Transferring the benefits of Agile project management using Scrum to a firm-fixed-price context: A study of German software development projects

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Academic declaration

Doctor of Business Administration: Portsmouth Business School.

"Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this research are the work of the named candidate and have not been submitted for any other academic award."

Daniel Georges

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This work is dedicated to
my beloved father, Dieter Georges,
who encouraged me always to aim high and
who passed away during my academic endeavours.

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I am very grateful for the extensive support of different people who have accompanied me on this formative journey. First and foremost, I would like to thank my wife Laurence, my three children and my whole family for the sacrifices they have made over the last five years. None of this would have been possible without your support. Thank you!

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Finally, I would like to thank my fellow students, who turned into friends.

Daniel Georges
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Glossary

APM	Agile Project Management
DBA	Doctor of Business Administration
CPD	Continuing Professional Development
CPM	Critical Path Method
CTO	Chief Technology Officer
DoD	Department of Defence
DSDM	Dynamic Systems Development Method
EVM	Earned Value Method
FDD	Feature Driven Development
FFP	Firm-Fixed-Price
GCI	Global Competencies Inventory
IT	Information Technology
MVP	Minimal Viable Product
PERT	Programme Evaluation and Review Technique
PhD	Doctor of Philosophy
PMO	Project Management Office
ROI	Return on Investment
SWOT	Strengths, Weaknesses, Opportunities and Threats
TPM	Traditional Project Management
TPS	Toyota Production System
WBS	Work Breakdown Structure
XP	eXtreme Programming

Abstract

This research explores whether Agile project management, using the Scrum process framework, is perceived to be effective and efficient in the context of firm-fixed-price[1] software development projects and, if the perception is positive, to understand why and how Agile project management is perceived to be beneficial within a firm-fixed-price context. To clarify this, the following research question is to be answered.:

How can applying the Agile practices, values and principles of 'communication, collaboration and short feedback cycles' used in the Scrum process framework help project stakeholders to increase perceived effectiveness and efficiency in the context of firm-fixed-price software development projects?

This research further explores if and how the Agile Scrum framework has to be modified in order to make it beneficial in firm-fixed-price contexts.

Over the past few decades, Agile project management has proven to be a success factor in complex and dynamic software projects (The Standish Group, 2015; Tomanek, Cermak, & Smutny, 2014, p.550; Vlaanderen, Jansen, Brinkkemper, & Jaspers, 2011; Wilson, 2012) as it meets the customer needs of shorter time to market and higher flexibility of continuously changing business requirements. While Agile approaches often come with time and material contracts, firm-fixed-price contracts are quite common for software development projects. Firm-fixed-price projects are especially requested in public tenders or at large companies in order to reduce financial risk for the customer and to ensure that projects are chosen with the highest return on investment (Ambler, 2008a; Gaebert, 2014a). However, applying an adaptive Agile process to a firm-fixed-price contract exposes the supplier to a substantial financial risk (Fowler, 2001, p.16), which is why this has been avoided so far. Nevertheless, there is a demand among Agile practitioners to use Agile approaches within a firm-fixed-price context because of the expected benefits. Yet, still no substantial academic research has been undertaken so far in this research field. This thesis has now addressed these demands, using Scrum as an Agile representative, as it is considered to be the most widely adopted Agile method worldwide (Hoda, Noble & Marshall, 2011, p.522) and provides a well-defined process framework.

[1] Fixed price, fixed scope, and fixed schedule (Dwivedi et al., 2013, p.76; Jørgensen, 2016, p.5)

The chosen research philosophy for this research is an interpretative one, as it suits well the exploratory and subjective nature of the research field. To answer the research question, an abductive approach was used with induction as the predominant approach. This resulted in a multimethod sequential qualitative approach with thirteen semi-structured interviews with Agile experts from Germany as the data gathering method for the first phase. In the second phase, the identified themes and patterns from the interviews were then discussed and validated in two guided focus groups, including eleven Agile experts in the first group and four Agile experts in the second group. The whole study was conducted in a cross-sectional time horizon to get a status quo in the researched field.

The findings highlight that applying Agile practices, values and principles for 'communication, collaboration and short feedback cycles', using the Scrum process framework, to FFP projects

a) is perceived to be beneficial (seven benefits have been identified),
b) is perceived to increase the effectiveness (four measures of effectiveness have been identified) and the efficiency (four measures of efficiency have been identified) of projects,
c) increases the likelihood of meeting stakeholders' expectations within the project constraints, i.e. to be successful (see Chapter 1),
d) needs modifications to mitigate these associated challenges (seven modifications have been identified to mitigate six challenges).

