprehensive documentation.

Customer collaboration over contract negotiation.

Responding to change over following a plan.

That is, while there is value in the items on the right, we value the items on the left more."

This manifesto can be said to be the starting point of Agile project management methodologies (Abrahamsson et al., 2002).

The Agile view toward project management started to gain ground after the manifesto as many companies developing IS using Agile methods began to report beneficial results after the change from traditional to agile. Between 2008 and 2011 the job listings asking for agile practitioners increased 400 percentages. These results are mostly only backed up by the practitioners because there is still a lack in comprehensive research on the reality of these benefits (Tripp, 2012).

2.1.3 Agile over Traditional Project Management

There have been many studies conducted which suggest positive impacts from agile project management implementations in different types of companies that have previously had the traditional waterfall type of project management (Serrador and Pinto, 2015) (Suetin et al., 2016) (Tripp, 2012) (Lindsjörn et al., 2016). Additionally, a report called CHAOS from the Standish Group is released yearly with the success rates of different types of software projects. A comparison between small projects (to which this study is concentrated on) using Agile and using Traditional is shown in Table 2.1. The table shows that projects using Agile project management methodologies are more successful compared to the traditional waterfall methodology.

TABLE 2.1: Comparison of success rates between small software projects with Agile and Traditional (Hastie and Wojewoda, 2015)

	Method	Successful	Challenged	Failed
Small size software projects	Agile	58 %	38 %	4 %
	Waterfall	44 %	45 %	11%

One of the main differences between traditional and agile project management is; the traditional project management uses approx. 33 % of the project duration on the pre-planning phase and agile methodologies state that the maximum time to be spent on this should be 10 % (Tripp, 2012). An other main difference are the iterations used in agile methodology which allow the product to be pre-released to the customer faster, allowing necessary feedback from the customer, and adding value to the customer by a getting a usable product faster (Tripp, 2012).

A study suggests that Agile has a positive impact on effectiveness and overall stakeholder satisfaction against organizational goals. This study also stated that the higher percentage of agile projects compared to traditional projects there are in a company, the higher is the percentage of successful projects. (Serrador and Pinto, 2015)

There is also research with the aim to defend traditional project management over Agile. In one of these results it is stated that Agile project management provides higher quality and that the final products made this way provide higher satisfaction for the customer mostly from the fact that the product requirements are more than satisfied. This study also states that traditional way would provide a lower cost and shorter project time but this statement can be said to have been affected by the stance of the researcher toward the traditional methods (Stare, 2013).

Many studies have been conducted over the years about Agile v. Traditional but in only a few the differences between each agile methodology have been held under the microscope (Tripp, 2012). One study about the differences between Agile methods states that there is actually no difference in benefits between each Agile method but instead the difference in results comes from the people and the selected process Critical Success Factors (CSF)². These two things, the people and the CSF's, are the only two which can be said to affect the agile project success in areas of cost, quality, scope, and time (Litchmore, 2016). This result eases the selection of an Agile methodology from the vast selection of different ones hence in reality there is no need for deep comparison.

In the next sections Scrum and Lean project management are introduced which were eventually selected as the main frameworks from which the tailored framework is made. Moreover, further justifications for choosing these two frameworks are presented in both sections addressed to these methodologies.

2.2 Scrum

In this section Scrum methodology is introduced and the main parts of its framework are explained hence they are to be used in the tailored framework. These main parts are composed of Scrum Core Team, Scrum Events, and Scrum Artefacts. Furthermore, as an added value there is a subsection on Scrum culture and what to take into account before implementing. This subsection also adds to the justification of Scrum implementation.

2.2.1 Introduction to Scrum

Scrum is a project management methodology developed for software development projects first introduced by Ken Schwaber and Jeff Sutherland in 1995 (Schwaber and Sutherland, 2016). It belongs under the umbrella term Agile project management and instead of focusing on the process of software development it focuses on the project management side. Compared to traditional project management where the planning is mainly done in advance, with high expenses on changes happening after the project has started, in Scrum the planning is spread throughout the project with lower expenses regarding unexpected changes (Mahnic and Drnovscek, 2005).

The main characters of Scrum are; iterative development, transparency, customer involvement, and one physical location for the project team. There are two main roles within a Scrum team which are the Product Owner and the Scrum Master. A Product Owner is in great contact with the client of the project and translates the

²Critical Success Factors are the things that need to go well for ensuring success of an organization. They represent managerial or enterprise areas that must be given special and continuous attention in order to bring high performance. Critical Success Factors include issues which are vital in a company's current operating activities and are vital for its future success (Boynton and Zmud, 1984)

product into backlogs for the Scrum Team. The Scrum Master is involved with inspiring and managing the team on following the Scrum values and practices. (Kautz, Johansen, and Uldahl, 2014)

Scrum's foundation is made of three pillars (Azanha et al., 2017):

- Transparency
- Inspection
- Adaptation

The first pillar, transparency, makes sure that the results are steady and within the predefinitions by keeping the development process visible and known to all involved parties. The second pillar, inspection, ensures that any disobedience by team members does not occur in the development process. The third, and the final pillar, adaptation, assures that previous faulty practices do not become a part of future projects / sprints. (Azanha et al., 2017)

On top of the three founding pillars, the scrum methodology can be characterized with six definitions (Schwaber and Sutherland, 2016):

- Flexible delivery
- Flexibility of deadlines
- Local teams
- Collaboration
- Orientation

In *Flexible delivery*; the contents of a delivered product are set as close as possible to the client's needs which requires flexibility. *Flexibility of deadlines*; there is a huge probability for a change in the deadlines which should be managed, i.e. having flexibility in the deadlines. *Local teams*; a local team should be composed of around six members, and positively less. *Collaboration*; being focused on being adaptive to change opposed to the client's needs, revisions are made frequently. *Orientation*; the team should be well oriented on what is required from them. (Schwaber and Sutherland, 2016)

The main tool in Scrum projects are the Backlogs. The Backlog, created by the Product Owner, is a list of items necessary to be conducted for the product in question. This list is prioritized, so that the top items are the most important ones and the latest might not even be conducted for the finished product. (Kautz, Johansen, and Uldahl, 2014).

Another important part of the Scrum methodology are Sprints. A Sprint can last from 5 days up to 30 days. After the first Sprint a publishable product should have been created. This allows for the product owner to receive feedback from the client and to update the product backlog, i.e. add new items or / and re-prioritize the existing ones, for the next sprint. (Kautz, Johansen, and Uldahl, 2014)

A Scrum project includes meetings held with the project members. These are Daily Scrum Meetings, Sprint Review Meetings, and a Retrospective Meeting. In the Daily Scrum Meetings, the members of the team discuss what they did on the previous work day, what obstacles they might have had, and what are the tasks for the current day. In the Sprint Review Meetings the team, the management, Product Owner, and representatives from the client meet for discussing the success of the Sprint against what was expected. In the Retrospective Meeting the Scrum Master, Product Owner, and the team hold a meeting focused on possible improvement points for the future. (Kautz, Johansen, and Uldahl, 2014)

2.2.2 Scrum Functionality: Previous Research

Out of agile software development practices Scrum is the most used one (Barabino et al., 2014). One reason for the popularity of Scrum are the benefits it has shown in multiple research studies.

Results from case studies about Scrum show that the method increases value of the projects toward the companies and their customer, gives tremendous time savings (80 %) and cost savings (50 %), and deliverables are ready sooner. This naturally increases confidence on projects and value of projects (Azanha et al., 2017). These results are confirmed by other authors which highlights the success of Scrum over traditional project management (Serrador and Pinto, 2015).

One study raised five main findings on the value of Scrum to organizations and these were (Cornelius, 2014):

- The Scrum framework supports a higher level of team empowerment and collaboration
- The Scrum framework supports efficiency and elimination of waste
- The Scrum framework supports the product teams to accomplish strategic alignment and transparency
- The Scrum framework supports improved customer experiences
- The Scrum framework supports satisfaction of customer demands, as the product can be released earlier

Additionally this study confirms that Scrum can be implemented without involving Organizational Change Management practices but this was the rarest case of implementation. (Cornelius, 2014)

2.2.3 Scrum Theory

There are multiple sources for gathering information on the theory surrounding Scrum but the most used source is the Scrum Guide which is published on <https://www.scrum.org> (Diebold et al., 2015). An other one, which carries the stamp of Body of Knowledge similar to the book called A Guide to the Project Management Body of Knowledge (PMBOK Guide), called SBOK Guide. These two literature releases are the main sources of information in the theory part in order to maintain consistency and uniformity.

The Scrum process flow for product development is shown in Figure 2.1 and the different points presented in the figure are explained in Scrum Events Subsection. The Project Vision Statement and Project Business Case are documents that are already included in both of the case companies' product development processes and are not therefore further explained or needed.

Scrum Core Team

The core team has three parties; the Product Owner, Scrum Master, and the Development Team. (Schwaber and Sutherland, 2016)

The Product Owner tries to maximize the value of the product and leads the development team to achieve optimum labour value balance. The Product Owner is solely responsible for the management of the product backlog (SCRUMstudy, 2016). The main tasks of a product owner are; developing product backlog items (being the voice of the customer), prioritizing the backlog items, optimizing the development teams work, ensuring the visibility and understandability of the backlog, and tells

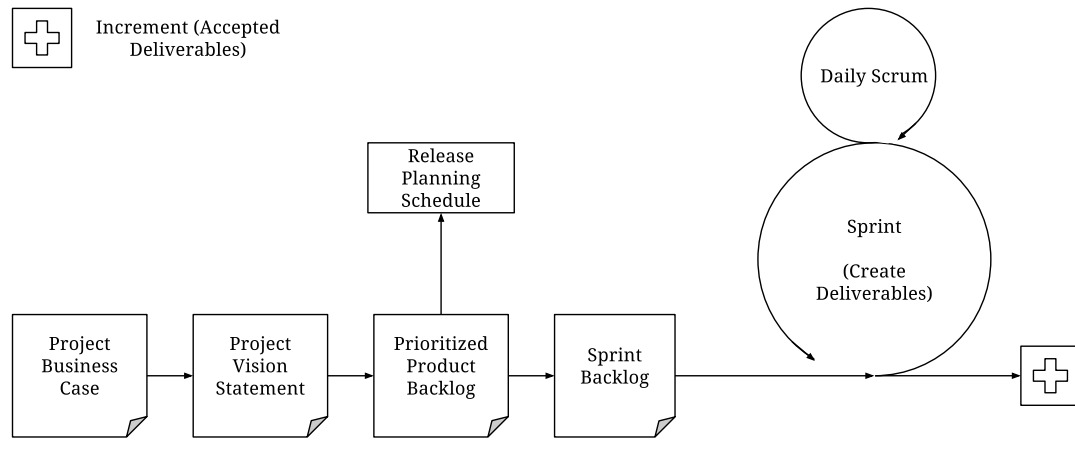


FIGURE 2.1: Scrum Process Flow (SCRUMstudy, 2016)

what the development team does next (Schwaber and Sutherland, 2016). Moreover, the product owner should keep a dual view in the project; understanding the needs of the stakeholders and the Scrum team. (SCRUMstudy, 2016)

The Scrum Master is responsible of delivering knowledge about Scrum and making sure that Scrum views are followed. This person also serves all the other parties in the Scrum core team. He / she helps the product owner on backlog practices, product planning, and facilitating Scrum events. Scrum Master aids the development team in self-organization, creation of high-value products, progress obstacles, and facilitating Scrum events. An other important role of the Scrum Master is guiding the introduction, implementation, and sustainment of the Scrum methodology in the organization. (SCRUMstudy, 2016)

The Scrum Team i.e. the development team is that group of people who do the backlog items and work on delivering a working product after each sprint. Basically, the self-organizing ability means that the team decides how they manage and work on the backlog items. The overall effectiveness arises from the self-organizing capability of the Scrum Team which is empowered by the organization. The qualities of the team members are cross-functional, so that the team is able to perform all the tasks required in the backlog. No matter the specialized skills of a team member, they are always referred to as developers. The team takes accountability on their actions as a whole (SCRUMstudy, 2016). An acceptable size of the team is from 3 to 9 people. The logic behind the team size drives from the functionality, where less than 3 decreases interaction and therefore the results, and more than 9 people makes the coordination difficult (Schwaber and Sutherland, 2016).

In reality the companies where Scrum has been implemented, the theory is not usually fully followed e.g. the team size in real-world situations has in some cases been below 3 or over 9. The reason for increased number of team members comes from the fact that if there are multiple small teams, the coordination of all of them becomes complex. Fewer but larger teams can be seen as a better option compared to this. Moreover, some companies have outsourced some aspects of the product development. (Diebold et al., 2015)

Scrum Events

The events are an important part of Scrum hence they create regularity and they are the so-called processes of the methodology. All of the events are time-boxed³ similar to the traditional project management's activity time periods i.e. an event has a fixed duration which aims to achieve less overhead and higher velocity (SCRUMstudy, 2016). The events are designed so that they allow critical transparency and inspection – two of the main values of Scrum (Schwaber and Sutherland, 2016).

The Sprint is the main event during which all the other events happen and it begins right after the last sprint has finished. The fixed time of a sprint should be from 4 to 6 weeks with the exception being when there are changes expected in the project requirements, here the fixed sprint time can be reduced up to 1 week (SCRUMstudy, 2016). During the sprint the sprint goal remains and no changes that endanger it are made, quality goals remain the same, and the scope can be renegotiated between the product owner and the development team. Short sprints reduce the risk to approx. one calendar month of costs and ensure inspection and adaptation of progress toward the sprint goal (Schwaber and Sutherland, 2016).

Sprint Planning is when the sprint is planned by the whole team. This planning phase has been time-boxed to eight hours for a one month long sprint. This means that the time can be shorter for shorter sprints and longer for longer sprints but there are no rules for this. Scrum Master schedules the event, makes sure everyone is present and that the planning lasts as long as required. Mainly the planning tries to answer the following questions: "What can be delivered from this sprint?" and "How will this be achieved?" (Schwaber and Sutherland, 2016). These questions divide the sprint planning meeting to objective definition and task estimation. In the objective planning the input is the prioritized product backlog of which the most prioritized ones are explained by the product owner. The Scrum Team then creates the sprint goal with the product owner. The other half of the meeting is for task estimation. Here the development team decides how to succeed with the product backlog. Moreover, the Sprint Planning has the following components (Schwaber and Sutherland, 2016):

- Forecast the functionality of the product after the sprint
- Create an understanding of what will be done in the sprint
- Discuss the product backlog, latest product increment, capacity and past performance of the development team
- How many and which backlog items will be done
- Create the sprint goal objective set which creates the reason for the sprint
- Connect the product backlog items to an execution plan to create a sprint backlog
- Roughly design the system (product increment) as a whole and connect the product backlog to it
- Plan enough to understand what can be accomplished during the sprint
- Development Team (Scrum Team) informs the Product Owner and Scrum Master of their self-organizing plans to accomplish the sprint goal

Daily Scrum lasts for 15 minutes at the beginning of every working day. In the daily Scrum a plan / forecast is made for that day and the previous day's work is

³In Scrum, time is seen as one of the most important constraints in project management. In order to address the constraint of time, Scrum uses 'Time-boxing' which means fixing a certain amount of time for each process and activity in a project. This ensures that the team members take an optimum amount of work in a particular period of time. Some benefits are a more efficient development process, less overheads, and high pace for teams.

inspected. The development team explains to each other what they did the previous day toward the sprint goal and what they will do today and was there some obstacles worth mentioning. The daily Scrum should be held at the same time at the same location every time for decreased complexity. (Schwaber and Sutherland, 2016)

Sprint Review is a 4 hour meeting for a sprint of 1 month. Scrum Master is responsible for the scheduling and attendance of the meeting. In the meeting the Scrum core team reflects on the increment and work that was done in the sprint to the stakeholders. The Scrum Core Team and the stakeholders then go through discussion on what can still be done to create value. In the sprint review there are the following items (Schwaber and Sutherland, 2016):

- Scrum Core Team and key stakeholders invited by the Product Owner attend
- Product owner lists the Product Backlog items that were done and not done
- The development team assesses the pros and cons of the development work done during the sprint
- The development team shows their work and takes questions about the increment
- The whole group discusses what do next which aids the upcoming sprint planning
- Review on the product of what might have changed because of the marketplace or other influences
- Reviewing on time-line, budget, capabilities, and requirements for the next assumed release
- Adjust the product backlog from the discussed items

Sprint Retrospective is held in between the Sprint Review and the Sprint Planning by the development team with the Scrum Master as a peer. This meeting is time-boxed to three hours for a one month sprint. The meeting focuses on improving the development process. There are three main points the team needs to discuss (SCRUMstudy, 2016):

1. What are the best practices which the team should continue to do?
2. What are the process improvements the team should implement / start doing?
3. What are the process problems and bottlenecks which the team should stop doing in future?

The Scrum Events mentioned here are an important part of practising a functional Scrum. Even as these methods are seen as important, there are a lot of variety in the actual occurrences happening in companies that have implemented Scrum. Daily Scrum has been switched to a every-other-day Scrum or, in some cases, lengthened to 30 minutes. The reason for different time-boxing or scheduling comes from the team sizes where a larger team needs more time to discuss everything and a smaller team does not need to discuss for so long or so often.

The Sprint Planning is mostly conducted as proposed by the Scrum theory because this has proven to be beneficial as in accurate planning and estimating.

With the Sprint Review, all of the companies practising Scrum have a meeting dedicated to it. In one company the review meeting has been split in two where in the first meeting developers from other projects are included to review the results and in the other one the client for the project is included. This gives the team a change to make minor changes before an increment is shown to a customer.

Finally, the Retrospective Meeting is a part of most Scrum practitioners and it is held on the same day as the review but the time-boxing varies greatly. (Diebold et al., 2015)

Scrum Artefacts

Product Backlog is a list of things which need to be done in the current / future sprint(s). These are features, changes, fixes, requirements, and functions. The items on the list are always changing since the requirements toward the product are also changing from feedback of the market place, development team and the customer. The Product Backlog is to be prioritized by the Product Owner. The items situated higher are in written in more detail than the lower ones. For a sprint the items are redefined so that they are clear and have a possibility to reach a "done" state – this estimate that an item can reach "done state within a sprint is done by the development team. The product backlog should have the following attributes: description, order, estimate, and value. (Schwaber and Sutherland, 2016)

Prioritized Product Backlog is a single document with all the requirements and features prioritized for the product in question (SCRUMstudy, 2016). This can be used for monitoring the progress toward the goal. Some tools for forecasting the progress of a process are called burn-downs, burn-ups, and cumulative flows. (Schwaber and Sutherland, 2016)

Sprint Backlog is a forecast made by the development team about how much will be released in the increment after the sprint. The Sprint Backlog should reflect the sprint goal i.e. the Sprint Backlog is redefined during the sprint toward the agreed sprint goal as the development team acknowledges new information. Sprint Backlog is solely for the development team but it should be transparent and visible for the other parties also. This backlog should be revised in the Daily Scrum Meetings for monitoring the progress of the sprint against the sprint goal. (Schwaber and Sutherland, 2016)

Increment is the collection of all the product backlog items completed in a sprint. Completed means that the item fulfils the requirements of being "done" defined by the whole Scrum core team. The definition of "done" must be understood between all the members of the Scrum Team. This is a valuable consensus hence it is a big part of the produced quality. (Schwaber and Sutherland, 2016)

All of the artefacts mentioned here should be highly transparent inside the Scrum organization. The transparency is maintained and increased by the Scrum Master. (Schwaber and Sutherland, 2016)

Stories, themes, and epics, which are the main items on backlogs, are often creating confusion in the Scrum implementation phase and hence it is good to compare them to each other. User stories are the main tool for sprints. In definition a user story is a sentence written with the voice of a customer; "As a customer I would like to get suggestions about similar purchases as I am currently looking on the webpage". Themes, on the other hand, are user stories grouped together based on their similarity. Finally, epics are seen as big user stories which are connected together as stories for one user experience. Epics usually only have value when all the stories in the epic are completed (Jarrell, 2014).