As a result, the major contribution of this research to theory is a theoretical model which depicts these benefits and challenges and their impact on effectiveness and efficiency, including recommended modifications to mitigate the identified challenges. As a contribution to practice, the Scrum process framework has been adapted to fit in the context of German FFP contracts to increase the perceived effectiveness and efficiency of these projects. In addition, important points for clients' obligations have been derived based on the modifications, which might serve as a checklist for practitioners.

Keywords: Agile project management, Scrum, firm-fixed-price contract, theoretical model, extended modified Scrum framework

1 Introduction

This research explores whether Agile Project Management (APM), using the Scrum process framework, is perceived to be effective[2] and efficient[3] in the context of firm-fixed-price[4] (FFP) software development projects and, if the perception is positive, to understand why and how APM is perceived to be beneficial within an FFP context. In terms of this research FFP means that a predefined fixed scope is delivered on a fixed schedule for a firm-fixed-price, on which the supplier and the customer have agreed in a contract based on German law. The supplier is paid when the customer has accepted what has been delivered by the supplier.

Over the past few decades, information technology (IT) has become crucial for every business branch to support or run core business processes. For example, enterprise resource planning (ERP) software such as SAP is a de facto standard in today's business world for the integrated management of customers and suppliers. Yet, more often, the standard software does not fit every business process (Xin & Levina, 2008, p.6) and must therefore be customised or parts of it must be individually developed. As today's core business processes rely heavily on software, its availability and correct working are vital for the business success of a company (Kaur & Sengupta, 2013, p.1). Thus, the success of software development projects that deliver this software are vital for the business success of a company.

This chapter addresses why the majority of software development projects still fail (Gaebert, 2014c, p.97; Gartner, 2012; Kaur & Sengupta, 2013, p.3; The Standish Group, 2015; Wateridge, 1995, p.169; Williams, 2005, p.497), why traditional project management (TPM) has been predominantly used to conduct software development projects so far and why TPM hardly addresses these projects' issues properly (Papadopoulos, 2015; Serrador & Pinto, 2015). It further shows how APM is designed to address these project challenges. The chapter then clarifies why the FFP contract type is mostly demanded by the customer, mainly using TPM and not APM, which presupposes a time and material (T&M) contract (Franklin, 2008, p.270). This leads finally to the research gap, the research question(s) and the scope of this research.

[2] Effectiveness is often referred to as *"doing the right thing"* (Drucker, 1973, p.36; DeMarco, 2002, p.122)
[3] Efficiency is often referred to as *"doing things right"* (Drucker, 1973, p.36), which means doing something *"with minimum waste"* DeMarco (2002, p.122)
[4] Fixed scope, fixed price, fixed schedule. Often called iron triangle, as a change in one dimension affects the other two. (Dwivedi et al., 2013, p.76; Jørgensen, 2016, p.5)

1.1 Reasons for software project failures

Over the past few decades, the number of software development projects that have failed[5] or were challenged[6] has remained high, although there have been many improvements in project management and software development processes (Dwivedi et al., 2015, p.11; Gaebert, 2014c, p.97; Gartner, 2012; Hughes, Rana, & Simintiras, 2017, p.142; Kaur & Sengupta, 2013, p.3; The Standish Group, 2015; Wateridge, 1995, p.169; Williams, 2005, p.497). These failed projects destroyed value in terms of money and business opportunities (Flyvbjerg & Budzier, 2011, p.23; Kaur & Sengupta, 2013, p.3). Flyvbjerg and Budzier (2011, p.23) demonstrate how the U.S. company Lewis underestimated the impact of a $5 million IT project on its business. During the launch phase, Lewis was unable to fulfil its orders, with the result that three distribution centres had to close for a week, resulting in nearly $193 million in extra costs. A more recent example from the public sector mentioned in their paper is the German toll collection system to tax heavyweight trucks. The development of the system started in September 2002. Because of the complexity of the system, the developers were not able to integrate different software systems, which led to project delays[7] and cost overruns, which resulted in an estimated $10 billion in lost revenue for the German government. The dispute between the German government and the supplier consortium was not resolved until the end of 2018. According to Flyvbjerg and Budzier (2011, p.24), one in six of the IT projects from their sample caused a cost overrun of 200%, and this impact could be the end of some small and medium enterprises. Thus, IT project success might have a huge impact on a company's future.

The CHAOS reports from the Standish Group, which have been published every year since 1994, give an overview of the state of software development projects. The 2015 report contains the evaluation from about 50,000 projects around the world (The Standish Group, 2015, p.13), and shows that for the last 20 years only around 30% of software development projects can be labelled as successful. In former Standish reports, project success was defined by being on time, on budget and on target. On target or often called on scope means that the project implemented all features and functions as initially specified. These project constraints 'fixed

[5] The project has been cancelled at some point during the project cycle.
[6] The project has been completed and is operational but over-budget, over the time estimate, and offers fewer features and functions than originally specified.
[7] The launch was planned for August 2003, but due to the problems finally launched in January 2005.

schedule, fixed price and fixed scope' are often called 'the iron triangle', as a change in one dimension affects the other two (Dwivedi et al., 2013, p.76; Jørgensen, 2016, p.5) and are taken to measure project success (Mishra, Dangayach, & Mittal, 2011, p. 357). However, recent studies (e.g. Serrador & Pinto, 2015, p.1043) show that meeting stakeholder expectations has become more and more important nowadays, as the IT business context is changing steadily in fast-moving markets. Therefore, a project might still be declared a failure if it has been delivered on time, on budget and within a predefined scope, but does not meet stakeholder expectations. This view is emphasised by Davis (2014, p.198) who shows in her longitudinal literature review that the success criteria have changed from a more technical view in the 1970s, i.e. on time, on budget and within scope, to a more stakeholder-focussed approach to project success in the present, including stakeholder expectations. Consequently, the Standish report 2015 extended their definition of success to *"on time, on budget, on target, value and satisfaction"* (p.1), which acknowledges that achieving business value and stakeholder satisfaction is much more important than implementing the initial defined scope. Therefore, the term project success for software development for this study is defined as staying inside the iron triangle, plus meeting stakeholder expectations. This definition of project success is depicted in Figure 1.

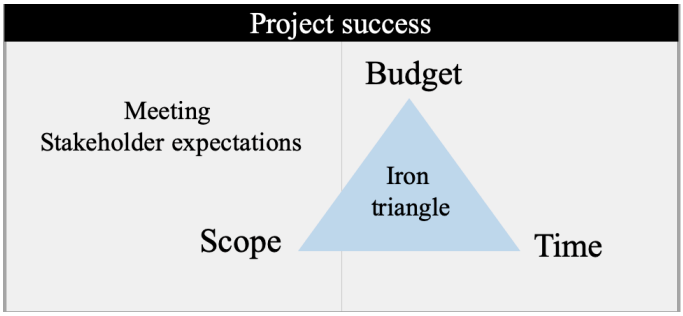


Figure 1: Definition of project success in software development projects; Source: The author

As the definition of project success has changed to a more stakeholder-focussed approach, the failure rate of IT projects in former reports might be even higher if evaluated by the criteria above, i.e. if the delivered product does not deliver business value or meet the stakeholder expectations.

Table 1 depicts all software development project outcomes for the last 20 years world-wide.

Year	Successful (%)	Challenged (%)	Failed (%)
1994	16	53	31
1996	27	33	40
1998	26	46	28
2000	28	49	23
2004	29	53	18
2006	35	46	19
2008	32	44	24
2010	37	42	21
2011	29	49	22
2012	27	56	17
2013	31	50	19
2014	28	55	17
2015	29	52	19

Table 1: Merged view on software development projects on time, on budget and with a satisfactory result, based on data provided by the Standish Group CHAOS reports 2009, p.1 & 2015, p.2.

Based on the results of the Standish report, Clancy (2014) states clearly the main reasons why projects have failed or have been challenged, namely *"incomplete requirements"*, *"the lack of user involvement"* and *"changing requirements"* (p.9). Moløkken-Østvold and Furulund (2007) identify similar reasons for project overruns: *"frequent requirement changes and new requirements"*, *"lack of well-defined requirements"* and *"lack of competent customers able to make decisions"* (p.2). Other empirical studies have also identified *"incomplete, ambiguous and changing requirements"* (p.98) as the main reasons for project failure (Gaebert, 2014c). Accordingly, the top three factors for successful projects are *"user involvement"*, *"executive management support"* and *"clear statement of requirements"* (Clancy, 2014, p.8). This means that a clear statement of requirements and/or user involvement to clarify these requirements are critical factors for project success or failure.