Release Planning Schedule is a phased product deployment schedule which should be shared with the project stakeholders. The length of a Sprint is also declared here. It tells which deliverables are going to be released to the customers, planned intervals, and dates for the releases. There may not be a release scheduled

at the end of every Sprint iteration. Sometimes, a release can be planned only after a set of Sprint iterations are done. Depending on the organization strategy, the schedule creation may be driven by product functionality – the objective is to deliver when a predetermined functionality is developed – or the planning may be driven by date – the release happens on a predefined date set by the client and company together. A deliverable should be released when it gives sufficient value to a client. This schedule is prepared during the first Sprint Planning. (SCRUMstudy, 2016)

How the practitioners of Scrum make use of the artefacts in their everyday work is very similar to how the Scrum theory describes them. One artefact which seems to have least value to the practitioners is the definition of done. The definition of done comes more from the user stories which are the main source of requirements seen from the client's side. (Diebold et al., 2015)

2.2.4 Scrum Culture

In times the implementation of a Scrum methodology in a company is unsuccessful. One reason for unsuccessful implementations raises from the organizational change viewpoint where Scrum might differ greatly from the original organizational values and views which can become an insurmountable challenge. Therefore, it is important to address some of the main theories surrounding organizational change and Scrum implementation. (Maximini, 2015)

The different aspects of traditional project management culture v. Scrum culture can be best presented by using a two column table (see Table 2.2).

TABLE 2.2: Organizational Culture Comparison Between Traditional Project Management and Scrum

Traditional Culture	Scrum Culture
Position	Role
Expert	Generalist
Team lead	Scrum master
Project manager	Product owner
Passiveness	Activeness
Vast pre-planning	Light pre-planning
Semi-transparency	Transparency
Presence	Accomplishment
Low involvement from client	High involvement from client
Delegation of responsibility	Adoption of responsibility
Control over employees	Self-control
Job	Passion

Based on Gloger and Häusling (2011)

The Scrum culture follows some distinct rules. The culture revolves around a disagreement toward most of the things that the so-called waterfall culture represents i.e. top-down management, abundant planning in advance, information secrecy etc. The most appreciated quality in the Scrum culture is that all the members participate and bring value to the attended goals with their labour input. The overall cultural atmosphere is highly casual whether it comes to clothing or office space. Moreover, the organizational infrastructure is flattened and even managers can be addresses on their mistakes in front of the whole team. It should also be said that the Scrum culture values the work hours which should not be exceeded. (Maximini, 2015)

2.2.5 Before Scrum Implementation

There are six different approaches to Scrum which should be addressed before any kind of implementation is commenced. These are Scrum PRN⁴, Virtual Scrum Software Studio, Scrum Software Studio, Façade Scrum Organization, Profound Scrum Organization, and Sustainable Profound Scrum Organization. (Maximini, 2015)

TABLE 2.3: Different Approaches to Scrum

Name	Description	Advantages	Disadvantages
Scrum PRN	Method only used when needed	Quick	Temporary, no real improvement
Virtual Scrum Software Studio	An internal organizational structure	Permanent, small impact on organizational structures	Necessary to follow the standard protocols in most cases
Scrum Software Studio	An organizational unit i.e. own legal entity	High benefits possible, clear rules for Scrum projects	Scrum expertise needed, slow implementation
Façade Scrum	Same processes with agile names	None	Nothing changes
Profound Scrum	Whole organization supports Scrum	All the advantages of wholly implemented Scrum	very long implementation, requires a pulling force of without the implementation crumbles
Sustainable Profound Scrum	Same as profound but remains stable even when no pulling force	A sustainable Scrum culture has been established	Traditional structure is mostly gone which might bring change resistance

Based on (Maximini, 2015)

⁴PRN is from a Latin phrase "pro re nata" meaning "take as much as you need".

Before the implementation of Scrum, a decision between different approaches needs to be made. The comparison of these different approaches is laid out in Table 2.3. There are questions which aid on the decision making in this case. The following information should be attained from a case company (Maximini, 2015):

1. What does the case company want to achieve with the introduction of Scrum?
2. Who is the leading force of the Scrum implementation and what position does he have in the company?
3. What is supporting the decision of Scrum introduction?
4. How many teams and individuals will be directly affected?
5. Over what time should the Scrum be implemented?
6. What is the budget for the implementation?
7. Which experts can you count on?

On top of the aforementioned questions, some supporting information should be acquired before the start of the implementation; the information on regard the motivation and true need of a new project management method. If there is a demand for Scrum in the company, some of the following statements should represent the current situation (Maximini, 2015):

- The time of releasing a product lasts longer each time
- The schedules of releases are not kept
- The release stabilization lasts longer each time
- Planning phase takes a long time
- During one release it is hard to begin a new one
- During a release it is hard to make changes
- The software quality is decreasing
- There is more documentation needed from the project teams
- “Death Marches” affect the morale of the project teams
- Customer demands are increasingly not met
- High percent of implemented features are not used by the customer
- The project participants do not really understand what to expect from a project
- Project plans get outdated fast when a project starts and there is almost no predictability
- Project members are getting less motivated
- The costs of projects is increasing
- Projects benefits are not evaluated well
- Risks are realized too late into a project when countermeasures are difficult

If most of the aforementioned points are happening on some level at the company a Scrum or agile methodology implementation can be justified.

2.3 Lean Project Management

The original lean concept was introduced by Toyota in the 1980's but it was only on the year 2003 when the concept of lean was connected with software development by Mary and Tom Poppendieck (Kumar and Shankar, 2016). In this Master's thesis the reference of Lean is towards the software development lean concept.

Lean project management is about focusing on the things that matter, eliminating waste, and doing the right things at the right time (Maurya, 2010). The aforementioned Scrum methodology is said by some researches not to be only under Agile project management but also close to Lean project management (Kniberg and Skarin, 2010). In this section the Lean approach to software development is introduced and the differences toward Scrum are shown. The main values that surround the Lean project management methodology are (Kliem, 2016):

- Focus on the customer
- Eliminate waste
- Separate value-added and non-value-added
- Product should be pulled by the market rather than pushed to the market
- Add standardization
- Use available technology to your advantage
- Seek information over data
- Emphasize continuous flow
- Aim for simplicity and flexibility; less is more
- See the forest from the trees
- Trust and confidence at the core of organization culture
- Seek continuous improvement by educating people and transparency

Lean project management does not differ much with Scrum at the value level. As it can be observed from the list, focusing on the customer, pull over push, continuous flow, simplicity and flexibility, trust and confidence, and transparency all are similar values to the Scrum methodology. The added value from Lean methodology is mostly about concentrating on the waste in order to cut the project costs which was one of the main limitations of Scrum; not being able to reduce this (Suetin et al., 2016). Moreover, out of the values mentioned in the list there are seven main principles for lean which are: eliminating waste, building quality in, creating knowledge, deferring commitment, delivering fast, respecting people, and optimizing the whole (Poppendieck, 2007).

The two main arguments supporting lean software development approach are that when it is correctly applied the projects are finished with the lowest possible cost and that the projects are finished quickly (Poppendieck, 2007). These were the downsides of Scrum which is able to provide flexibility and quality but lacks the ability to manage the budget and schedule (Kumar and Shankar, 2016).

2.3.1 Continuous Improvement

The creation of a lean environment is performed by using 8 steps illustrated in Figure 2.2.

Determine context step is where the status quo is challenged by the person driving the change. The context can be either an environment where the change needs to be done on top of an existing structure or an environment where the change is created on the side without affecting an existing structure (Kliem, 2016). With the case companies the change is made on top of an existing structure which is usually the case.

Map current and proposed value streams is the step where, in this case, the current value stream is mapped using the value stream mapping provided by the Lean methodology where the actions from start to the end of a project are mapped (see the tool in Subsection 2.3.2) (Kliem, 2016).

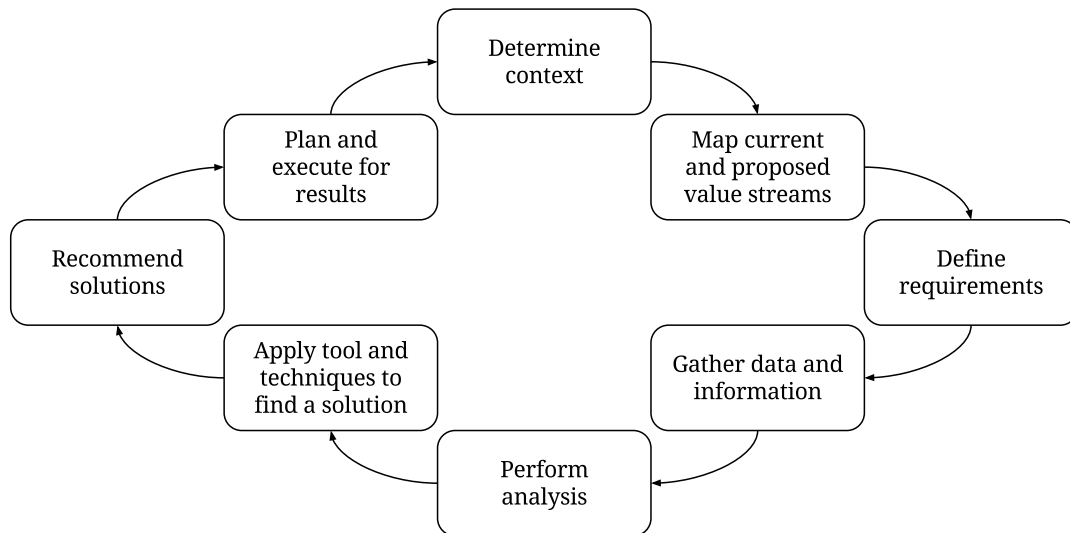


FIGURE 2.2: General loop for practising lean (Kliem, 2016)

Define requirements is a step where the requirements from the customer side are defined. The important requirements can be defined using a tool called cause-and-effect diagram (see Subsection 2.3.4). This tool is for understanding which of the process parts inside the value stream need most attention (Kliem, 2016). An other tool for finding whether there are requirements outside the process is called a pareto chart (see Subsection 2.3.3).

Gather data and information step is a necessary step in order to base the decision of change on something but there are no data gathering methods provided by the lean methodology. Therefore, it is sensible to use the data gathering methods already mentioned in Section 4.2.

Perform analysis step is where the gathered data and information from the company is analysed for concluding whether some or all of the following things are happening: excessive inventory, product defects, long lead time, long queue time, large backlog, changeover time, lack of coordination, inadequate communication, and unmotivated workers (Kliem, 2016).

Apply tools and techniques to find a solution, this step is formed of the possibility to use multiple different tools provided by the lean methodology. Most used tools by the practitioners are listed here: Kanban (see Sub section 2.3.5), Just-in-Time (see Subsection 2.3.6), and 5S (see Subsection 2.3.7) (Kliem, 2016).

Recommend solutions, in this step solutions that have been found by applying the tools should be recommended to the management by using a situation, target, proposal document which defines the current state, the wished state, and the solution to reach the wished state from the current state (Murray, 2007).

Plan and execute means to plan how the proposed solution will be implemented and executed. In this case it follows the way described in Chapter 4.2.

2.3.2 Value Stream Mapping

Value stream mapping helps to determine where in the internal process of software development value is added to the customer and where value is not added i.e. waste. Creating a value stream map is relatively easy and it should not take more than 30 minutes to make. The point is to create a flow chart of the development process'

main parts and then connect each step and space between steps with a time. (Poppendieck and Poppendieck, 2003)

2.3.3 Pareto Chart

The name Pareto Chart derives from the Pareto Principle which states that usually within an effect out of the contributing forces to that effect only a few can be said to be the main cause for the effect. Pareto chart is a chart where the contributing forces are listed as bars so that the ones with the highest level of contribution are on the left and lowest on the right. An accumulating line with the percentages is also drawn which shows how much e.g. the first three bars are contributing. This chart helps the team or the researcher to find the vital few contributors and to focus most of the energy on solving these problems for example. (Institute for Healthcare Improvement, 2004)

2.3.4 Cause-and-Effect Diagram

The process of working through a cause-and-effect diagram is relatively easy and it can be done using six steps (Kniberg, 2009):

1. Select a problem and write it down
2. From the problem start looking for visible causes upwards – from the problem
3. Then solve downwards for what causes the problem – to the problem
4. Find and identify cycles i.e. circular paths
5. Do the previous steps couple of times to clarify the diagram
6. Decide on the root causes and start looking for countermeasures

The aforementioned countermeasure is an experiment and it does not promise a pure solution to a problem. After the countermeasures have taken place the cause-and-effect diagram process can be made again (Kniberg, 2009).

2.3.5 Kanban

In simple, Kanban is a way of, in this case, managing tasks. Kanban board is a tool which helps to have the tasks at hand when they are needed and by this way reducing Work-in-Process (WIP). WIP is one of the things Lean practises try to minimize. There are three main rules for using Kanban:

1. Visualize work-flow
2. Limit WIP
3. Measure and improve flow

Behind these rules are multiple actions that need to be done to get the Kanban successfully implemented.

Map your work-flow is the first necessary step where the process in which the Kanban is to be implemented is mapped into main work-flow parts. It is important to map an existing process and not an ideal non-existing process. As the work-flow is mapped, a Kanban board should be created where the tasks will move from each step to an other.

Visualize WIP is where the tasks are added on the Kanban board and each task is given attributes e.g. creation date, deadline, created by, priority etc. depending on the needs.

Set your initial WIP limits is a step where the team working within the process should be involved. It should be mentioned to the team that a lower WIP has two benefits: it reduces the overall lead time and improves quality produced by the task. The WIP limits should be written on the Kanban board to enforce it so that the workers follow this.

Get the "Pull" this step brings the main quality of Kanban into action. There are two types of ways tasks can move forward; either they are pushed forward by the persons who make the tasks or they are pulled forward by the persons who require the tasks to be completed. Kanban works on the pull-manner. This means that there are tasks needed to be done and the ones with the highest priority are pulled forward as there is a person available on doing them.

Look for bottlenecks is a part of keeping the flow of work steady. As there are many tasks on the WIP and tasks waiting to be started this can be seen by the workers and management from the Kanban board and action can be taken. The WIP limit helps to manage the bottlenecks as the WIP limit is reached the bottleneck can be avoided hence the people work faster as there are less tasks at hand.

Inspect and Adapt is mainly done by keeping track on the lead time of the project / iteration and the cycle times of each task. This is usually done by an application used by the company. By tracking the cycle times the managers can see if the tasks are being completed on time, and by tracking the lead time which eventually form from all the cycle times helps to visualize whether the project will be finished on time. (Klipp, 2014)

A study on Kanban board has found that Kanban is a beneficial visualization tool but it should be used appropriately in order for the true benefits to be shown (Al-Baik and Miller, 2015).

2.3.6 Just-in-Time

Just-in-Time (JIT) differs from the aforementioned tools because it is not a true tool with a user manual on how to do it. Instead, it is an allowing force for using pull-method for the task movement. JIT means that things are done just when they are needed to be done, not before and not after. Implementing this ideology will have advantages such as lessened WIP but it requires that the ideology is accepted by the whole organization. Pull and JIT work hand in hand as when the pull-method is working well also is the JIT but in order for this to be achievable there needs to be transparency and high level of communication between workers, and between workers and management. (Poppendieck and Poppendieck, 2003)

2.3.7 5S

Even with processes where the work is mainly done by using computers and without the usual industrial working environment with different kind of tools, standardizations is something that should be done in places where it gives benefits for the process. For standardization the best tool to use is 5S. Where the 5 S' are Sort, Straighten, Scrub, Systematize, and Standardize. Sort is about, in this case, to discard all the redundant files stored at the company's data storage e.g. a cloud service. Straighten is to place the leftover important data in places where it can be easily found and not disturb the work-flow. Scrub could be used to keep the equipment used, which in this case is mainly computers, clean. Systematize could be used for keeping sure that the 5S' is followed in the company. Standardize would be to implement 5S into as many places as possible. 5S is not so straightforward when used in

a software development environment but by applying it even somehow it can give advantages for the company (Kliem, 2016).

2.3.8 Lean over Scrum

Lean is currently the fastest growing product development methodology (Al-Baik and Miller, 2015). Lean studies are mostly providing similar results as ones made about Scrum; both methodologies aid on conducting successful projects. Lean, on the other hand, shows better results in managing the project schedule over the Scrum methodology and slightly better results in managing project budget (Lei et al., 2017).

In one case study a company working on Software Innovation replaced Scrum methodology with a Lean version and got beneficial results in the product lead time; this was halved, reduced generation of bugs; 10 % decrease, and improved productivity (Sjøberg, Johnsen, and Solberg, 2012). Another study which simulated the effects of using Scrum v. Lean v. Waterfall concluded that Scrum is better than Waterfall but Lean is better than Scrum because it uses frequent releases, as does Scrum, but also the WIP is kept at minimum (Cocco et al., 2011).

One study put the challenges faced in Scrum projects and offered solutions from Lean practices. Some of these are shown in Table 2.4.

To conclude on Table 2.4, Scrum framework is very good as it is but the Lean viewpoint acts as a good way of avoiding the pitfalls that seem to occur when using Scrum.

2.3.9 Scrumban and Conclusion to Lean

At this point it is good to clarify the terms Lean, Kanban, and Scrumban. Lean is made on following the Lean beliefs which were mentioned in Section 2.3. Lean also includes Kanban into its tools and practices but on top of this Kanban is also an independent Agile method broken away from the Lean method. This separate Kanban approach will not be further mentioned hence it is already well presented inside the Lean methodology. The Scrumban, on the other hand, is a methodology developed from Lean and Agile best practices but mostly focusing on the Kanban view which is based only on three core points; work-flow visualization, limiting WIP, and measuring lead time (Nikitina, Kajko-Mattsson, and Stråle, 2012). Because of the lack of definite rules the Kanban method is the least descriptive from all the Agile project management methods as seen in Figure 2.3.

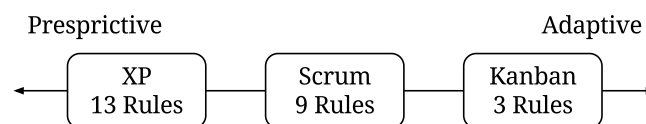


FIGURE 2.3: Three popular agile methodologies on a scale from prescriptive to adaptive (adapted from (Shankarmani et al., 2012))

In its essence Scrumban uses the combination of both Scrum and Kanban and creates a framework which cannot truly be seen as a new framework, just as those two frameworks; Scrum and Kanban. There are cases in practice where a company has started with Scrum but later included some parts of Kanban e.g. Kanban Board to their framework (Nikitina, Kajko-Mattsson, and Stråle, 2012). Unfortunately, literature does not tell how this combination has been implemented. The researcher

TABLE 2.4: Challenges faced by Scrum answered by Lean (Dharmapal and Sikamani, 2014)

Scrum Challenge	Lean Solution
Unwanted user stories in the backlog	Identify waste at an early stage
Integration of stories on independent software parts difficult	Look at the system as a whole all the time
Too many stories in backlog	Decide on stories on when required
Tools do not capture all necessary information	Use technology as your advantage and acquire such a tool
Resources not available on time	Eliminate waiting time and plan resource requirements
Product owner not fully understanding requirements and goal	See the systems as a whole and begin development only when requirements are clear
Unavailability of workers with adequate skills	Emphasize that right work should go to right resource
Meetings take too much time	Shorten the meetings as much as possible, bring lean mentality
Scope does not get frozen but it keeps changing	Freezing the scope as early as possible helps to get the product delivered faster
Too much flexibility in the deadline	Freeze the deadline as soon as possible for faster delivery
No acceptance criteria	Make the acceptance criteria clear so that the team does not do excess work - waste
Improper estimates of work	Empower the team to understand the importance of work estimates
Incorrectly prioritized user stories	Product owner should pay more attention on prioritizing hence this help to eliminate waste
No time arranged for reviews	This is a very important part of quality - empower the team to do reviews
No demo to customer	A demo helps create honesty and trust between the customer

has discovered only one book on Scrumban (Reddy, 2016) which tries to explain the implementation and practices identified by the Scrumban methodology but a peer review made on this book suggests that the book does not succeed in explaining any of the aforementioned topics (Cetnerowski, 2015). Therefore, Scrumban will not be further presented in this study but this finding provides an extra reason for tailoring a framework using Scrum and Lean with Kanban hence there is not sufficient knowledge on this area.