Based on the results of a literature review and a survey, Gaebert (2014a, p.540) finds that it is impossible to predict or clearly describe every requirement up front. She concludes that there is always a certain level of complexity and uncertainty in every project, which might lead to

project failures. These findings are supported by earlier research from Williams (2005, p.502), who emphasises that project failure can be categorised along two dimensions, namely complexity and uncertainty of requirements. Therefore, the reasons why requirements are incomplete are system inherent. The specified requirements are based on knowledge from the past or the present, but there can only be assumptions about the future, without the knowledge as to how the situation will change (Gaebert, 2014a, p.540). In addition, customers often presuppose a certain domain knowledge which is therefore not specified (Gaebert, 2014a, p.541), while the supplier is not aware of this fact. Finally, even when a requirement is well-defined, there might still be different interpretations as to how a requirement should be implemented.

To close requirement gaps, to reduce uncertainty and to react to external project influences, close communication and collaboration with the customers is frequently supposed (Gaebert, 2014c, p.110). Regular meetings and discussion with the customers will help the development team to understand the business domain and to clarify business requirements. The importance of communication is supported by several studies which emphasise that communication is a critical success factor in project management (Cockburn, 2006; Holzmann & Panizel, 2013, p.67; Mishra, Mishra & Ostrovska, 2012, p.1068). According to Wysocki (2011, p.73), communication is a critical success factor and can be found in seven of the ten top reasons why projects succeed. Therefore, a less formal but more customer-centric project management approach such as in APM, based on regular communication and collaboration with the customer, has been suggested to help to align the requirements with the business needs, and meet stakeholder expectations. How this works exactly is further described in Chapter 2.

1.2 Traditional project management for software development projects

One well-known project management approach is the traditional plan-based approach (TPM). This approach is always aligned to formal project plans. The history of TPM goes back to the 1950s when the US Department of Defence (DoD) introduced modern project management tools and techniques during the Cold War. The standardisation of project management arose from the need to meet tight deadlines and budgets and to coordinate a huge number of suppliers in large DoD projects (Garel, 2013). Several well-known techniques in project management were introduced by the DoD (Sone, 2008, p.5). These included the Critical Path Method (CPM) and the Programme Evaluation and Review Technique (PERT) to manage activity completion, the Work Breakdown Structures method (WBS) for managing tasks and the Earned Value Management method (EVM) to measure and control the project performance based on cost and schedule.

TPM suggests a linear way of executing projects. Its methods are often organised into different sequential phases such as initiation or analysis, planning, execution, control, and closure or acceptance. They comprise a step-by-step approach, detailed processes and techniques, formal project plans, comprehensive documentation such as customer requirements, detailed product designs and technical documentation, and rigorous testing at the end (DeCarlo, 2004, p.6). The term ‘waterfall approach’ is also frequently used for TPM, as one project phase leads to another, just as water cascades down a waterfall. Once a phase has been accomplished, the next phase can be initiated. A return to a previous phase is not intended. Therefore, every project conducted with TPM must be predictable and every necessary detail must be clear up front as this is the base for the project plan (DeCarlo, 2004, p. 6).

As TPM assumes that business needs can be fully and clearly specified, documented and planned up front, an FFP can be calculated before project execution, and no further communication or customer involvement is necessary until the planned contract objective is delivered (Gaebert, 2014c, p.99). The customer is mainly involved in the initiation and acceptance phase in this formal process. As everything is clear up front, little or no communication is needed during the other phases. Because of the amount of upfront documentation, TPM is often called a *“heavyweight”* method (Cline, 2015, p.xxiii), as a lot of work in terms of time and money is invested in the beginning. Consequently, it seems clear that if the specification or a part of the plan changes, a huge part of the initial investment is

lost. Changes are not intended by TPM; everything can be planned, executed and measured in the most efficient way. For example, the IT infrastructure for production might be ordered, paid for and set up right after the testing phase has been successfully finished and not earlier, which saves operating costs. Thus, the focus in TPM is on planning the project in the most efficient way.

TPM was originally invented for engineering projects and was later also applied to software development projects. According to DeCarlo (2004), TPM *"works well under conditions of relatively low speed and low uncertainty"* (p.6) and is therefore well suited *"for traditional construction and engineering projects and others that have a well-defined, concrete goal and a proven path to get there."* (p.6). Gupta and Dwivedi (2015, p.137) confirm that plan-based approaches work well if requirements are static. For frequently changing requirements these approaches are considered too slow and insensitive. Therefore, this approach is unlikely to be suitable for software development projects, where most projects are unique and are heavily influenced by external market impulses. Sone (2008, p.9) concludes that in terms of today's highly dynamic software development projects, TPM may only add cost and complexity and may provide a false sense of security as something that is unpredictable should be controlled and forecasted. This has also been confirmed in recent research (Gaebert, 2014c, p.99).

The failures of these traditional, heavyweight or plan-based software development projects are legion. The percentage of failures in such traditional IT projects remained high and relatively stable across the last two decades of research (Gaebert, 2014c, p.97; Gartner, 2012; Kaur & Sengupta, 2013, p.3; The Standish Group, 2015; Wateridge, 1995, p.169; Williams, 2005, p.497), especially regarding speed and quality (Forrester Report, 2005; The Standish Group, 2009). These failed projects destroyed value and have led to a lack of trust between customers and suppliers. Because of that, customers want to reduce their risk through FFP projects as they can refuse the payment at the end if the delivered product does not meet their expectations. The huge number of IT project failures is the reason why organisations have looked for other ways of developing products as TPM approaches, especially the traditional waterfall model, turned out to be inappropriate for complex, dynamic software projects (DeCarlo, 2004, p. 6; The Standish Group, 2009; Wilson, 2012). Despite a number of success stories, traditional plan-based projects suffer, to different degrees, from scope creep, long time-to-market, high costs, inadequate quality and functionality, overengineered solutions and high

management overhead (Bernier, Dubé, & Roy, 2012, p.30; Lindvall et al., 2002; Santos, Flentge, Begin, & Navarro, 2011). But these are only the effects caused by the root problem of plan-based approaches being unable to react to changing external and internal requirements. Therefore, Koskela and Howell (2002a, p.2) conclude that the underlying assumption of TPM is obsolete for IT projects, and they propose that project management now has to focus on value generation and the optimisation of the process flow.

1.3 Reasons for using Agile project management

Over the past decade, APM has proven to be a success factor in complex and dynamic software projects (The Standish Group, 2015; Tomanek, Cermak, & Smutny, 2014, p.550; Vlaanderen, Jansen, Brinkkemper, & Jaspers, 2011; Wilson, 2012). APM defines practices, values and principles for communication and collaboration with rapid feedback cycles to reduce uncertainty in complex projects and to react to upcoming changes in requirements. These core values and principles are stated in the Agile manifesto (Beck et al., 2001) and are valid for all underlying Agile methodologies. These include eXtreme Programming (XP), Scrum, Dynamic Systems Development Method (DSDM) and Feature Driven Development (FDD) (Lee & Xia, 2010).

While the Agile values are rather abstract, the principles more precisely describe their intention. The Agile practices provide specific practical implementation. For example, one of the four core values, is, according to Fowler and Highsmith (2001), *"Customer collaboration over contract negotiation*" (p.2), which means that customer collaboration is seen to be more valuable than contract negotiation. A specific principle from the Agile manifesto, which promotes customer collaboration, is that *"Businesspeople and developers work together daily throughout the project."* (p.3). An Agile practice from Scrum that implements this would be the daily stand-up meeting. In such a meeting the Scrum team comes together to discuss what they have achieved since yesterday's stand-up meeting, what prevented them from working on their tasks and what they plan to do until the next stand-up meeting.

In contrast to TPM, APM assumes that not every problem and solution is clear at the beginning of a project, and therefore cannot be described clearly and completely in an upfront specification (Gaebert 2014c, p.99). Thus, APM expects and embraces changes to the requirements even late in a project, as requirements will emerge during the project lifetime and

APM provides appropriate practices to handle these. Customer involvement is one of the crucial aspects in APM to close those requirement gaps and to meet their expectations. The customer takes part in the team and has full visibility of what the team does (Fowler & Highsmith, 2001, p.3). APM is effective in meeting the customer needs of shorter time-to-market and high flexibility to adapt to continuously changing business requirements. This capability to adapt to changing business requirements is achieved by focussing on and continuously re-evaluating business value through intensive communication and collaboration within short feedback cycles among the project stakeholders. The short feedback cycles are used to continuously synchronise the current project progress with the business needs. As a result, APM focusses on requirements which provide the highest business value at the first moment, as it cannot be determined if less important features will remain necessary in the future, thereby creating more value in the beginning (Pichler, 2010, p.112). That means, for example, that implementing 50 percent of the project features might result in having implemented 80 percent of the expected business value, which might already be enough to meet stakeholder expectations, which is very effective and efficient. Furthermore, Agile provides the possibility to deliver already implemented features in small and frequent releases, which can be used immediately by the end users. These releases are also used to get feedback from the users, which steers subsequent releases. As users can use parts of the application earlier, this leads to an earlier return on investment (ROI) as well as faster time-to-market possibilities (Pichler, 2010, p.30). However, this flexibility in delivery also needs flexibility in terms of billing. To support this flexibility, Agile projects must be conducted under time and material (T&M) contracts (Franklin, 2008, p.272).