To conclude this section, the Lean project management framework developed by Mary and Tom Poppendieck covers a sufficient amount of Lean practices and some Agile practices as well but the researcher feels that by using the Scrum methodology as a the foundation and adding Lean tools presented by the Poppendieck couple, while keeping in mind the Agile Manifesto, a better suiting framework can be generated for the two case companies (the sources with page numbers for more detailed explanations on the Lean tools can be found from Appendix F).

2.4 Tailoring Project Management Methodologies

There are some articles and a Ph.D. thesis written about tailoring project management frameworks from traditional and agile methodologies, and from mixed agile methodologies (Jyothi and Rao, 2011) (Lee and Yong, 2013) (Campanelli and Parreiras, 2015) (Wang, Conboy, and Cawley, 2012) (Uikey and Suman, 2016) (Špundaka, 2014). There has also been studies on how to add Kanban practices to an existing Scrum practice (Nikitina, Kajko-Mattsson, and Stråle, 2012) (Rutherford et al., 2010). And one study, found by the researcher, on tailoring a framework from Scrum and Lean methodologies (Dharmapal and Sikamani, 2014). Additionally, there is one article which studied the usage of different Scrum methods by the practitioners (Diebold et al., 2015). This section will present the highlights of these aforementioned studies as a literature collection on tailoring project management methodologies which will then be used as a base for aiding the development of the Scrum with Lean framework for the two case companies.

No pure Agile methodology works perfectly without using some other methodology as a support. There is also a difference in the tailoring when small projects⁵ are in consideration hence small projects require different approaches compared to larger ones. With small projects it has been studied that the Agile methods are more feasible than traditional methods. Some of the reasons why traditional project management methods are not suitable are listed here (Lee and Yong, 2013):

- Inadequate planning
- Low priority
- Project teams are inexperienced
- Project manager has multiple roles
- Traditional project management methods are aimed for large projects

All of the aforementioned points occur at the case companies. The low priority toward projects at the case companies arises from the fact that there are close to 60 projects yearly at each of the companies of which all have, more or less, the same priority.

Although this study has recognized, on some level, that Agile methodologies are suitable for the case companies, a method for the tailoring attempt should be followed. A systematic literature review on Agile methods tailoring has been performed and the results point to *Method Engineering* as the best practice for developing a tailored agile framework. Figure 2.4 displays this method. (Campanelli and Parreiras, 2015)

The first part of a tailoring attempt is to recognize the beneficial and most suitable project management methodologies for a company in question. A helpful tool for

⁵There is no distinct differentiation between small and large projects but generally Very Small Entities / Enterprises (VSEs) which employ less than 25 people are involved with small projects and this is the case with the companies in this study

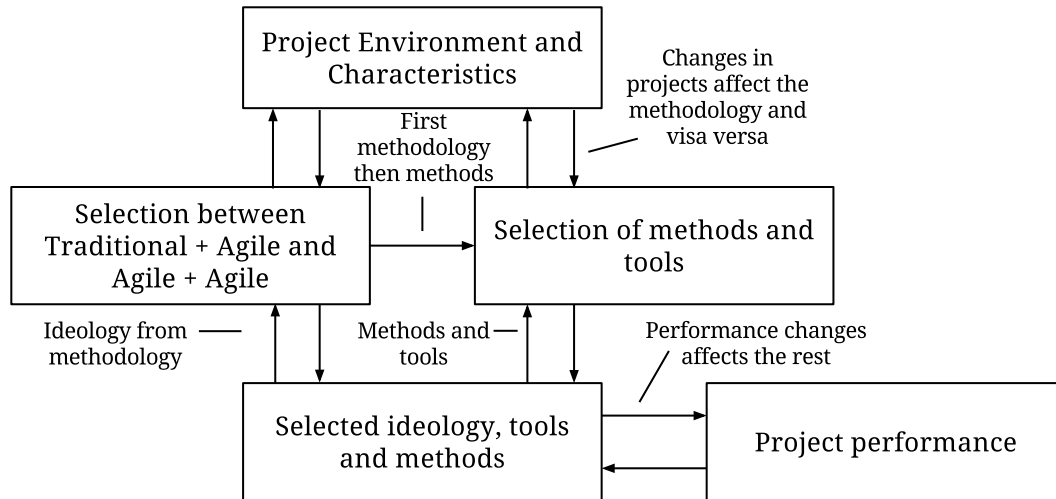


FIGURE 2.4: Method Engineering practice for tailoring a project management framework (based on (Campanelli and Parreiras, 2015) and (Lee and Yong, 2013))

this is to identify five risk-based agility factors from the project environment and characteristics. These factors are (Lee and Yong, 2013):

1. Team size – lower number points to agile
2. Criticality of project – less critical points to agile
3. Amount of requirement changes during a project – higher points to agile
4. Work culture – more chaos points to agile

It should be kept in mind that it is also necessary to understand the project environment and project characteristics. For this the Case Study method is used in this thesis. Additionally it is also important to study the current project performance even though there are no agile methodologies implemented. This, as seen from Figure 2.4, can be used to aid on the correct selection of the tools and methods.

The second part of the Method Engineering is to select the methods and tools from the ones that appear in the selected methodologies. The researcher has not been able to find a method for selecting appropriate tools and practices. Only method seems to be to "identify" the most suitable tools and practices (Qumer, 2010). In the case of Lean methodology an aiding method is found from one study which recognizes the challenges in Scrum and uses tools and techniques from Lean Development to address these (Dharmapal and Sikamani, 2014). This can be beneficial for selecting the correct tools from the Lean methodology. For Scrum one study found out what are the most used practices in companies that already have implemented and integrated Scrum into their projects (Diebold et al., 2015). This view from practice can be seen as beneficial when selecting Scrum practices.

The final part is when the ideology, tools, and methods have been gathered. After this an implementation of the practices is ready to be started. When the implementation is complete the project environment, characteristics, and performance should be studied again and the ideology, tools, and practices adjusted accordingly.

Chapter 3

Problem Formulation

After the literature review and a pre-analysis of the case companies the problem can be generated. In order to succeed in stating the problem, two sides of the study should be taken into account; the academical and the practical. The academical viewpoint gets a greater weight since this Master's thesis exists mainly to support and add value to the research area of project management, more accurately to the area of Agile project management. The other side is the practical one which needs to be taken into account since this study also aims to give value for the involved case companies.

There is evidence found in the literature that a research gap exists in the area of combining agile methodologies together, mainly methodologies of Scrum and Lean project management. Moreover, the following needs have been identified that lead to the aforementioned gap; finding a way to combine different project management methodologies together (Špundaka, 2014), investigate the impacts of Lean and Scrum¹, study the trade-off's when implementing Lean and Scrum together (Nurdiani, Börstler, and Fricker, 2016), additional results on combining Scrum and Lean in projects (Lei et al., 2017) (Theocharis et al., 2015), and general need for conducting different studies on Agile and Lean project management (Azanha et al., 2017).

The two companies have multiple challenges of which many can possibly be solved by implementing methodologies from both Scrum and Lean methodologies. The reason for choosing both Scrum and Lean for the tailored methodology is the argument that Scrum provides product development companies with agility, quality, and added value for the customer. The Lean methodology, on the other hand, provides benefits in the cost and schedule part of project success. Therefore it is supported, for the practical side, to choose to combine these two methodologies.

3.1 Problem Statement

The problem statement has been formulated as the following:

Lean and Scrum project management methods have both shown benefits for product development companies but both of the methodologies have weaknesses. The hypothesis is that Lean and Scrum can offer higher benefits for this type of companies if best of each are implemented as a combination.

Many researcher have tried to combine agile with traditional project management but only a few have tried the same with Scrum and Lean. Therefore, there exists a gap between Lean and Scrum research which is the combination of these two.

¹In many studies the methodology from Scrum is used but the researchers refer to it only as Agile. In this study these references are identified from the articles and referred here as Scrum.

The problem is; how can the most suitable and beneficial project management methodologies be tailored for the case companies?

3.2 Research Questions

In order to answer the proposed problem statement, some other questions need to be answered. These are the research questions and they are formulated as the following:

1. Which Critical Success Factors (CSF) should be used to measure the project success'?
2. How are the Critical Success Factors ranked at the companies?
3. Which methodologies could increase the low ranked CSF's?
4. Which tools and practices from these methodologies should be included in the tailored framework?

There are two approaches on answering these questions which both have been used; conducting a literature review for answering RQ1, and using project management tailoring practices found from the literature study supported by the case study method with interviews, questionnaires, and observations for answering, RQ2, RQ3, and RQ4.

Chapter 4

Theoretical Framework

4.1 Research Design

The selection of the research design pointed into a case study in the beginning because of the agreement between the case companies and the researcher. But the decision can not fully depend on this reasoning alone, therefore the decision was based on methods from literature.

The choice of a research design can be largely based on the research question. If the research question is trying to answer questions "how?" or "why?", a case study method can be applied. The good fit of a case study method increases when the problem requires extensive understanding of the system in question. With the problem at hand an in-depth description of the system is necessary which the close co-operation with the case companies favours. (Yin, 2009)

The three conditions for choosing the research method are (a) type of the research question, (b) how much control the researcher has on behavioural events, and (c) the level of focus on contemporary events. There are five main research methods from which to choose the one to be used; experiment, survey, archival analysis, history, and case study. These are shown with the three conditions in Table 4.1.

TABLE 4.1: Selection of a research method by conditions (Yin, 2009).

METHOD	Type of research question	Level of control on behavioural events	Level of focus on contemporary events
Experiment	how, why?	yes	yes
Survey	who, what, where, how many, how much?	no	yes
Archival Analysis	who, what, where, how many, how much?	no	yes/no
History	how, why?	no	no
Case Study	how, why?	no	yes

Hence the problem statement is a "how?" one, the problem requires in-depth understanding of the system, there is no need to control the the behavioural events, and the study focuses on contemporary events, it can be argued that a case study method fits within this context. Although, the case study method is similar to the

history method, the case study adds two important things; it allows direct observations from the events at the company and sources information from the composed interviews. Moreover, in a case study the researcher is able to gather all sorts of information from documents, interviews, artefacts, and observations.

There are different types of research purposes which also help to guide whether a single case study is preferable or would a multi-case study be more suitable. The purpose of the research is to refine the existing theories under agile project management. By looking at a table that links the research purpose with research questions and research structure, the most suitable research structure can be discovered (see Table 4.2).

TABLE 4.2: Discovering research structure through purpose and research question (Voss, Tsikriktsis, and Frohlich, 2002).

Purpose	Research question	Research structure
<i>Exploration</i>		
Discover areas in theory development	Is there something worth discovering?	In-depth case study Longitudinal field study
<i>Theory building</i>		
Identifying and describing variables, their linkages, and why they occur	What are the key variables?	In-depth case studies Multi-site case study Best-in-class case studies
<i>Theory testing</i>		
Prediction of future outcomes	How an existing theory survives under empirical data?	Experiment Quasi-experiment Multiple-case study
<i>Theory refinement</i>		
Improve the structure of a theory in light of attained new information	How generalizable is a theory?	Experiment Quasi-experiment Case study

By looking at the table, it can be discovered that under the row Theory refinement is the most suitable option. The problem at hand is looking at an existing theory which has not yet been extensively researched and the structure still needs refinement. From here the case study option is found and therefore selected as the main research structure for this study. Additionally, case study method is usable in software engineering cases because the study is held in a natural context where a contemporary phenomena is studied. The objects of the study are private companies developing software products which also suits well within the case study method (Runeson and Höst, 2009).

4.2 Case Study Method

Case study is an empirical study and the acceptance towards these kind of studies in a software development environment has been increasing in the passed decade. Some of the problems faced in this environment are very complex hence they are effected by multiple components e.g. processes, people, and office environment.

Therefore, this kind of system can be difficult to study with analytical quantitative research methods where as a case study method can provide valuable and important knowledge when applied. Acquiring knowledge from situations as software development can be argued to bring more significance than a statistical analysis. (Runeson and Höst, 2009)

Before going into detail with the case study method it is important to distinguish between it and action research. Action research tries to change some aspect of the thing under research e.g. improve the software development process. This method is very close to case study but when the study involves pre- and post-event studies the method used should be case study (Runeson and Höst, 2009). To conclude, in this thesis, the case study method is presented and used instead of action research because these two are very similar to each other and the case study method suits better for the purpose.

A case study, in this case, is a study of current phenomena getting its information from multiple different sources. The information sources include direct observations, interviews, and archives (Yin, 2009). The steps of a case study research are shown in Figure 4.1.

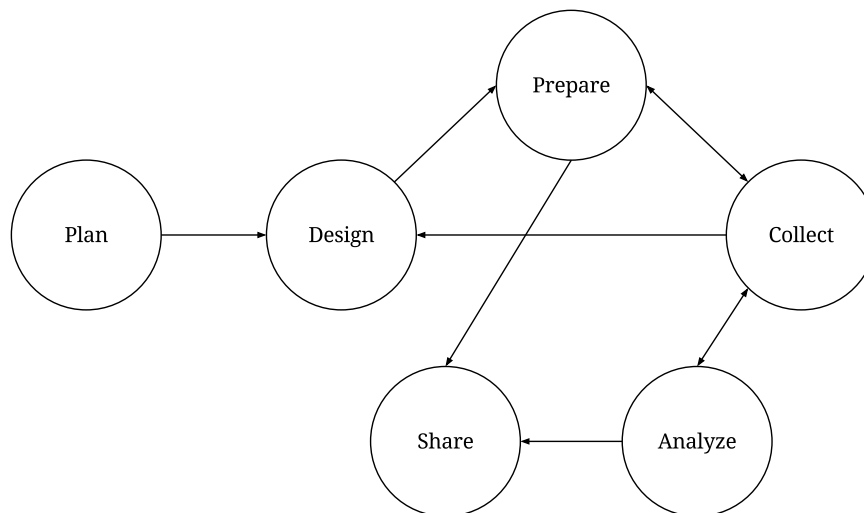


FIGURE 4.1: Steps for the Case Study Research Method (Yin, 2009)

As mentioned before, the characteristics of the method was found to be in theory refinement i.e. improvement. An other characteristic of this case study is exploratory which means to find out what is happening, finding new understanding, and coming up with new ideas and hypotheses for future research (Runeson and Höst, 2009). In away, these two characteristics overlap in this study since the system is both improved and observed at the same time.

When a real world situation is being studied, a trade-off or balance between control and realism is to be made. In software development case study research this balance is usually forced to the the realism side because there are no ways of increasing the controllability of the situation. (Runeson and Höst, 2009)

The research process itself can be characterized of being either flexible or fixed. In this case the study is flexible because the parameters of the study change as new information is found from interviews or surveys. This is typical for case studies. (Runeson and Höst, 2009)

Such a thing as triangulation is used for increased precision and validity of the research. Triangulation stands for taking multiple angles toward the studied phenomenon. This can be achieved by collecting the same data (interviewing) from different individuals, using different data collection methods, and using the different sources for the base theory (Runeson and Höst, 2009). All of these triangulation methods are used in this study; the data is gathered from as many individuals as possible, both interviews and surveys are used for data collection, and the theory is collected from multiple different sources with different standings toward the theory.

The overall research method characteristics are listed in Table 4.3:

TABLE 4.3: Chosen research method characteristics

Methodology	Primary objective	Primary data	Design
Case study	Explanatory (Improving)	Qualitative	Flexible

Because in a case study there are usually more variables than data points, it will not provide results with statistical significance. A case study will base its arguments on many different types of evidence from observations, interviews, and questionnaires (Runeson and Höst, 2009)

The validity of the study comes from three aspects; internal validity, external validity, and reliability. Internal validity comes from understanding that there is a third factor influencing the first one, the second factor influencing the first one is not the only one. External validity can be achieved by understanding the context of things and how the results of the study can be generalized to other cases which is important for defining a theory. Reliability is concerned with the reproducibility of the study. The study should be conducted so that hypothetically the results should be the same if an other researcher does replicates the study. (Runeson and Höst, 2009)

To conclude, there are three types of data analysis for qualitative data; hypothesis generation, hypothesis confirmation, and negative case analysis techniques. These techniques can be used in combination (Runeson and Höst, 2009). For this study the negative case analysis technique is selected i.e. "If it is not valid for this case, then it is not valid for any (or only few) cases"¹. This is because of the nature of case study research. It gives less academical value if a case study supports the results from previous studies than if a case study does not support the previous results. This means if the results of this case study imply that Scrum mixed with Lean theory does not provide benefits compared to Scrum or Lean alone, this disrupts the previous results and gives more reason to study the effects of Scrum and Lean combination in a negative light.

4.3 Quantitative Analysis

Although the primary data for this study is qualitative, there is a possibility to conduct quantitative analysis on the questionnaire answers. This supports the study and can be used for finding whether the two case companies are statistically similar. In order to perform this kind of analysis 3 statistical tests are performed; the Kolmogorov-Smirnov test (K-S), Shapiro-Wilk test, and the Levene's test (if the data

¹This quote is from (Flyvbjerg, 2006) page 14.

points are normally distributed) or the Mann-Whitney test (if the data is non-normally distributed).

The K-S and the Shapiro-Wilk test whether a distribution is normal or not i.e. how much the distribution deviates from a normally distributed one with the same mean and standard deviation as the data set. The test results with $p > .05$ mean that the data set is not significantly different to a normally distributed one and test results with $p < 0.5$ mean that the data is significantly different from a normally distributed (Field, 2010). Both of these tests are recommended to be used with a sample size less than 50 (Ghasemi and Zahediasl, 2012). After discovering whether the data is normally distributed or not one of the following tests should be performed.

The Levene's tests the null hypothesis that the variances between two groups is zero. If the Levene's test result is significant ($p \leq .05$) then the variances between the two groups are significantly different or with $p > .05$ the null hypothesis can still be considered viable. This test only works on normally distributed data sets. (Field, 2010)

The Mann-Whitney test is a non-parametric test i.e. it is designed for groups that are not normally distributed. This test relies on ranking the data where the lowest value gets the rank 1, next highest rank 2, etc. The analysis is done on these ranks rather than on the actual data. This test is used for finding whether there is a statistically significant difference between the two selected groups. (Field, 2010)

The tests run for this study are all run with a program called R-Studio.

4.4 Conducting Interviews

The interviewing dialogue between the study subjects and the researcher is based on the interview questions provided by the researcher. These questions surround the interest of the study and they should be formulated to support the developed research questions. There are two types of questions; open or closed. Open questions can be answered openly by the subject and closed questions can be answered from a set of different answers given by the researcher.