The CHAOS report (Hastie & Wojewoda, 2015, p.1) shows that all sizes of projects conducted with APM are more likely to be successful than projects conducted with TPM, as they are more likely to meet stakeholder expectations. Therefore, APM is chosen as the preferred project management approach for many projects nowadays (Duka, 2012, p.692; McAvoy & Butler, 2009, p.372; Stare, 2014, p.296).

The project success rate of the different approaches, with Agile having lower rate of fail and higher rate of success in every category, is depicted in Table 2.

Size	Method	Successful (%)	Challenged (%)	Failed (%)
All Size Projects	Agile	39	52	9
	Waterfall	11	60	29
Large Size Projects	Agile	18	59	23
	Waterfall	3	55	42
Medium Size Projects	Agile	27	62	11
	Waterfall	7	68	25
Small Size Projects	Agile	58	38	4
	Waterfall	44	45	11

Table 2: The resolution of all sizes of software projects from 2011-2015 (Hastie & Wojewoda, 2015, p.1)

1.4 Reasons for firm-fixed-price projects in the industry

Even if TPM projects are less likely to be successful, this approach is regularly taken because, for several reasons, customers demand an FFP, which better fits the TPM approach. FFP projects are quite common for new individual software development projects (Franklin, 2008, p.269) and are especially requested for public tenders or by large companies in order to reduce customers' financial risk, which is transferred to the supplier, and to ensure that projects are chosen with the highest ROI (Ambler, 2008a). Furthermore, the customer may demand a fixed-price contract to choose the cheapest supplier, i.e. the one with the lowest bid. These FFP projects also have fixed scope and fixed date requirements, building the iron triangle (Dwivedi et al., 2013, p.76; Jørgensen, 2016, p.5), which is the basis of the contract. Furthermore, an FFP contract is often required by the customer's legal department. Moreover, the iron triangle is often used to measure project success and efficiency (Mishra, Dangayach, & Mittal, 2011, p. 357) as it consists of fixed cost, fixed time and fixed scope/quality (Weaver, 2007, p.4). Reducing the measurement of project success to the iron triangle limits the subjectivity that is inherent in software development projects (Agarwal & Rathod, 2006, p.359) and is therefore often used as an objective measurement for contract fulfilment.

1.5 Research gap

The iron triangle of FFP projects contradicts the APM idea of emerging and changing business requirements (Hoda, Noble, & Mashall, 2009, p.188; Lindsjørn & Moustafa, 2018, p.1), as the scope of the project must be explained in detail up front (Dvir & Lechler, 2004, p.26), which is viewed as impossible in complex and dynamic projects (Gaebert, 2014c, p.99). As a result, conducting FFP projects with APM methods is nascent as FFP projects require a different project approach than APM requires (Fowler, 2001, p.16; Schwaber, 2004, pp.147-149). Therefore, little research has been conducted in this field. Fowler, one of the authors of the Agile manifesto, stresses that *"trying to fit a fixed-price model to an adaptive process ends up in a very painful explosion"* (Fowler, 2001, p.6). He emphasises that discussions will certainly arise as to what extent functionality is covered by the contract and to what extent it is not. This discussion has to be led by always bearing in mind that the upfront price estimation is likely to be obsolete, while the financial risk is fully on the supplier's side. Therefore, FFP projects have been largely avoided in the APM literature. Even Agile evangelists such as Ken Schwaber confirm that there are no simple recipes for handling such projects without reverting to traditional heavyweight project management methodologies (Schwaber, 2004).

Nonetheless, there is a common interest in the practitioner community in using APM in FFP projects (Balaji, 2013, p.248), as Agile approaches promise higher stakeholder satisfaction, which leads to higher rates of project success (The Standish Group, 2015), while fulfilling the client's demand for FFP contracts. Consequently, this research deals with the question of how Agile techniques of APM can be successfully applied to FFP projects.

The author of this thesis has twenty years of professional experience in TPM and Agile software development projects, of which ten years were as Agile project lead and in senior management. Based on this experience and several practitioner reports (e.g. Balaji, 2013; Franklin, 2008), applying Agile techniques, i.e. Agile practices, principles and values, to FFP projects can still be beneficial in certain project environments. As Scrum is considered to be the most widely adopted Agile method worldwide (Hoda, Noble, & Marshall, 2011, p.522) and as it has a well-defined process framework, the Scrum process framework has been chosen as a basis for this research.

1.6 Research question and objectives

Based on the area of conflict that FFP projects are demanded from several customers, but APM promises higher stakeholder satisfaction as it is supposed to increase the effectiveness and efficiency in these projects, the central research question for this study is:

How can applying the Agile practices, values and principles of 'communication, collaboration and short feedback cycles' used in the Scrum process framework help project stakeholders to increase perceived effectiveness and efficiency in the context of firm-fixed-price software development projects?

In order to answer the research question, the following three research sub-questions (SRQ) were posed:

SRQ1: What are the perceived benefits of applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' to firm-fixed-price projects and how do they increase perceived effectiveness and efficiency?

SRQ2: What challenges are perceived to arise when applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' without any modifications within a firm-fixed-price context and how do they decrease perceived effectiveness and efficiency?

SRQ3: What modifications are perceived to be necessary to be implemented within the Scrum process framework to mitigate the conflict between these two approaches and to increase perceived effectiveness and efficiency?

As a result of this study, a theoretical model with benefits and challenges and their impact on effectiveness and efficiency should be devised, which contributes to theory. Therefore, the three research sub-questions were mapped into a theoretical model to answer the overall research question.

The theoretical model is structured as follows:

Applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' to firm-fixed-price projects:

1. is perceived to be beneficial, as it increases the perceived effectiveness and efficiency
2. without modifications is perceived to be challenging, as it decreases the perceived effectiveness and efficiency
3. with recommended modifications is perceived to mitigate the challenges
4. with recommended modifications is perceived to lead to higher project success (impact on project success not tested in this thesis), as the overall perceived effectiveness and efficiency is increased and is therefore more likely to meet stakeholder expectations within the iron triangle

This theoretical model is depicted in Figure 2.

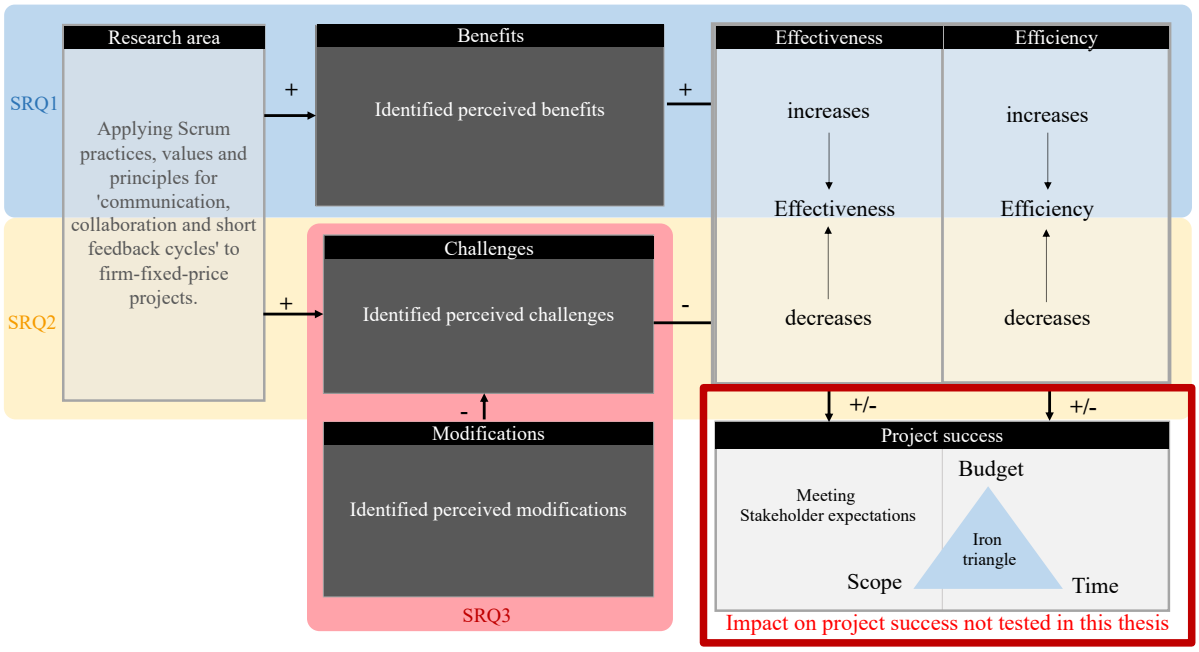


Figure 2: Sub research questions depicted in a theoretical model; Source: The author

As output from this theoretical model and as a contribution to practice, an adapted Scrum process framework for reaping the benefits of APM with Scrum in FFP projects should be devised, which helps to enhance professional practice.