The structure of an interview can be unstructured, semi-structured, or fully structured. In an unstructured interview the conversation is guided by the researcher based on the interests and it can develop into any direction depending on the interaction between the subject. In a semi-structured interview there are some planned questions but they can unfold themselves in any order. Finally, a fully structured is mostly like a questionnaire and it is not of interest hence questionnaires are also used in this study (Runeson and Höst, 2009).

To conclude, the interviews held in this study are open and semi-structured. The interviews start with predefined questions but at some point of the interview when the questions have run out the unstructured part comes in – this is referred to as a pyramid model of conducting interviews (Runeson and Höst, 2009). The questionnaires held can naturally be seen as closed and fully structured interviews.

4.5 Metrics

The interview and questionnaire questions need to be focused on achieving a common goal. The common goal for the questions is to find out the performance of projects keeping in mind the Scrum and Lean methodologies. There are multiple performance metrics identified for project success which have also been categorized. These are communication factors, technical factors, organizational factors,

environmental factors, product factors, team factors, and project management factors. Within each category there are approx. 10 critical success factors (CSF) with the exception of project management factors of which there are 30. (Sudhakar, 2012)

For a full project success realization all of these categories should be taken into account. Rather than doing such a profound inspection on project success, it makes more sense for this thesis to focus on metrics which support answering the problem statement.

Out of all the critical success factors for project success found from the literature, the chosen ones are listed in Table 4.4. Each of the CSF's is numbered and in total there are 23 CSF's. From these 23 questions are formed to be used in the questionnaire for both of the case companies.

TABLE 4.4: Chosen Critical Success Factors from Sudhakar 2012

#	CSF	Factor Category
1	Communication	Communication
2	Cooperation	
3	Business process re-engineering	Organizational
4	Increasing efficiency	
5	Customer involvement	Environmental
6	Quality control	Product
7	Realization of user requirements	
8	Select right project team	Team
9	Project team coordination	
10	Task orientation	
11	Team commitment	
12	Team empowerment	
13	Project planning	Project management
14	Project control mechanisms	
15	Project schedule	
16	Project manager's competence	
17	Clear project goal	
18	Availability of resources	
19	Project monitoring	
20	Progress meetings	
21	Project review and feedback	
22	Project management methodology	
23	Clear responsibilities and accountability	

As seen in Table 4.4 most of the CSF's are from the Project Management factors, second most from the Team factors, Product, Organizational and Communication having the same amount, and Environmental the least. This spread of factors gives

a reason to also weight the amount of questions on the same way. The best way to do this is to ask one question on each of the factors. This is done only for the questionnaire held at the case companies. The reason for this is because a questionnaire is more structured compared to interviews which helps to compare the project success before and after the implementation (if an implementation is done). The interviews on the other hand are used to support the results by the reason of triangulation.

The basis for choosing these critical success factors to be used for forming and focusing the questions on was because they can be affected by the new tailored framework. There is no reason to choose factors that arguably cannot be affected.

To conclude, the difference between project success and project management should be addressed. In literature there is a mention of reasons for project failure from unsuccessful project management. These are; wrong basis for project, incompetent project manager, non-supportive top management, badly defined tasks, lack of project management methods, management techniques not used well, and lack of commitment (Munns and Bjeirmi, 1996). If these aforementioned points are compared to the CSF's in Table 4.4, it can be seen that all of these are well presented which means that the CSF's also give away any defects in the project management part of project success.

Chapter 5

Case Studies

5.1 Introduction to Case Companies

The companies used for the case research are both situated in Bogotá, Colombia. The companies are called Canned Head, employing 14 persons, and Diip, employing 11 persons. Therefore, they are both classified as Very Small Entities (VSEs) based on the ISO standard 29110; the companies employ less than 25 people. The European Commission classifies the companies as SEs, small enterprises with less than 50 employees but more than 10.

5.1.1 Canned Head Studios

Canned Head Studios was established in 2015 by three entrepreneurs. Their main products are the development of web pages, community management tools, search engine marketing (SEM) solutions, web- and smart-phone applications, and digital marketing solutions.

The organization is formed from six departments; development, design, sales, marketing, customer relationships, and finance.

The company produces its products in a way of short intense projects. Each project lasts approximately for 1 month and in a year there are close to 50 finished projects. Hence there are over 4 projects per month, on each project works partly or fully only 3 persons from development, 2 from marketing and 1 from design. The project life cycle for each project follows similar steps as in the pure waterfall model. First a meeting with a client from which the requirements are specified (also viewed as conception). Then the project is initiated, the product requirements are analysed, and a design for the product is created, all following the waterfall model. Then the product is constructed, tested and deployed. All of these product development steps are highly linked to cooperation from the customer's side.

Canned Head Studios has began building a more detailed project process for their product type with the highest demand called "web application". Web application refers to a system that works on a web browser and is suitable for mobile browsing, and which is used for interaction with the client's customers. Developing this kind of product is most requested by clients and therefore the most often developed product by the company. These projects are small and there is always a new request around the corner. The company wishes to improve the process of developing web applications in order to increase the profitability and to decrease the project duration.

The process improvement requires a deeper understanding of the AS-IS situation at the company. As mentioned earlier the company has began their process mapping with the help of the researcher. The current process is simplified in Figure 5.1 (look Appendix A for a more detailed figure).

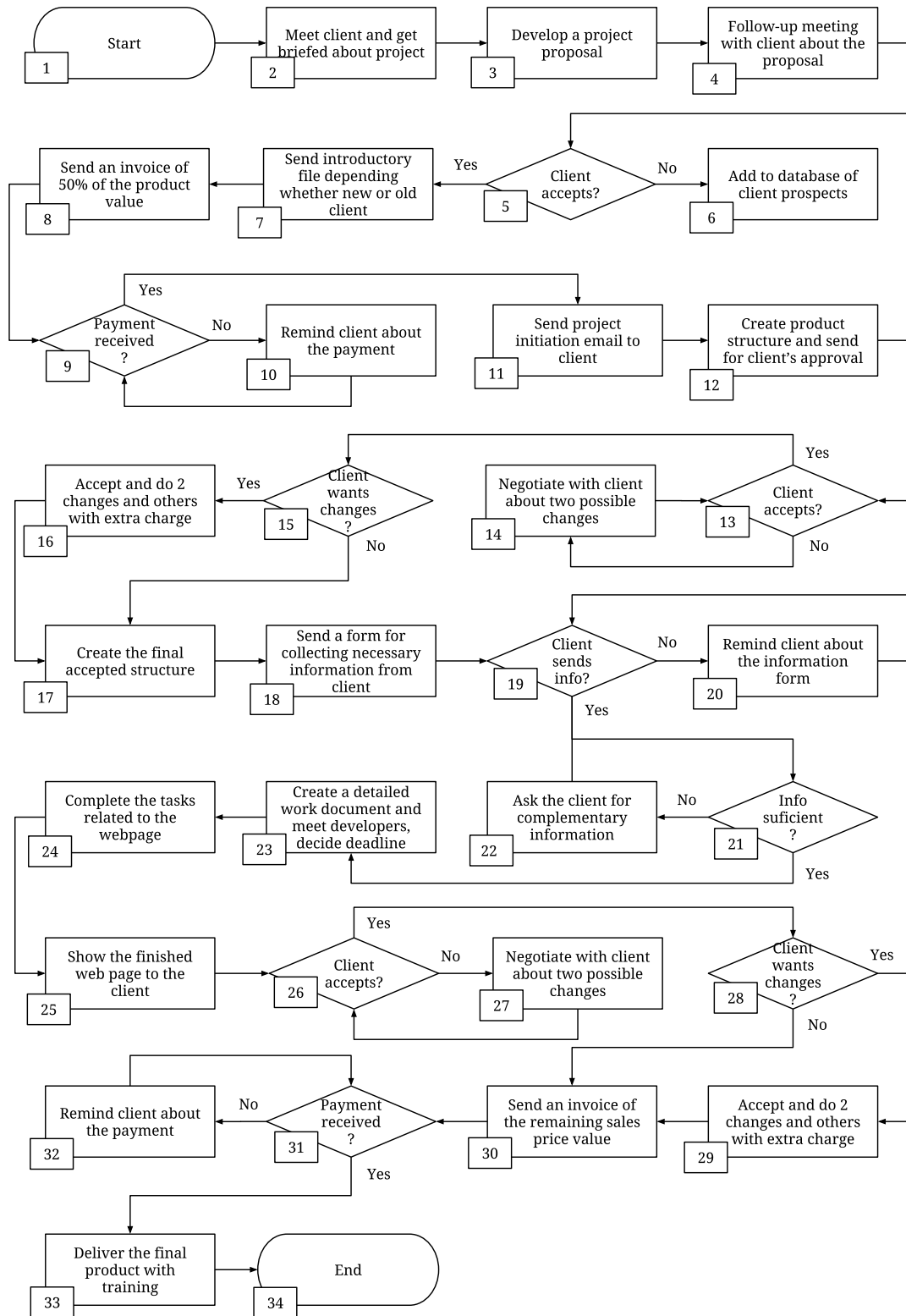


FIGURE 5.1: Project flow chart of AS-IS for web application development in Canned Head Studios.

The process of developing a web page consists of 34 phases. The phases are explained in a more detailed fashion in Table 5.1.

Looking the detailed process flowchart in Appendix A the minimum time for

TABLE 5.1: Web application process steps explained

#	Label & Explanation	WD*
1, 2	A The client is received through the sales team – the project manager meets with the client and receives information on the required product	1
3	B Based on the aforementioned information project proposal is created	1
4, 5, 6	C The project proposal is presented to the client and they are given 2 days to decide	3
7	D Introductory mail with registration is sent to client – client's response is waited	2
8, 9, 10	E 50 % of the product value is invoiced – client's payment is waited	6
11	F Client is informed about the project initiation, schedule, etc.	1
12, 13, 14, 15, 16	G Product structure is created and sent for the client – client's response is waited, if it is no or if the client requests changes, 2 changes can be negotiated with extra charge	7
17	H The final product structure is created	1
18, 19, 20, 21, 22	I A form requesting necessary details is sent to the client, client's response is waited and if still insufficient it is requested again	7
23	J A detailed work document and tasks are created with the project deadline by with help from designers and programmers	2
24	K The project is initiated internally and all the tasks related to the product are done by the team members, this is a straight forward process	7
25, 26, 27, 28, 29	L The finished product is shown to the client and client's acceptance is waited – if client does not accept final product, two changes can be negotiated and created	5
30, 31, 32, 33, 34	M Invoice request for the rest of sale price is sent and client's payment is waited – during the wait training is given for the client and when the payment is received the web page is connected to real domain and project is finalized	7

*WD = Working Days approximation based on interviews

a project to be done from beginning to finish is 27 days but mostly because of the possible delays caused by the customer, the maximum time for a project comes to 56 days. This means that depending on whether the interaction between the client and the company is not working fluently, a project can last approx. double of what it would last if the interaction was instantaneous. Furthermore, in Table 5.1 the times are averaged based on the interviews. There the total time comes to 49.5 working days for a project duration.

In order to realize more clearly how the time is spent in the process and how

much of that time is non-value adding, a value stream mapping (VSM) is performed on the process. For this procedure the literature is followed and the main process steps are identified (labelled in Table 5.1 as A, B, C,...) and these are put on a horizontal line with vertical differences showing whether the process step is value added or not. The VSM is shown in Figure 5.2.

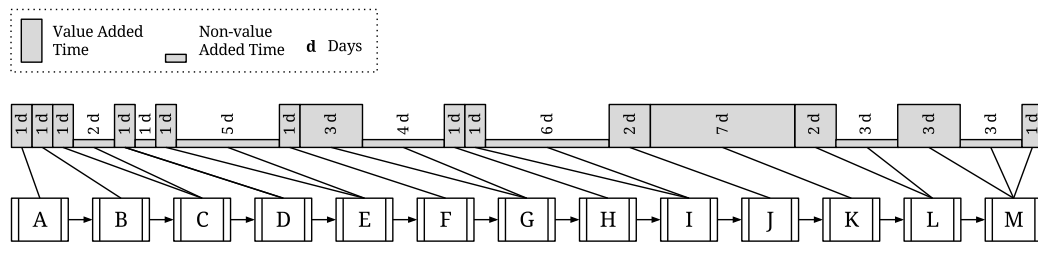


FIGURE 5.2: Value Stream Mapping for Canned Head Studio's Web Application Development

From Figure 5.2 it is seen that for the process of developing web applications at Canned Head the value added time is 26 days and the non-value added time is 24 days. By analysing the reasons behind the non-value added time i.e. waste, it comes from the cooperation with the client. The process wastes approx. 24 days for waiting for the client in a project. There are multiple points where the client does not either respond in time or the client wants to make changes which causes great delays for the project lead time.

It needs to be noted that here the process is seen as a whole from the first meeting with the client to the termination of the project. A more detailed view on the value added days would be necessary to find whether all hours in these days are actually value added. Hence, the fact that 48 % of the total project time is already waste, gives reason to focus on this problem instead of making a more detailed analysis.

5.1.2 Challenges faced by Canned Head

Based on the first interviews (before April 2017) shown in Appendix B there are multiple challenges faced by the company. The most important ones which imply problems in the project management practices are listed in Table 5.2:

These aforementioned causes and effects happening in the project management area of the company indicate a strong need for more clear roles for team members in projects; a project manager should have the main task of managing a project or projects and this task should not be compromised for other tasks. Also, new processes like reviewing what others have done should be in the agenda. Furthermore, most of the challenges like budget, schedule, lack of skills, lack of well defined roles, and handling simultaneous projects at once can be answered, to some extent, by implementing suitable project management practices. Suitable methodology for defining roles, increasing quality, and increasing capability to handle multiple project can be said to be Scrum. Suitable methodology for helping the projects stay within budget and schedule can be said to be Lean project management. Basing the arguments on the literature review part of this thesis.

For a deeper understanding on the overlaying causes for a low project success, on top of the aforementioned ones, cause-and-effect diagram method can be used. This diagram is developed based on the literature review Subsection 5.2 and it is shown in Figure 5.3. Additionally, in order to categorize the causes, the success factors from

TABLE 5.2: Cause and effect relation in Canned Head project management challenges

Cause	Effect
Too many simultaneous projects compared to workforce	Creates confusion and disorder
Not enough time to the project deadline	Resources work overtime and sometimes additional staff is hired which creates more disorder and cost
Contract creation is difficult because clients demand short deadlines and low budgets	Because of competition and the need for work bad contracts are accepted which means projects are not as profitable as wanted
Developers lack skills and code does not get reviewed enough	Hard to maintain and deliver high quality
Because developers lack necessary skills	Most of the work (60 %) is still done by the three owners
Lack of a true project management figure	Assigned project managers spend more time on other things rather than on project management activities

a project management star are used. A project management star has two triangles on top of each other like in the Star of David. The first triangle consists of scope, cost, and time, and the second triangle consists of risk, quality, and resources. (Project Management Institute, 2013)

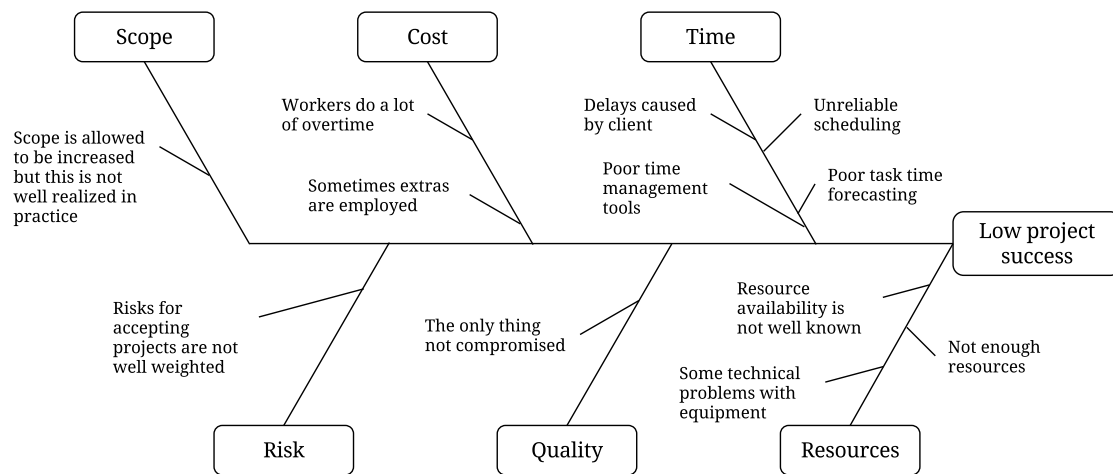


FIGURE 5.3: Cause-and-Effect Diagram for Canned Head's Project Management Practices

As seen in the figure, the causes having an effect to the low project success are happening in all of the areas defined by the project management star except in the quality area. This figure mainly shows that the causes are spread on a wide range of different areas so that a profound change in the project management methods is necessary.

5.1.3 Diip

Diip is a more matured company compared to Canned Head Studios. It was established in 2008 by a single entrepreneur. Diip products comprise of film production, post-production, graphic design, experimental and interactive design. The company employs 11 people of which many have wide skill sets. The company has a yearly revenue of around 300 000 euros but has stated their goal as to increase their revenue up to 1 000 000 euros within 5 years. Some of the challenges for the company are: lack of professionals in their field in Colombia, competition bringing the prices down to unbearable level, lack of monitoring project progress, and poor overall methods for managing projects on a high level.

A normal project for Diip has three main phases: pre-production, production, and post-production (see figure 5.4).

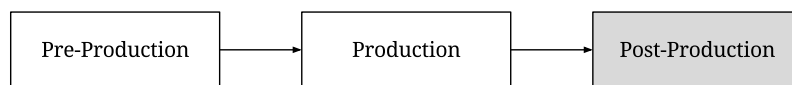


FIGURE 5.4: Main processes for Diip to develop a product.

All of these processes are different and important for a successful product but because of time restraints and the fact that agile project management has been most proven in software development environments (Conforto et al., 2014), the natural choice is to only take post-production under the case study which has most resemblance with software development process. Moreover, some projects of Diip only use this aforementioned phase i.e. it is a major process requiring improvement.

The post-production process is not as well defined as it is with Canned Head Studios. This is because there is no clear structure to the detailed operations and only the main steps of the process are followed. These steps are shown in Figure 5.5.

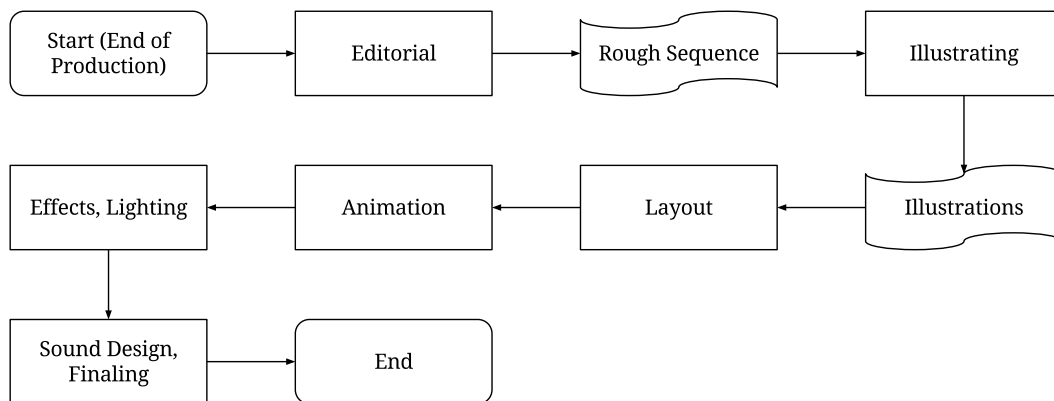


FIGURE 5.5: Lightly detailed post-production process followed at Diip.

There is no need for a deeper look into this development process hence this thesis is scoped to only focus on the project management process. The fact is still that the development process at Diip should be more detailed and this might currently be causing some of the problems on top of the project management related ones.

5.2 Collected Data and Analyses

In this section all of the collected data from interviews, questionnaires, and observations is presented with the intention of continuing the chain of evidence which was started in the beginning of this chapter. The information presented here is the main aid for creating the tailored Agile project management framework.

5.2.1 Interviews

There were multiple interviews held for each of the case companies. The interview pattern followed the pyramid model as mentioned in literature where the questions began with predefined ones and ended with improvised ones. The main point for the interviews was to collect general information about the companies hence both of the companies were new for the researcher. Additionally some of the more improvised and open questions did reveal deep information on the current project management practices at the companies.

Best way to present the information gathered from the interviews is to use categorizing methods with the main findings. For this the categories from the Critical Success Factors are used which were Communication, Organizational, Environmental, Product, Team, and Project Management. The findings for Diip are shown in Table 5.3 and for Canned Head in Table 5.4. For the whole interviews see Appendix B.

In both Canned Head Studios and Diip the strong points are CSF Categories in Communication, Product, and Team. The badly performing CSF Categories in both cases are Organizational, Environmental, and Project Management.

5.2.2 Questionnaire

An identical questionnaire was held for both of the companies, for all of the available employees, and the company founders. The questionnaire had information in the beginning stating that it is anonymous, respondents should answer truthfully and there was information about how the questionnaire is formed. The researcher was present with each of the respondents in case there were misunderstandings with the questions. The last part of the questionnaire had open questions which are categorized as part of an interview, they are presented in the interview section (see Section 5.2.1). All of the questions and the questionnaire itself can be found from Appendix D.

In all of the questionnaire questions the answer was given in a scale from 1 to 5, where 1 represented a lot to improve and 5 nothing to improve. The questions are based on the aforementioned CSF's which can be seen from Table 4.4 and the question numbers are directly connected to the CSF's. The questions are listed in Table 5.5

In Figure 5.6 the average results are shown as a bar chart for Diip's answers. The answers with average results less than 4 are shown next to their representative bars.

In Figure 5.7 the average results for Canned are shown. The reason for choosing the answers averaging below 4 is because the framework developed in this study is to achieve two main goals; it should be easily implementable and it should increase the project performance. These two goals cross each other and therefore it is necessary to make the line between *how much contribution for the implementation can be made* and *how much improvement is wanted*. In this case the companies feel satisfied with the level 4 and want to increase the success of the CFS's below 4.

TABLE 5.3: CSF Categories Linked with Interview Findings for Diip

Negative effect / Positive effect

CSF Category	Finding
Communication	Good communication between team members and management
Organizational	Lack of constant learning and improvement
Environmental	Client is too involved – delays occur because client has too much say in changes Client's needs are often misinterpreted – there is a need to involve the creative employees in the process
Product	Product quality is high – team members have good technological knowledge User requirements are realized well
Team	Some roles are not well defined or not followed by employees Team commitment is high Concentration can be low at times
Project Management	The availability of resources is not well known Not enough feedback about projects The team is not aware of the project progress or all of the projects being carried out Schedule forecasts are wrong – lack of knowledge on resource availability knowledge Lack of development process Some reliabilities of roles are not followed – badly assigned roles

5.2.3 Observations

Because the researcher spent over three months working with the case companies on a daily basis, observations happened continuously. A big importance for acquiring information through observations is to find proof of realness from the information gathered via interviews and questionnaires. Additionally, observations add to the validity of the data based on the triangulation theory. (Runeson and Höst, 2009)

In order to do the aforementioned, the poorly performing categories are enforced by trying to find supportive arguments from the observation. The same is done for the well performing categories.

In Communication it was noticed that the teams in both cases have a good level of communication – the teams are situated in the same room and no one is afraid to announce themselves when having problems or misunderstandings. On the other hand, there was a noticeable amount of unnecessary communication between individuals in the same team or other teams. This could be also seen as a cultural difference from the researcher's side. It can be confirmed that Communication category

TABLE 5.4: CSF Categories Linked with Interview Findings for Canned Head

CSF Category	Finding
Communication	<p>Communication problems when changes are made ill-informed to others</p> <p>Overall communication between team members is good</p>
Organizational	Lack of well defined processes
Environmental	Problems with getting proactive feedback from client – or information is not passed well to development team
Product	Good quality is always reached in the end with user requirements satisfied
Team	<p>Strong commitment from the employees</p> <p>Teams feel empowered at all times</p> <p>Task orientation is usually good</p>
Project Management	<p>Poor task allocation in beginning of project – hard to forecast and create reliable schedule</p> <p>Transparency of tasks lacks uniformity – sometimes tasks are given only face-to-face</p> <p>Scheduling is made but it is not conformed</p> <p>Lack of progress meetings during projects</p>

does not need improvement. In the case of Canned Head's questionnaire answers the first answer point (#1 in Figure 5.7) was given less than a 4 average but with the observations and interviews pointing to a higher point it can be arguably left out from necessary improvements.

The Organizational CSF category does not get support or opposition from the observations hence this would have required a longer observation time (CSF's in this category are Business process re-engineering and Increasing efficiency).

The Environmental category is one of the biggest weak points for both companies. The customer is truly not that well included with the development process for Canned Head. There seems to be an unnecessary will to include the client as much as possible in the beginning of the project but almost totally discontinue the face-to-face communication after this – client is mostly only met if there are problems which freeze the project process. With Diip there were no mentionable observations concerning this category.

The Product category was one of the highlights for both of the companies. As a witness for the end products, the researcher can confirm that the client is close on always satisfied with the quality and the realized user requirements. Although this is the case, this is done by wrong means. The team is pushed to the limit with long days and overwhelming amounts of tasks. In the long run this is not sustainable for neither of the companies. This being part of the Project Management category, it is discussed in a forthcoming paragraph.

The Team category was a high performing one in the interviews but had some

TABLE 5.5: Questions Asked in the Questionnaire

#	Question
1	How would you rate the communication between all the participants in projects?
2	How would you rate the cooperation between all the participants in projects?
3	Have the project practices improved from project to project?
4	Has the efficiency of projects improved from project to project?
5	How much is the client involved with the projects?
6	How well is the quality of the product controlled?
7	How well are the user requirements realized?
8	How well are the project teams formed? Is the mixture and amount of team members good?
9	How well is the team coordinated by the project manager or management?
10	How well do you understand the tasks given to you?
11	How would you rate the team commitment?
12	Do you feel trusted and supported (empowered) in a team?
13	How well are projects planned before projects and / or during projects?
14	How well is the project controlled? How well does the project steer towards the goal?
15	How well are the project schedules kept?
16	How competent do you see the project manager(s)? If you are one, rate yourself
17	Is the goal of a project usually clear to you?
18	How would you rate the availability of resources / workers in a project? Are you usually doing more tasks than you can handle or do you have time to finish all tasks on time?
19	How do you feel the project is monitored? Do you know how much of the project is left and whether the project is going well or bad?
20	Do think there are enough project progress meetings and whether they are performed well or badly?
21	Are project review meetings held, where you can give feedback, and are they performed well or badly?
22	Are you aware whether some project management methodology is followed in projects?
23	How clear are your responsibilities and accountability?

points below a 4 average from the questionnaire for both of the companies. These points were "Select right project team" for Diip, and "Project team coordination" for Canned Head. By using the observations these points can be understood better.

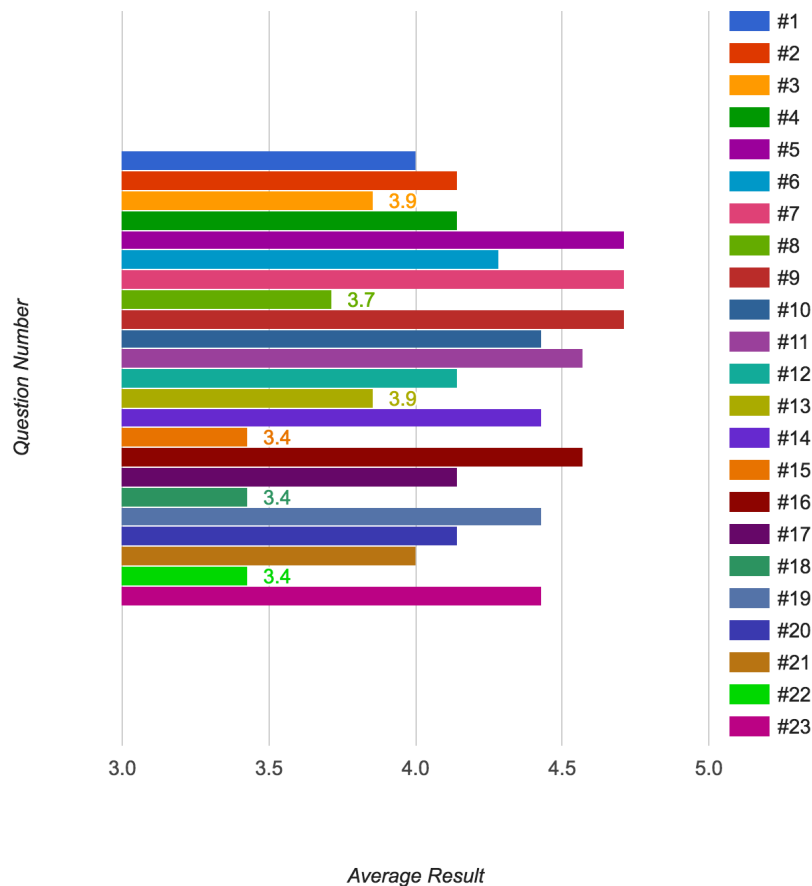


FIGURE 5.6: Average Results from Questionnaire for Diip

There are not many employees at Diip, so the teams are forcibly formed. The real problem for Diip lies on the Project Management side with the poorly elected and followed roles. For Canned Head the project team is well coordinated with the used methods but there is a lack of understanding of the development process and the lack of project management methodologies does not help i.e. with a common understanding on the development and project management process the problem of team coordination can be argued to be less severe. Finally, based on these arguments the Team category can be left out from the necessary improvement points faced by the Agile project management framework.

The Project Management category has within it most of the CSF's and it is a weakly performing one in both the interviews and the questionnaires. The main reason for this is that in reality there is no real project management methodology that is being followed. The formula is simple; plan a lot before the project is initiated and trust the schedule and budget forecasts. These forecasts rarely come out as planned – this was discussed in the problem definition part of this study. Additionally, there is some knowledge on project management practices at both of the companies but this knowledge is not put into use because the persons with this knowledge are too occupied with other tasks. Both of the companies are starting to realize the importance of an exploited functional project management framework.

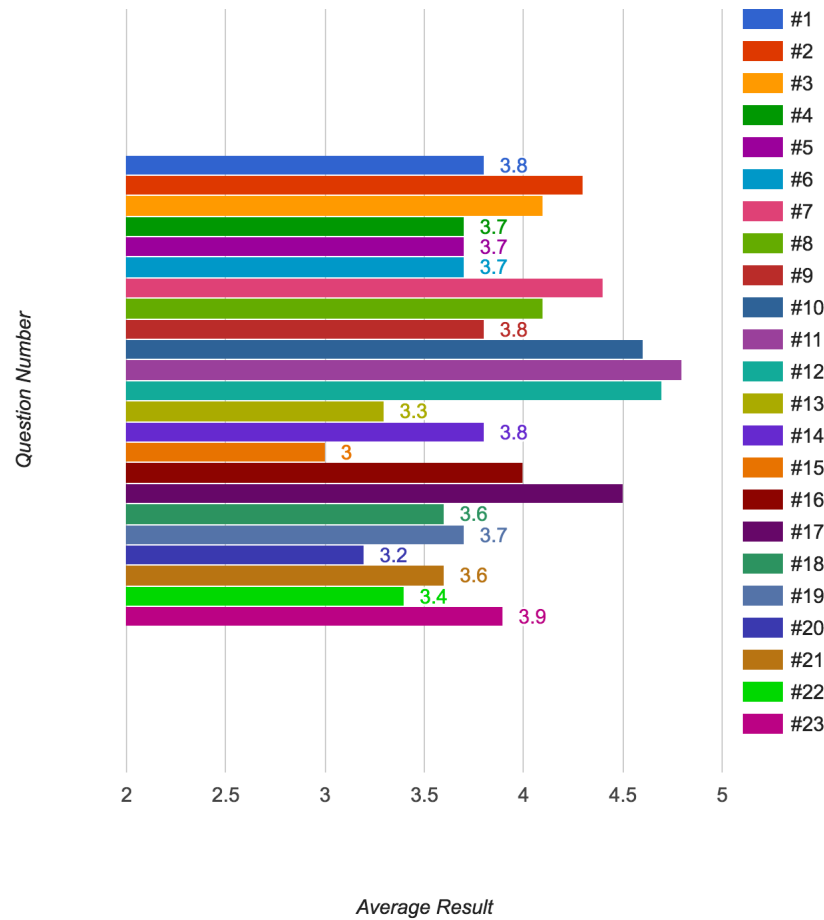


FIGURE 5.7: Average Results from Questionnaire for Canned

5.3 Data Analysis with R-Studio

The data from the questionnaires is analysed in this section in order to support the creation of the tailored agile project management framework.

First interest is to look at the questionnaire answers to see whether the results from Diip and Canned Head Studios were similar. For this statistical analysis is made following Section 4.3. The R code can be seen from Appendix E where the normality tests, K-S and Shapiro-Wilk, resulted in p-values less than 0.5; the answers are not normally distributed – hence the Mann-Whitney test was run.

The results from the final Mann-Whitney tests pointing out the questions that can be considered statistically similar, with $p > .05$, are shown below ($x = \text{Canned Head Studios}$, $y = \text{Diip}$).

```

data: x$`Question 2` and y$`Question 2`
W = 35.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

data: x$`Question 3` and y$`Question 3`
W = 41.5, p-value = 0.52
alternative hypothesis: true location shift is not equal to 0

data: x$`Question 17` and y$`Question 17`
W = 41.5, p-value = 0.5153
alternative hypothesis: true location shift is not equal to 0

data: x$`Question 22` and y$`Question 22`
W = 34.5, p-value = 1
alternative hypothesis: true location shift is not equal to 0

```

Hence the results from questions 2, 3, 17, and 22 can be considered having the same answers, only one which was considered to require improvement is question number 22 (CSF: Project management methodology, Category: Project management). This means that Canned Head Studios and Diip both have same view on the current condition of the usage of project management methodology which on average is rated 3.2 for Canned Head and 3.4 for Diip. Finally, by looking at these results it can be concluded that overall the companies cannot be viewed similar which means that they should both have different tailored project management frameworks.

Furthermore, a box plot was made for both of the companies' answers which displays the variance of the answers and the differences between the companies. These two box plots are shown in figures 5.8 and 5.9.

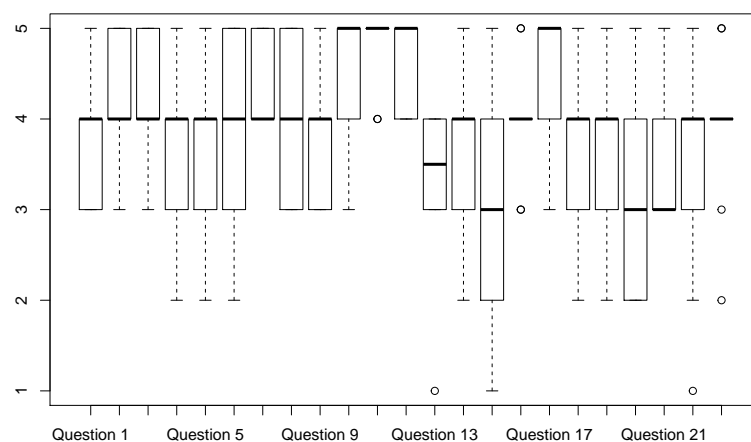


FIGURE 5.8: Box Plot of Canned Head Questionnaire Answers

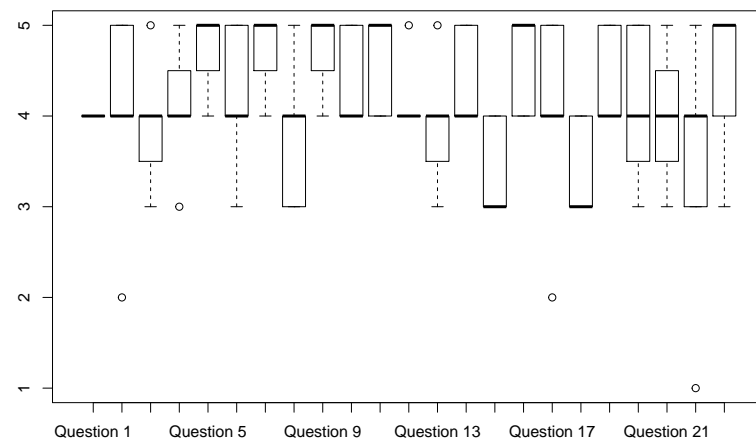


FIGURE 5.9: Box Plot of Diip Questionnaire Answers

The box plots show that most of the answers for Canned Head are situated between 3 and 4, and most of the answers for Diip are situated between 4 and 5. Also, the variance between answers is much lower for Diip and much higher for Canned Head.

5.3.1 Collected Results from Data Analyses

The previous sections of this chapter have shown and analysed both the qualitative data (interviews and observations), and the quantitative data (questionnaire). To conclude this chapter these results are collected in this section, giving the base for the tailoring effort.

The CSF's for that require improvement by tools and methods from the tailored framework are shown in Table 5.6:

These CSF's will be connected with each of the framework suggested for each of the companies.

TABLE 5.6: CSF's that need improvement (pointed by company name)

Category	CSF	#	Company
Communication	Communication	1	
	Cooperation	2	
Organizational	Business process re-engineering	3	Canned, Diip
	Increasing efficiency	4	Canned, Diip
Environmental	Customer involvement	5	Canned, Diip
Product	Quality control	6	
	Realization of user requirements	7	
Team	Select right project team	8	
	Project team coordination	9	
	Task orientation	10	
	Team commitment	11	
	Team empowerment	12	
Project management	Project planning	13	Canned, Diip
	Project control mechanisms	14	Canned
	Project schedule	15	Canned, Diip
	Project manager's competence	16	Canned
	Clear project goal		
	Availability of resources	18	Canned, Diip
	Project monitoring	19	Canned
	Progress meetings	20	Canned
	Project review and feedback	21	Canned
	Project management methodology	22	Canned, Diip
	Clear responsibilities and accountability	23	Canned, Diip

Chapter 6

Tailored Framework

In this chapter the tailored framework is developed for both of the case companies. The tailoring attempt is supported by the knowledge gathered in Chapters 5 and 2. The aim is to develop a framework following the steps described in Section 2.4.

6.1 Selecting the Methodologies

Hence there are two case companies, the two sections explaining and presenting the frameworks can be compressed so that the tailoring process is only followed for Canned Head but not repeated for the Diip, where only the differences are shown. Selecting the methodologies section follows the first 2 aforementioned steps from Section 2.4.

1st step of the tailoring attempt is to recognize the beneficial and most suitable project management methodology area. Whether to continue with methodologies from Traditional and Agile or from Agile and Agile combination can be based on the 4 factors; team size, criticality of project, amount of requirement changes during a project, and work culture. These factors are shown in Table 6.1.

TABLE 6.1: Selection between Traditional and Agile hybrids

Selection Factor	Value	Preferred Methodology
Team Size	Low (2-5 persons)	Agile
Criticality of Project	Low (over 50 projects per year)	Agile
Requirement Changes	High	Agile
Work Culture	Start-up like (Chaos is present)	Agile

The table shows that the right methodology should be tailored from Agile methodologies, based on the method provided by (Lee and Yong, 2013).

2nd step is to select the most suitable methodologies under the Agile project management area. It has already been proven in the previous parts of this study that Scrum and Lean are suitable for both of the case companies but this can be argued further by comparing the most used agile methodologies (Litchmore, 2016) together to find whether the argument of using Scrum and Lean actually holds. The comparison is made in Table 6.2.

Table 6.2 shows a list of different Agile methodologies with small descriptions and arguments whether the methodology is suitable or not. The researcher found

TABLE 6.2: Comparison of Agile Methodologies modified from (Litchmore, 2016)

Agile Methodology	Definition	Suitability
Adaptive Software Development (ASD)	Focuses on large and complex projects	Not suitable, projects are not large nor too complex
Agile Modelling (AMOD)	For modelling and documenting a software based system	Not suitable, lacks project management practices
Agile Unified Process (AUP)	Relatively easy approach for developing business application software using agile techniques and concepts	Not suitable, aimed for large business software development
Business Analyst Designer Methods (BADM)	Method for designing business change	Not suitable, designed for business analysts
Crystal Clear Methods	For small teams focusing on efficiency and people	Suitable, similar to scrum but focuses more on coding
Disciplined Agile Delivery (DAD)	Combines multiple agile methodologies, aimed for scaling	Not suitable, too wide for easy implementation
Dynamic Systems Development Method (DSDM)	Focuses on project budget and deadlines	Not suitable, does not focus on time and resources
Extreme Programming (XP)	Focuses on the development method	Not suitable, not enough project management practices
Feature-Driven Development (FDD)	Combines different industry best practices	Suitable, similar to scrum but focuses more on coding
Lean Software Development	Uses lean manufacturing principles on software development	Suitable, adds value and lacks research
Kanban (Development)	Uses Kanban from manufacturing for software development	Suitable, also within Lean Software Development
Scrum	An iterative and incremental agile method for managing software engineering projects	Suitable, focuses mostly on project management side
Scrumban	Tries to merge Kanban and Lean but	Not suitable, already within Lean and Scrum

that Crystal Clear Methods, FDD, Lean Software Development, and Kanban (Development) are the only truly suitable ones for Canned Head. Kanban can be reduced from the list because it is already included within the Lean framework. Crystal Clear, FDD, and Scrum are all similar methodologies but Scrum is the one with the largest acceptance in the industry which implies that it also has the most well defined methodology. Therefore, Scrum can be chosen over Crystal Clear and FDD. Additionally, one study declares that within the industry it is most common to have Scrum supported by Lean as a followed framework (Wang, Conboy, and Cawley, 2012).

Finally, Scrum and Lean are chosen for the methodologies to be used for the tailored project management framework.

6.2 Selecting the Tools and Practices

3rd step is to select the most beneficial methods and tools from the chosen methodologies. In order to aid the selection, the CSF's from the Table 5.6 are used. The CSF's that need improvement and the tools and practices from both Lean and Scrum are connected in Table 6.3.

For the selection of the tools all of the knowledge gathered during this study was used; interviews, questionnaires, observations, and development process analysis.

For Canned Head and Diip the most suitable framework is to follow Lean methodology's Continuous Improvement tool for beginning to involve business process re-engineering into their organizational behaviour – this tool was also used partly in this study for understanding that the client needs to be more involved with the development at Canned Head. Both of the companies should also include JIT and Kanban from Lean. This could be done hand-in-hand with the Sprint Backlog (also for both of the companies).

As with the problems occurring with Customer involvement CSF, the companies should add the role of Product Owner and start following the values of Scrum culture. The Project planning CSF can be increased by implementing the Sprint Planning practice from Scrum. The project schedule CSF was also low rated at both of the companies. For this, the Sprint Backlog should be implemented. The availability of resources CSF can be supported by implementing the Sprint Planning from Scrum. This allows the teams to have a manageable workload. Moreover, both of the companies should implement the Scrum Core Team to support having clear responsibilities and accountability. This basically means to involve the roles of Scrum Master, Product Owner, and the Scrum Team. For Canned the project control mechanisms CSF should also increase after this implementation hence it covers the Scrum Team.

Finally, there are some parts of the framework only for Canned Head which are the Daily Scrum, Sprint Review, and Sprint Retrospective. By implementing these the Project monitoring, Progress meetings, and Project review and feedback CSF's should increase after the implementation. The sections are shown next to the tools and practices in Table 6.3 for the Companies to study.

TABLE 6.3: Connecting the chosen CSF's with available tools and practices (Poppendieck and Poppendieck, 2003) (SCRUMstudy, 2016)

CSF	Methodology	Tool / Practice	Company
Business process re-engineering	Lean	Continuous Improvement (Section 2.3.1)	Canned, Diip
Increasing efficiency	Lean	JIT, Kanban (Section 2.3.6, 2.3.5)	Canned, Diip
Customer involvement	Scrum	Product Owner, Scrum Culture (Section 2.2.3, 2.2.4)	Canned, Diip
Project planning	Scrum	Sprint Planning (Section 2.2.3)	Canned, Diip
Project control mechanisms	Scrum	Scrum Team (Section 2.2.3)	Canned
Project schedule	Scrum	Sprint Backlog (Section 2.2.3)	Canned, Diip
Project Manager's competence	Scrum	Scrum Master (Section 2.2.3)	Canned
Availability of resources	Scrum	Sprint Planning (Section 2.2.3)	Canned, Diip
Project monitoring	Scrum	Sprint Backlog (Section 2.2.3)	Canned
Progress meetings	Scrum	Daily Scrum (Section 2.2.3)	Canned
Project review and feedback	Scrum	Sprint Review, Sprint Retrospective (Section 2.2.3)	Canned
Project management methodology	Scrum	All previously assigned Scrum practices cover for this	Canned, Diip
Clear responsibilities and accountability	Scrum	Scrum Core Team (Section 2.2.3)	Canned, Diip

Chapter 7

Discussion of Findings

This is the final chapter of this thesis. It covers the conclusion, discussion, and future work. In conclusion the big picture of the thesis is told, synthesized, the pieces are fitted together, and the reasons for the importance of this thesis are further explained. In discussion the findings are given meaning by the researcher and how valuable they are, and the reasons for their value. In future work the possible next steps are considered, for the companies and academicians.

7.1 Conclusion

This thesis was written in hopes of creating a suitable and beneficial project management frameworks for two Colombian companies; Canned Head Studios and Diip. The path of the thesis was to first analyse the companies using the Case Study method in order to find the weak points in their project management practices. This was done by using literature for discovering applicable Critical Success Factors (CSF's) to be measured against both of the companies. Then the CSF's were used as a base in creating interviews and questionnaires with the aim of ranking the CSF's. Observations were used to back up the findings from the questionnaires and interviews.

Additionally, the product development processes were analysed for understanding whether there were some critical problems to be found. This was not the case and the focus remained on the project management practices.

From ranking the CSF's, it was discovered that both of the companies had some weak performing CSF's which could be enhanced by implementing a new project management framework. Furthermore, the questionnaire results about the CSF's for the companies were statistically different – it was concluded that the companies cannot share the same framework but need to have tailored ones for each.

The literature suggested that the most beneficial framework should be a tailored one and from the Agile umbrella's methodologies. By using both the weak performing CSF's and the literature it was found that a tailored framework from Scrum and Lean methodologies would be most suitable. Finally, the tools and practices from the aforementioned methodologies were selected for each of the companies based on their suitability.

There are multiple results from this thesis which amplify its importance. First, it was discovered that there was a strong need for suitable project management practices at the companies. This can be argued to be the case with similar companies around the world. Second, it was found that although the companies performed differently on the CSF's, suitable tools and practices were found for both from only Scrum and Lean methodologies. This implies that tailoring Scrum and Lean together

is a good solution for other similar companies. Third, the failed implementation effort (See Section 7.2.1) supports the claims found from literature where it is said that it requires high investments, time- and budget-wise, from companies trying to add new project management practices into their organization. One person without professional understanding of this kind of implementation is not enough. Additionally, some considerations to be taken into account before implementation are presented in this thesis.

Finally, this thesis provides not only frameworks for the case companies but also an overall framework for other small companies wishing to improve their project success, by presenting a way of discovering project performance and selecting right methodologies to follow.

7.2 Discussion

It was found that both of the case companies lack a proper project management framework. This affected the performance of the projects in the three dimensional project goal; project cost, requirements, and time. Two of the under performing dimensions were cost and time. This was one of the reasons to conduct the study of tailoring new project management frameworks. The other reason for conducting the study was the finding that there is a lack of proper understanding within academia about tailoring project management methodologies and not enough studies done considering the project management practices in small companies.

The case study analysis on the companies revealed more details on why the projects were unsuccessful. Conducting interviews, questionnaires, and observations to measure the performance of project success CSF's revealed that the companies performed well on the Communication, Product, and Team categories but badly on Organizational, Environmental, and Project Management categories. This implies that in small companies the work environment is friendly and tight-knit and the main focus is on delivering a quality product – on which both of the companies succeeded well. On the other hand, the lack of followed project management frameworks, badly assigned roles, and insufficient contact with the clients were seen as the main reasons for the overall low success of projects.

In order for companies, like the ones been in this study, to increase their project successes, it is necessary for them to run a similar analysis done in this thesis for suitable CSF's and a similar methods engineering effort in order to connect the weak performing CSF's with suitable methodologies.

7.2.1 Implementation Effort

In this subsection the implementation effort is discussed. During this study there became a point of time where the researcher was forced to make a decision to start an implementation effort at Canned Head although the framework was not finalized. This was because of the time frame of 5 months of which the first month was spent on generating the problem and the second month on the literature review. The deeper analysis on the CSF's was just began at this point but because the projects at Canned Head last approx. 1 month and at least 1 month would be needed for the analysis, it was necessary to begin implementation efforts even without a clear framework. From the initial analysis it was discovered that there are problems with the roles, progress monitoring, and client cooperation. For this it was decided to

begin implementing Product Owner, Scrum Master, and Daily Scrum practices to address the aforementioned problems.

The researcher had a brief meeting with Canned Head's management about starting the implementation. The management agreed on this and pointed one of the project managers at the company to support the researcher on the implementation.

After meeting with the project manager it came clear that the project manager would be too busy to also have the role of Product Owner, and start holding the Daily Scrum meetings. Furthermore, only person for being able to acquire the role of Scrum Master would have been the researcher himself. Hence the researcher did not fully understand the detailed processes involved with the development process, he could not be assigned with the role of Scrum Master.

Because of the aforementioned problems, it was decided not to implement a framework during this study.

7.3 Future Work

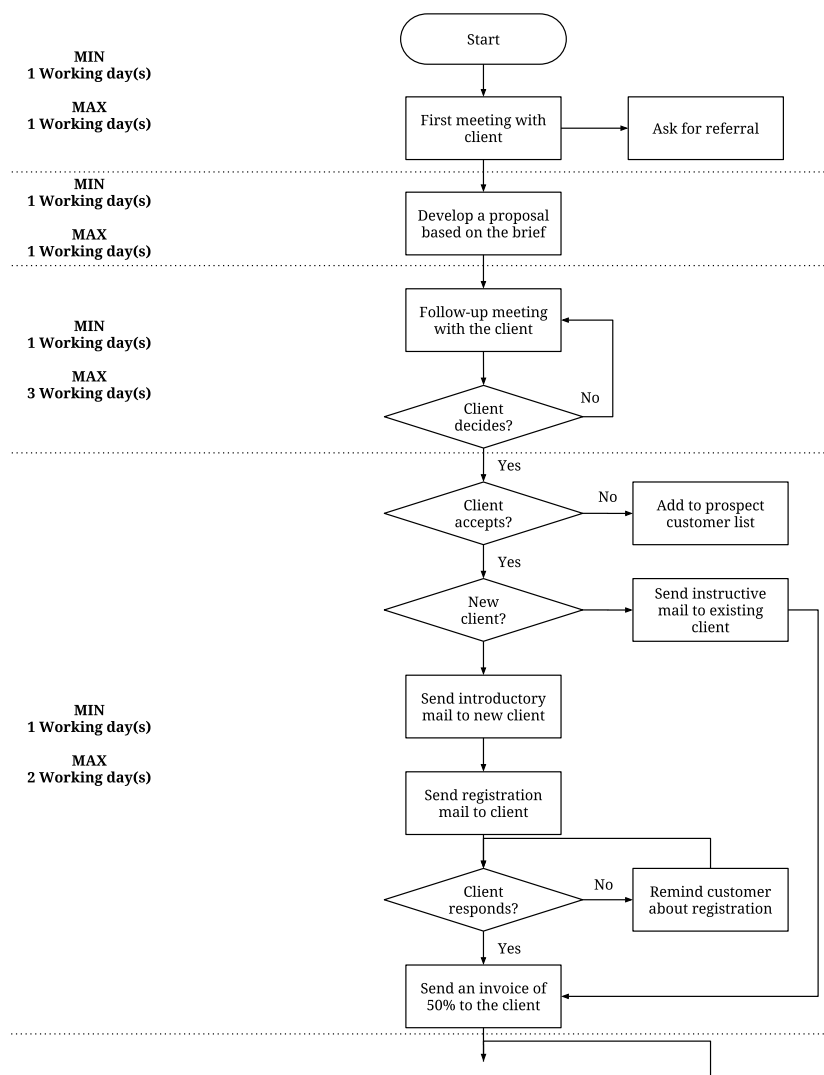
The next obvious step for the case companies is to begin planning how they will implement the presented frameworks. The companies should invest time on reading this thesis and the pages from the Lean and Scrum books shown in Appendix F. The researcher feels that the best way for a successful implementation is that one of the company employees who knows the organization should be given a new task for at least 3 months to only focus on the implementation effort. In Section 2.2.5 are presented some questions the companies should ask themselves in order to find further reason and motivation for beginning implementation. Additionally, the companies, hence they are very accepting of a researcher's / student's presence, could invite a researcher for aiding and recording the implementation effort. This would be a logical continuum for this thesis.

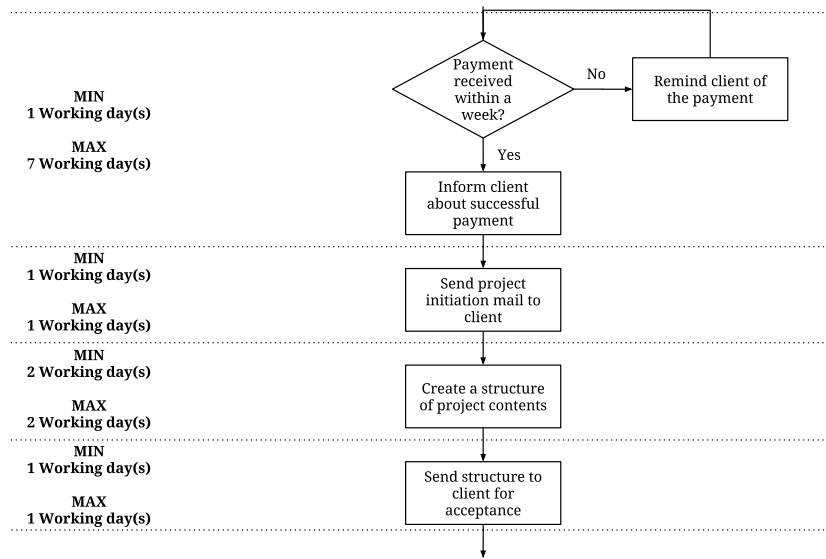
Whether the companies succeed or not in the implementation, the results could be studied and analysed in order to find whether the frameworks presented in this thesis provide benefits. Furthermore, the work in this thesis should be repeated by an other researcher for enforcing or challenging its functionality.

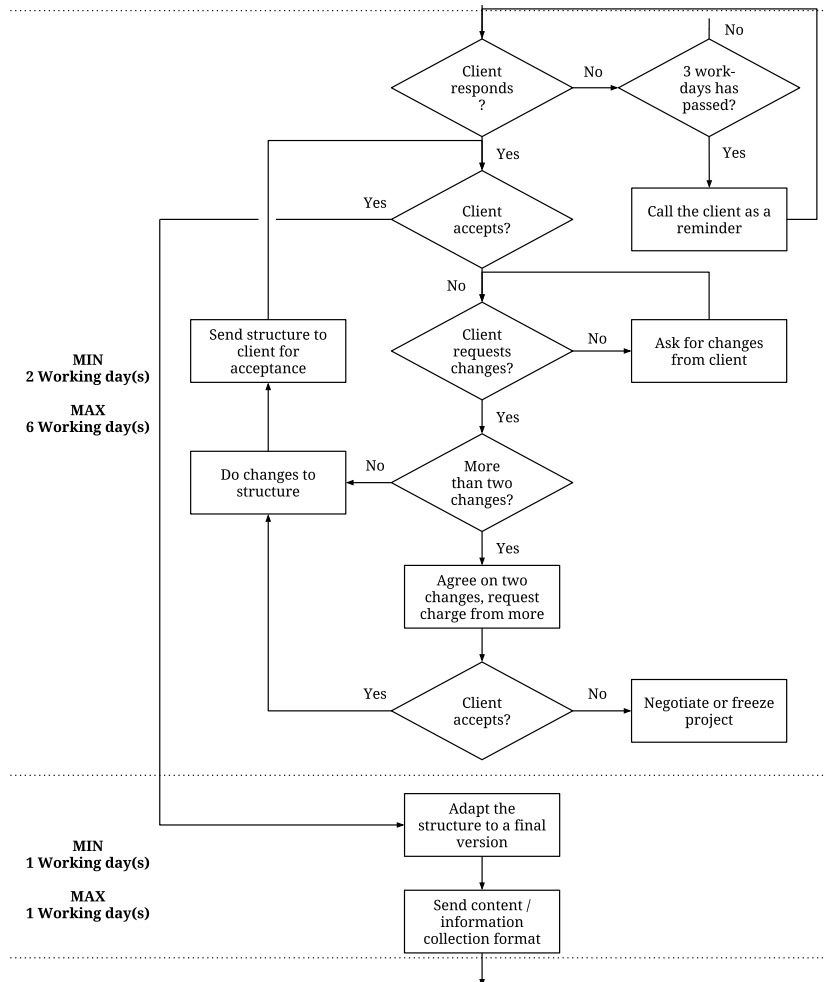
For academia, a gap in the literature was found; both methodologies Lean and Scrum are widely studied regarding their successfulness but, for aiding the tailoring effort, the researcher was unable to find a list of tools and practices from either the Scrum or Lean side where the functionality of the tools and practices would have been under critical inspection and whether they are independent of each other or interconnected. This would have helped in linking the low performing CSF's with suitable methods.

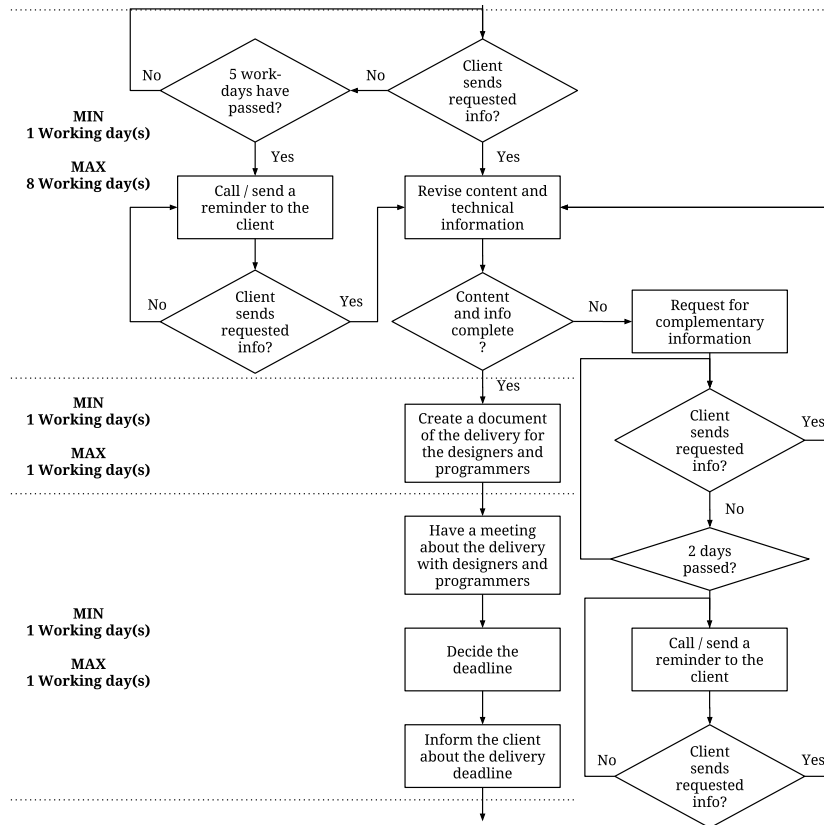
Appendix A

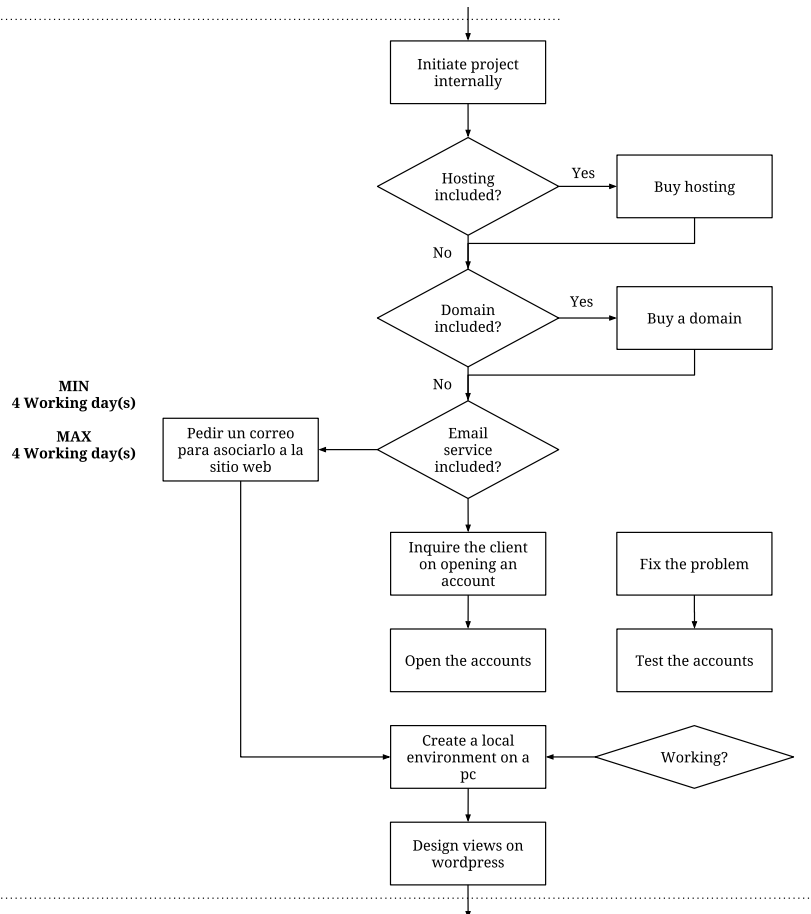
Canned Head Studios Project Process Flowchart

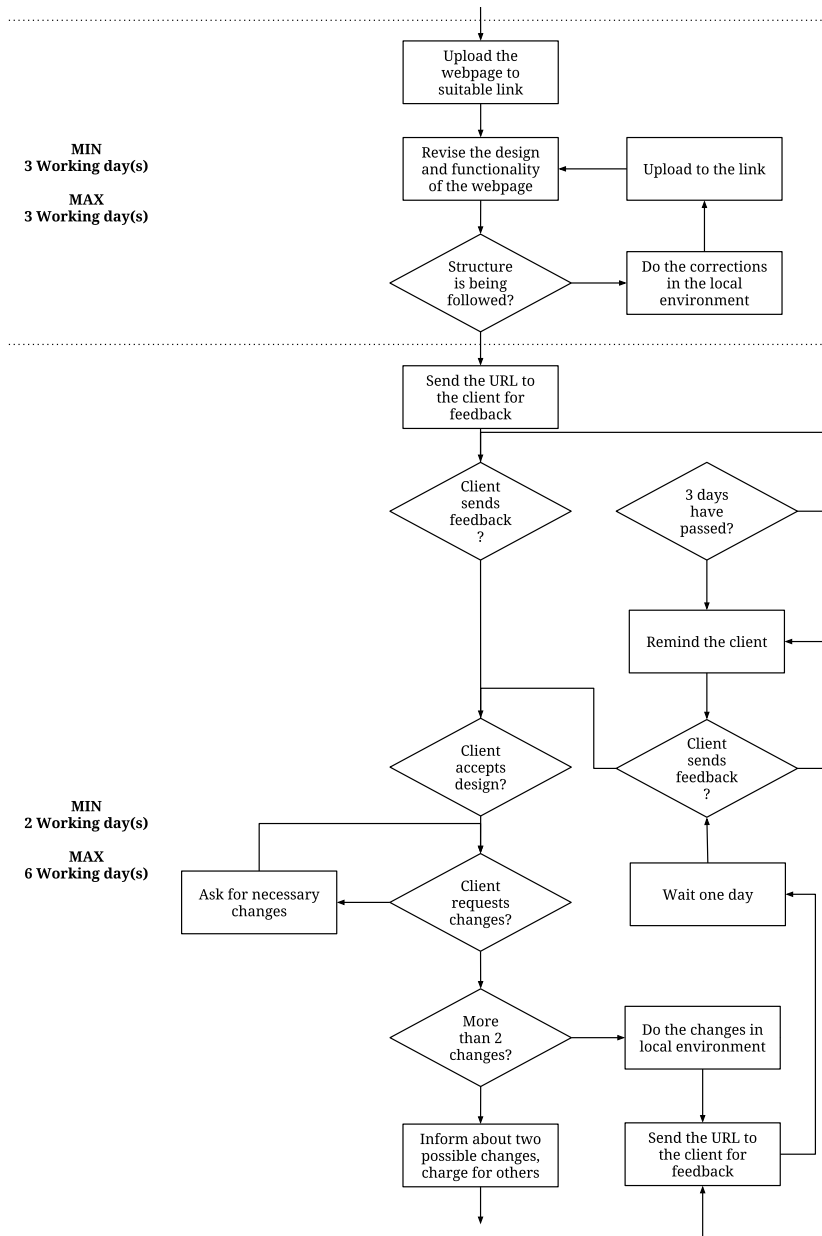


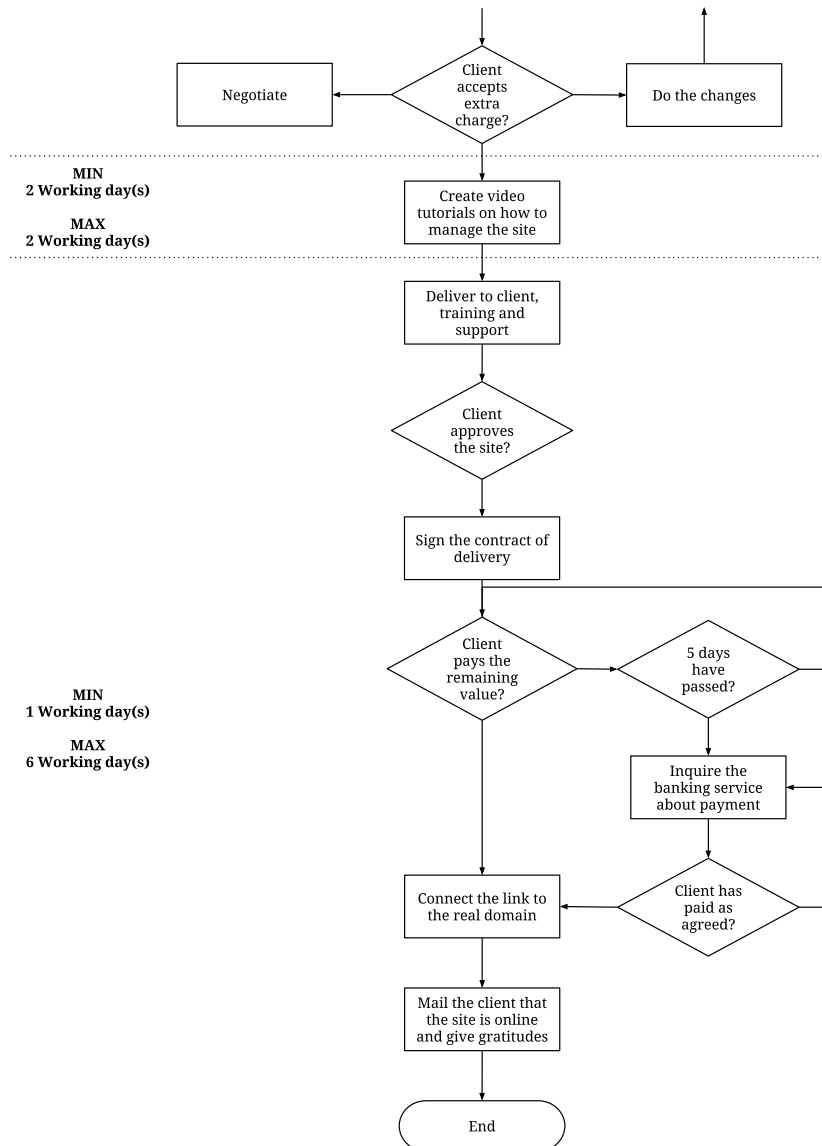












Appendix B

Interviews With the Case Companies

TABLE B.1: General interview with Canned Head and Diip 6.2.2017
part 1

Person	Question / Answer
Researcher:	When was the company founded?
Canned Head:	July 2015
Diip:	2008
Researcher:	What is the target market and customer?
Canned Head:	Agencies, big companies
Diip:	SME's, individuals, agencies, artists, music producers, publicity agencies
Researcher:	What does the company provide for its customers?
Canned Head:	Services; web pages, community management, search engine marketing, applications, web-based applications, digital marketing
Diip:	Production, post-production, design, graphic design, experimental design, interactive design
Researcher:	How many people work in the company?
Canned Head:	14
Diip:	11
Researcher:	How would you categorize the employees?
Canned Head:	Into development, design, marketing, and sales
Diip:	Into administrative, design team, and marketing

TABLE B.2: General interview with Canned Head and Diip 6.2.2017
part 2

Person	Question / Answer
Researcher:	How many people in each category?
Canned Head:	Development: 4, design: 2, marketing: 3, sales: 1, customer relationships: 1, accounting: 1
Diip:	Administrative: 3, design team: 6, marketing: 2
Researcher:	Is the product development done as projects?
Canned Head:	Yes
Diip:	Yes and ongoing services
Researcher:	What is the average length of a project?
Canned Head:	1 month
Diip:	1.5 months but exceptions of 6-8 months
Researcher:	How many projects in a year?
Canned Head:	48
Diip:	80
Researcher:	How many employees involved in a single project?
Canned Head:	3 for software and 2 from marketing but marketing juggles other projects as well
Diip:	3 in design, 1 marketing, and 1 administrative
Researcher:	How many simultaneous projects?
Canned Head:	Around 25 for development and around 3 for marketing
Diip:	Between 5 and 7 projects

TABLE B.3: Project process challenges interview with Canned Head and Diip 6.2.2017 part 1

Person	Question / Answer
Researcher:	Do you have an existing project process of some kind?
Canned Head:	Talk with the client, write the requirements, fit it with the resources, even without resources projects are accepted, "harvest" and "asana" tools are used, every monday put the tasks in asana and set up a goal, harvest and asana are connected, asana timetable management, marketing time management is harder because not done in asana.
Diip:	Brief from client and diip proposes vision, negotiation of price (customer decides), after this divide two administrative and design teams. Administrative goes through all the legal parts. The design team project manager, activities are divided. Tasks subdivided for pre-production (the planning 1,5 weeks), production (actual work 2 days tops), post-production (4 weeks). Asana is the task tool, and Google drive is used.
Researcher:	Biggest issue when thinking about the project process?
Canned Head:	Not enough time, contract creating, quality (most important)
Diip:	Not enough people because of the agreed budget always too small and no hiring of workforce can be made
Researcher:	Which part seems most problematic; initiating, planning, executing, monitoring & controlling, closing?
Canned Head:	Monitoring and controlling is only done in harvest which records the time used for each process step so this needs improvement. Also, in executing, 60 % of the work is performed by the three founders and 40 % is done by the development team. This is unwanted.
Diip:	Monitoring done after the project, biggest issue with the planning of accurate duration of tasks
Researcher:	Are projects finished on time; percentage of late?
Canned Head:	20 %
Diip:	5 %
Researcher:	Do projects run over budget; percentage of over?
Canned Head:	30 %
Diip:	25 %

TABLE B.4: Project process challenges interview with Canned Head and Diip 6.2.2017 part 2

Person	Question / Answer
Researcher:	Does the project scope remain; percentage of narrower scope at delivery?
Canned Head:	Scope usually remains! Had a project where the understanding between the client and the company was uncertain and the company had to use over a year for creating what the company actually wanted. This has not happened afterwards.
Diip:	Always at least the minimum. Sometimes scope changes to a broader one
Researcher:	What is the average quality / customer satisfaction percentage between 0 % and 100 %?
Canned Head:	95 %
Diip:	100 %
Researcher:	Where is most improvement needed from the previous questions?
Canned Head:	Most important is to stay within budget and that the projects are delivered on time
Diip:	Keeping budget needs most improvement, the customers pay (6 months) after the project is finished
Researcher:	Where do you see the company in 10 years? What is the overall goal?
Canned Head:	50 % of growth per year
Diip:	Diip wants to grow and get the processes clear. 300 000 dollars / yearly, after 5 years a 1000 000 / year

TABLE B.5: Interview with Diip's project manager 8.3.2017 Part 1

Person	Question / Answer
<p>Researcher:</p> <p>Diip:</p>	<p>Tell me about the post-production process?</p> <p>First we go for a brief with a client after a request from the client where they explain what they want and we present what we can offer. We take 40 % of project value in advance, 30 % after the project has finished and 30 % after one month of finishing. Sometimes it takes more time to get the payment from the customer. After the project has been agreed with the customer the information goes to the accounting (accounting process follows the same steps always) and also the project manager is informed here. In post-production we use the editing team which tasks are managed, controlled and observed by the project manager. We follow similar post-production pipeline as Dreamworks studios.</p>
<p>Researcher:</p> <p>Diip:</p>	<p>Tell me about the personnel involved in post-production?</p> <p>We have an operations manager who is the founder of the company and also with the widest skill set, his main task is to make sure that all the operations run smoothly. We have a director of post-production who is supposed to be in charge of the post-production process but instead he is mainly working on animation. We have an executive producer who's main tasks are sales, being in contact with the customers and proposals. I am the project manager in charge of overall project success by being in contact with clients and the operative manager, I also manage the teams. Then we have an Illustrator from whom the overall picture about the company comes from. This person is very important for us, a key member. We also have a director who's task is mainly to keep cut the film and make sure the flow is good. We have a junior animator and an animator. Other persons are in administrative being in charge of sales and contact with clients and financial things.</p>
<p>Researcher:</p> <p>Diip:</p>	<p>How do you manage the team and the projects?</p> <p>I use ASANA tool where I create and assign tasks for people. Managing the team is mainly day to day thing as I am all the time in contact with everybody. I set minor goals for tracking the progress of a project.</p>

TABLE B.6: Interview with Diip's project manager 8.3.2017 Part 2

Person	Question / Answer
Researcher:	Are there some problems that come to mind in the project process?
Diip:	Some of the roles are not well defined. The director of post-production can be more focused on animation on example than on the actual task which would be to focus on managing the post-production process. Sometimes the client is too involved with the design and decisions on final design get delayed a lot. Sometimes we do not involve the client and we need to make change in very late in the project to satisfy the customer.

TABLE B.7: Interview with Canned Head's project manager 22.3.2017

Person	Question / Answer
Researcher:	I heard from the management that you started to manage 3 projects, tell me shortly about these projects?
Canned Head:	Actually I manage around 7 projects. But one is currently on its beginning phase as I'm ready to send a mock-up (a web page image showing some of it's main parts) to a customer.
Researcher:	What is your role for these projects and tell about your typical project?
Canned Head:	I have many roles. I manage the projects and I'm also a product owner and I do other tasks demanded by the management. For a project I usually use ASANA to set out tasks but sometimes I do not have time so I delegate tasks face to face. One of the hard parts about a project for me is the time estimations I get from developers which are usually too long and inaccurate. Other problems I face is the overall time management. I can manage my time well but when I get new tasks from the management or when a customer suddenly demands something the days become almost too busy.
Researcher:	How are the teams for each project, how many persons, and what are their roles?
Canned Head:	I have two team members in a usual project and me of course; one in development and one in design, I do other tasks such as being in contact with the client to create the requirements and control the changes asked by the customer. Because I have so many simultaneous projects my schedule is really full.
Researcher:	How long do you expect each project will last?
Canned Head:	A project should last for one month and this is what we call a sprint. Usually this is the time we aim at but regarding on the customer it can last more or even can be finished before deadline. Usually, though, we go over the deadline.

TABLE B.8: Interviews with All Diip Employees 1.4 - 17.4.2017 Part 1

Person	Question / Answer
Researcher:	What are the main improvement elements in projects from your point of view?
Respondent 1:	I think that organization and prioritization are key in project performance, since sometimes projects can not be completed in time because we are starting other projects. I suggest organizing times and defining priorities for the projects better.
Respondent 2:	More feedback among all, and make the team aware of all the projects that are being carried out so that everyone is on the same page.
Respondent 3:	Better communication between the client, executives and the "creative" employees. If ideas were developed between the three, they would be better and better suited to users, times and tools.
Respondent 4:	Improve the calculation of the schedule that is offered to the client in contrast to the available human resources.
Respondent 5:	Problems can be seen in efficiency of time, concentration of employees, pro-activity towards clients needs, constant improvement and constant learning of.
Respondent 6:	We must improve on the tracking of goals and elaboration of schedules, because we do not follow a specific method of project management, then there is no order or steps to follow at the moment when a project starts. Currently it's all very intuitive.
Respondent 7:	Network; we no longer use pen-drives, build a better network for that.

TABLE B.9: Interviews with All Diip Employees 1.4 - 17.4.2017 Part 2

Person	Question / Answer
Researcher:	What are the main successful elements in projects from your point of view?
Respondent 1:	The management supervision and the accompaniment of the directors of the area the efficiency of the team and their willingness to the projects.
Respondent 2:	I think there is a good synergy between all the elements of the team, that is, we get along and that helps to make the work more efficient with better results.
Respondent 3:	A very good quality in terms of the technical knowledge. The people who work here are very good, even though we are few.
Respondent 4:	Excellent communication within the groups and as well the constant professional challenges being faced.
Respondent 5:	Friendly work environment. Cute projects to perform. Positive leadership. Quality.
Respondent 6:	Timely delivery on the date agreed with the customer. Also, we keep the customers involved at all times in the process, which is why the final product is successful because we always went hand in hand with them and we could interpret what was their final desire.
Respondent 7:	The team, everyone is really good in their field.

TABLE B.10: Interviews with All Canned Head Employees 1.4 -
17.4.2017 Part 1

Person	Question / Answer
Researcher:	What are the main improvement elements in projects from your point of view?
Respondent 1:	As for the development of projects, a point to improve can be to better estimate the delivery times, allocate as many tasks as possible when starting a project to estimate the time of each task.
Respondent 2:	Establish all user cases together with the client from the beginning so as not to make last-minute adjustments to customer requests.
Respondent 3:	Better planning.
Respondent 4:	Better scheduling, normally it is hard to get the full content and feedback from the client.
Respondent 5:	Improvement in planning and communication during the project. Many changes are made on the fly and there are very few team meetings. The work will also be more efficient if the teams are constructed better.
Respondent 6:	Lack of personnel, lack of well defined processes.
Respondent 7:	Communication, monitoring and reviewing of projects need improvement.
Respondent 8:	Be clear about the scope of the project and the processes to carry them out.
Respondent 9:	Increase the number of meetings so that the whole team is aware of their tasks for the week and goals to meet in front of the team and the client. Better detail and understanding of the need of the client and work to be done.
Respondent 10:	It is necessary to organize the projects better, to handle the schedule and to conform to the scheduled thing.

TABLE B.11: Interviews with All Canned Head Employees 1.4 - 17.4.2017 Part 2

Person	Question / Answer
Researcher:	What are the main successful elements in projects from your point of view?
Respondent 1:	One of the elements, in my opinion, the most successful has been the commitment of all members, regardless of the area in which they operate, and I also consider that support and unconditional support are always present, in order that everyone, and in my particular case, grow personally and professionally. Another important element is the seriousness and the effort with which each project and each client are always faced, and thus always deliver a quality product.
Respondent 2:	The knowledge that the working group has for effective decision-making when carrying out a project.
Respondent 3:	The communication.
Respondent 4:	The teams are good.
Respondent 5:	The main successes are commitment and teamwork.
Respondent 6:	Commitment, good communication with the client and end product quality.
Respondent 7:	Commitment, teamwork, compliance.
Respondent 8:	The commitment and knowledge of the team.
Respondent 9:	Have a clear and friendly communication with the client from the beginning to the end. That the team takes responsibility for their tasks. (Commitment in times of delivery). Perfectionism. Help in the team. Make the project clear from every point of view. (For each department as: design - development).
Respondent 10:	Teamwork, commitment and coordination

Appendix C

Consent Agreement

Consent Agreement

Name of Researcher: Perttu Villehard Puonti
 Contact Information: perttu@puonti.fi

Purpose of empirical study:

Studying the effects of agile software development methodology implemented in a company where the current methodology is based on traditional methods in order to see whether this brings benefits. The effects are analyzed by using interviews conducted from different individuals inside the company before and after the implementation of new methods.

Procedures:

Some of the main elements in the project management practices will be changed e.g. roles of team members, meeting times and frequencies, and task management procedures. Additionally, the process under study will be examined before the implementation by using tools e.g. flowcharting and value stream mapping.

Participation, risk, and benefit:

Participation is voluntary from the individuals and names of the participants will not be published. There is a risk that the change in project management practices will hurt the success / outcome of the pilot project. No matter what the result of this study is, there are benefits for the company. An outsider's viewpoint brings valuable information on the organizational system's functioning and tells whether it is a good idea to rethink the project management approaches used in the company.

23.3.2017, Bogotá, Colombia
Date and Place

 Perttu Puonti

Appendix D

Questionnaire for Canned Head Studios

29/03/2017

Before Implementation / Antes de la implementación

Before Implementation / Antes de la implementación

The intention of this questionnaire is to find out how the organization views its project management process currently - what is good and what is bad / La intención de este cuestionario es averiguar cómo la organización ve actualmente su proceso de gestión de proyectos: lo que es bueno y lo que es malo

*Required

1. What is your role in the company? Checkmark all the roles you have / ¿Cuál es tu rol en la empresa? Marque todos los roles que tiene *

Tick all that apply.

- ☐ Developer / Desarrollador
- ☐ Designer / Diseñador
- ☐ Project Manager / Manager de proyectos
- ☐ Community manager
- ☐ Writer / Escritor
- ☐ Other: _____

Notes for respondents / Notas para los encuestados

This questionnaire is anonymous / Este cuestionario es anónimo

Read all the questions carefully / Lea todas las preguntas cuidadosamente

Answer truthfully / Responda con sinceridad

Remember that in the scale 5 means perfect with nothing to improve and 1 means imperfect with a lot to improve / Recuerde que en la escala 5 significa perfecto con nada que mejorar y 1 significa imperfecto con mucho que mejorar

This questionnaire tries to find out the performance of projects so when answering think as generally about projects in your company as possible / Este cuestionario trata de averiguar el desempeño de los proyectos en general, cuando responda piense sobre los proyectos de su empresa de la forma más general posible

2. How would you rate the communication between all the participants in projects? / ¿Cómo calificaría la comunicación entre todos los participantes en los proyectos? *

Mark only one oval.

	1	2	3	4	5	
Totally unsatisfactory / Totalmente insatisfactorio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Totally satisfactory / Totalmente satisfactorio

29/03/2017

Before Implementation / Antes de la implementación

3. How would you rate the cooperation between all the participants in projects? / ¿Cómo calificaría la cooperación entre todos los participantes en los proyectos? *

Mark only one oval.

	1	2	3	4	5	
Totally unsatisfactory / Totalmente insatisfactorio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Totally satisfactory / Totalmente satisfactoria

4. Have the project practices improved from project to project? / ¿Las prácticas del proyecto han mejorado de un proyecto a otro? *

Mark only one oval.

	1	2	3	4	5	
Not at all / De ningún modo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Substantially / Sustancialmente

5. Has the efficiency of projects improved from project to project? / ¿Ha mejorado la eficiencia de los proyectos de un proyecto a otro? *

Mark only one oval.

	1	2	3	4	5	
Not at all / De ningún modo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Substantially / Sustancialmente

6. How much is the client involved with the projects? / ¿Qué tanto está involucrado el cliente en los proyectos? *

Mark only one oval.

	1	2	3	4	5	
Barely at all / En absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Substantially / Sustancialmente

7. How well is the quality of the product controlled? / ¿Se controla la calidad del producto? *

Mark only one oval.

	1	2	3	4	5	
Not at all / De ningún modo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Substantially / Sustancialmente

8. How well are the user requirements realized? / ¿Qué tan bien se cumplen los requisitos del usuario? *

Mark only one oval.

	1	2	3	4	5	
Barely / Apenas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Fully / Completamente

29/03/2017

Before Implementation / Antes de la implementación

9. How well are the project teams formed? Is the mixture and amount of team members good? / ¿Qué tan bien están formados los equipos del proyecto? ¿Es buena la mezcla y la cantidad de miembros del equipo? *
- Mark only one oval.

	1	2	3	4	5	
Unsuccessfully / Sin éxito	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully / Exitosamente

10. How well is the team coordinated by the project manager or management? / ¿Qué tan bien está coordinado el equipo por el gerente o director del proyecto? *
- Mark only one oval.

	1	2	3	4	5	
Unsuccessfully / Sin éxito	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully / Exitosamente

11. How well do you understand the tasks given to you? / ¿Qué tan bien entiendes las tareas que te han sido asignadas? *
- Mark only one oval.

	1	2	3	4	5	
Barely / Apenas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Completely / Completamente

12. How would you rate the team commitment? / ¿Cómo calificaría el compromiso del equipo? *
- Mark only one oval.

	1	2	3	4	5	
Not committed at all / No comprometido en absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Fully committed / Totalmente comprometido

13. Do you feel trusted and supported (empowered) in a team? / ¿Sientes apoyo y credibilidad (empoderado) en un equipo? *
- Mark only one oval.

	1	2	3	4	5	
Barely / Apenas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Completely / Completamente

14. How well are projects planned before projects and / or during projects? / ¿Qué tan bien se planifican los proyectos antes de los proyectos y / o durante los proyectos? *
- Mark only one oval.

	1	2	3	4	5	
Barely at all / En absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully / Exitosamente

29/03/2017

Before Implementation / Antes de la implementación

15. How well is the project controlled? How well does the project steer towards the goal? / ¿Qué tan bien se controla el proyecto? ¿Qué tan bien dirige el proyecto hacia la meta? *
- Mark only one oval.

	1	2	3	4	5	
Barely at all / En absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully / Exitosamente

16. How well are the project schedules kept? / ¿Qué tan bien se mantienen los calendarios del proyecto? *
- Mark only one oval.

	1	2	3	4	5	
Barely at all / Apenas en absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully / Exitosamente

17. How competent do you see the project manager(s)? If you are one, rate yourself / ¿Cuán competente ve el (los) gerente (s) del proyecto? Si usted es uno, califíquese usted mismo *
- Mark only one oval.

	1	2	3	4	5	
Not at all competent / Lo mas mínimo competente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Fully competent / Totalmente competente

18. Is the goal of a project usually clear to you? / ¿La meta de un proyecto suele ser clara para usted? *
- Mark only one oval.

	1	2	3	4	5	
Not at all / De ningún modo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Fully / Completamente

19. How would you rate the availability of resources / workers in a project? Are you usually doing more tasks than you can handle or do you have time to finish all tasks on time? / ¿Cómo calificaría la disponibilidad de recursos / trabajadores en un proyecto? ¿Suele hacer más tareas de las que puede manejar o tiene tiempo para terminar todas las tareas a tiempo? *
- Mark only one oval.

	1	2	3	4	5	
Poor availability / Mala disponibilidad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successful availability / Disponibilidad exitosa

20. How do you feel the project is monitored? Do you know how much of the project is left and whether the project is going well or bad? / ¿Cómo siente que el proyecto es monitoreado? ¿Sabe cuánto del proyecto queda y si el proyecto va bien o mal? *
- Mark only one oval.

	1	2	3	4	5	
Unsuccessfully monitored / Monitorizado sin éxito	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Successfully monitored / Monitorizado correctamente

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21. Do think there are enough project progress meetings and whether they are performed well or badly? / ¿Crees que hay suficientes reuniones de progreso del proyecto y si se realizan bien o mal? *

Mark only one oval.

	1	2	3	4	5	
Barely any meetings / Casi ninguna reunión	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sufficient and successful / Suficiente y exitoso

22. Are project review meetings held, where you can give feedback, and are they performed well or badly? / ¿Se llevan a cabo reuniones de revisión de proyectos donde se puede dar retroalimentación? Se realizan bien o mal? *

Mark only one oval.

	1	2	3	4	5	
No project review meetings / No hay reuniones de revisión del proyecto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Sufficient and successful / Suficiente y exitoso

23. Are you aware whether some project management methodology is followed in projects? / ¿Sabe si se sigue alguna metodología de gestión de proyectos? *

Mark only one oval.

	1	2	3	4	5	
I believe none is followed / Creo que no se sigue ninguno	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Some methodology is followed successfully / Algún método se sigue con éxito

24. How clear are your responsibilities and accountability? / ¿Cuán claras son sus responsabilidades y su responsabilidad? *

Mark only one oval.

	1	2	3	4	5	
Not clear at all / No está claro en absoluto	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Totally clear / Totalmente claro

25. What are the main improvement elements in projects from your point of view? / ¿Cuáles son los principales elementos de mejora de los proyectos desde su punto de vista? *

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26. What are the main successful elements in projects from your point of view? / ¿Cuáles son los principales elementos exitosos en los proyectos desde su punto de vista? *

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Appendix E

R Code

```
# Clear console

cat("\setminus014")

# Combine data to usable values

x <- c(Canned)
y <- c(Diip)

# ks.test for all Canned Head Questionnaire answers

ks.test(x$`Question 1`, pnorm)
ks.test(x$`Question 2`, pnorm)
ks.test(x$`Question 3`, pnorm)
ks.test(x$`Question 4`, pnorm)
ks.test(x$`Question 5`, pnorm)
ks.test(x$`Question 6`, pnorm)
ks.test(x$`Question 7`, pnorm)
ks.test(x$`Question 8`, pnorm)
ks.test(x$`Question 9`, pnorm)
ks.test(x$`Question 10`, pnorm)
ks.test(x$`Question 11`, pnorm)
ks.test(x$`Question 12`, pnorm)
ks.test(x$`Question 13`, pnorm)
ks.test(x$`Question 14`, pnorm)
ks.test(x$`Question 15`, pnorm)
ks.test(x$`Question 16`, pnorm)
ks.test(x$`Question 17`, pnorm)
ks.test(x$`Question 18`, pnorm)
ks.test(x$`Question 19`, pnorm)
ks.test(x$`Question 20`, pnorm)
ks.test(x$`Question 21`, pnorm)
ks.test(x$`Question 22`, pnorm)
ks.test(x$`Question 23`, pnorm)

# ks.test for all Diip Questionnaire answers
```

```
ks.test(y$`Question 1`, pnorm)
ks.test(y$`Question 2`, pnorm)
ks.test(y$`Question 3`, pnorm)
ks.test(y$`Question 4`, pnorm)
ks.test(y$`Question 5`, pnorm)
ks.test(y$`Question 6`, pnorm)
ks.test(y$`Question 7`, pnorm)
ks.test(y$`Question 8`, pnorm)
ks.test(y$`Question 9`, pnorm)
ks.test(y$`Question 10`, pnorm)
ks.test(y$`Question 11`, pnorm)
ks.test(y$`Question 12`, pnorm)
ks.test(y$`Question 13`, pnorm)
ks.test(y$`Question 14`, pnorm)
ks.test(y$`Question 15`, pnorm)
ks.test(y$`Question 16`, pnorm)
ks.test(y$`Question 17`, pnorm)
ks.test(y$`Question 18`, pnorm)
ks.test(y$`Question 19`, pnorm)
ks.test(y$`Question 20`, pnorm)
ks.test(y$`Question 21`, pnorm)
ks.test(y$`Question 22`, pnorm)
ks.test(y$`Question 23`, pnorm)

# shapiro.test for all Canned Questionnaire answers
#(only Question 15 p>0.5)

shapiro.test(x$`Question 1`)
shapiro.test(x$`Question 2`)
shapiro.test(x$`Question 3`)
shapiro.test(x$`Question 4`)
shapiro.test(x$`Question 5`)
shapiro.test(x$`Question 6`)
shapiro.test(x$`Question 7`)
shapiro.test(x$`Question 8`)
shapiro.test(x$`Question 9`)
shapiro.test(x$`Question 10`)
shapiro.test(x$`Question 11`)
shapiro.test(x$`Question 12`)
shapiro.test(x$`Question 13`)
shapiro.test(x$`Question 14`)
shapiro.test(x$`Question 15`)
shapiro.test(x$`Question 16`)
shapiro.test(x$`Question 17`)
shapiro.test(x$`Question 18`)
shapiro.test(x$`Question 19`)
shapiro.test(x$`Question 20`)
shapiro.test(x$`Question 21`)
shapiro.test(x$`Question 22`)
shapiro.test(x$`Question 23`)
```



```
# shapiro.test for all Diip Questionnaire answers

shapiro.test(y$`Question 1`)
shapiro.test(y$`Question 2`)
shapiro.test(y$`Question 3`)
shapiro.test(y$`Question 4`)
shapiro.test(y$`Question 5`)
shapiro.test(y$`Question 6`)
shapiro.test(y$`Question 7`)
shapiro.test(y$`Question 8`)
shapiro.test(y$`Question 9`)
shapiro.test(y$`Question 10`)
shapiro.test(y$`Question 11`)
shapiro.test(y$`Question 12`)
shapiro.test(y$`Question 13`)
shapiro.test(y$`Question 14`)
shapiro.test(y$`Question 15`)
shapiro.test(y$`Question 16`)
shapiro.test(y$`Question 17`)
shapiro.test(y$`Question 18`)
shapiro.test(y$`Question 19`)
shapiro.test(y$`Question 20`)
shapiro.test(y$`Question 21`)
shapiro.test(y$`Question 22`)
shapiro.test(y$`Question 23`)

# wilcox.test comparing Canned Head and Diip Questionnaire
# answers (Canned Head Question 15 was the only
# one with p value over 0.5 from shapiro.test but Diip had none.
# For Levene's test comparing Diip and
# Canned Head answers requires both p values to be over 0.5.
# Hence they weren't, only wilcox.test - equivalent
# to the Mann-Whitney test - is done.)

wilcox.test(x$`Question 1`, y$`Question 1`)
wilcox.test(x$`Question 2`, y$`Question 2`)
wilcox.test(x$`Question 3`, y$`Question 3`)
wilcox.test(x$`Question 4`, y$`Question 4`)
wilcox.test(x$`Question 5`, y$`Question 5`)
wilcox.test(x$`Question 6`, y$`Question 6`)
wilcox.test(x$`Question 7`, y$`Question 7`)
wilcox.test(x$`Question 8`, y$`Question 8`)
wilcox.test(x$`Question 9`, y$`Question 9`)
wilcox.test(x$`Question 10`, y$`Question 10`)
wilcox.test(x$`Question 11`, y$`Question 11`)
wilcox.test(x$`Question 12`, y$`Question 12`)
wilcox.test(x$`Question 13`, y$`Question 13`)
wilcox.test(x$`Question 14`, y$`Question 14`)
wilcox.test(x$`Question 15`, y$`Question 15`)
wilcox.test(x$`Question 16`, y$`Question 16`)
wilcox.test(x$`Question 17`, y$`Question 17`)
```

```
wilcox.test(x$`Question 18`, y$`Question 18`)  
wilcox.test(x$`Question 19`, y$`Question 19`)  
wilcox.test(x$`Question 20`, y$`Question 20`)  
wilcox.test(x$`Question 21`, y$`Question 21`)  
wilcox.test(x$`Question 22`, y$`Question 22`)  
wilcox.test(x$`Question 23`, y$`Question 23`)  
  
# Box plot of Questionnaire answers from Canned and Diip  
  
boxplot(x)  
boxplot(y)
```

Appendix F

Tools and Practices from Scrum and Lean Listed with Sources

TABLE F.1: Lean Software Development tools from book 'Lean Software Development: An Agile Toolkit' (Poppendieck and Poppendieck, 2003)

Tool Name	Page Number
Continuous Improvement	136-140
Value Stream Mapping (VSM)	22-27
Kanban	76-81
Just-in-Time (JIT)	65-67
5S	18-22

TABLE F.2: Scrum practices from book 'A Guide to the Scrum Body of Knowledge (SCRUMstudy, 2016)

Practice Name	Page Number
Scrum Core Team	41, 103
Product Owner	41, 43-45, 300
Scrum Master	41, 45-47, 309
Scrum Team	156, 309
Sprint	33, 36-37, 178, 295, 310
Sprint Planning	34, 208, 311
Daily Scrum (Daily Stand-up Meeting)	223-224, 286, 289
Sprint Review	34, 247, 311
Sprint Retrospect	236, 249-253
Product Backlog	111, 266, 300
Prioritized Product Backlog	86, 90, 100, 110-111, 167-173, 190, 300
Sprint Backlog	205-209, 311
Release Planning Schedule	174-179, 304
Scrum Culture	22-23

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