1.7 Research scope

As stated in Section 1.6, the research scope of this thesis lies in identifying the perceived benefits, challenges and recommended modifications and their impact on effectiveness and efficiency, while applying Scrum practices, values and principles to FFP. Although it is assumed that the perceived effectiveness and efficiency has an impact on project success[8], the impact on project success is not tested in this thesis, as the focus of this thesis is to understand why and how APM is perceived to be beneficial within an FFP context.

Even if Agile methodologies are not only limited to IT projects, the scope of this research is limited to custom software development projects, i.e. the focus is on project requirements that are implemented by programming or customising software. Furthermore, the research assumes that the underlying FFP contract is based on German law, is not negotiable and can only be extended to a minimum, as customers predominantly determine the contract model, which has also been emphasised by Gaebert (2014b, p.8). Thus, the suppliers are only able to offer their bid on this contract basis. Consequently, the focus of this research is on how APM using the Scrum process framework might work within the context of an FFP contract, without the possibility to change this contract. To achieve the aim of this research all types of software development projects and sizes are considered, regardless of the business domain on which they focus.

1.8 Structure of the thesis

This thesis is divided into seven chapters. The structure is as follows:

- Chapter 1 provides the rationale for the research, sets the research scope, and provides an overview of the research. It also introduces the theoretical model based on the three sub-questions.
- Chapter 2 starts with a clarification of the terminology for Scrum practices, values, principles, communication, collaboration, short feedback cycles, effectiveness and efficiency, as it provides an important base for this research. It also reviews the current literature surrounding APM and FFP projects with their distinct

[8] Effectiveness has an impact on meeting stakeholder expectations and the scope and efficiency has an impact on time and budget, and therefore has an impact on project success.

characteristics. The background of APM using T&M and TPM using FFP is reviewed in order to extend the discussion on how FFP projects might benefit from Agile practices, to identify where attention is needed and how both fields might be linked together. These insights are used to fill the theoretical model, as an assumption what might be transferred to the research context. Finally, the research gap is presented, which has been further investigated in this research.

- Chapter 3 outlines the chosen research methodology and why it serves best to answer the research objectives.
- Chapter 4 presents the findings from the empirical research. These findings are used to fill the theoretical model with the empirical data for later discussion.
- Chapter 5 compares the model based on the literature review to the model based on the empirical data. This leads to the discussion on the main contributions of this thesis, namely the final theoretical model and the adapted Scrum framework.
- In Chapter 6, the main conclusion is drawn, including how FFP projects might benefit from Agile practices, and for which projects they are recommendable.
- Chapter 7 reflects the professional and personal development of the author during this research.

2 Literature review

The introduction showed the reasons why software projects fail, how these project failures are related to plan-based approaches and FFP contracts and why projects with APM are more likely to succeed. The introduction also showed why there is a demand to combine Agile with FFP, why this is a contradiction but might still be beneficial and why Scrum is used as an Agile representative technique. This chapter reviews the current state of the academic literature in the research area in order to understand the background and to evolve the theoretical model. The chapter is structured as follows:

- Clarification of terminology
- Benefits and challenges of APM and Scrum and their impact on effectiveness and efficiency in projects
- Benefits and challenges of FFP contracts and their impact on effectiveness and efficiency in projects
- Linking the concepts of APM and FFP
- Summary and conclusions of the literature review

2.1 Literature review approach and timeline

Based on the research question and its three sub-questions, search strings were derived to look for benefits, challenges, effectiveness and efficiency in APM, FFP or mixed approaches. The applied search strings will be depicted at the beginning of Section 2.3, 2.4 and 2.5. As described in Section 1.1, Agile projects are more likely to be successful than traditional projects. The term project success was defined in Section 1.1 as meeting stakeholder expectations, on scope, on time and on budget. While meeting stakeholder expectations and delivering the expected scope are referred to doing the right thing - i.e. being effective - being on time and on budget are referred to doing things right - i.e. being efficient. Therefore, it is important to look, beside the benefits and challenges of APM and FFP, on the impact both have on effectiveness and efficiency. That is why effectiveness and efficiency were included for the literature review.

The following literature review is two-fold. The first part, which is represented by Section 2.2, clarifies the used terms from the research question and provides the background to why the study is worth doing. The second part, beginning with Section 2.3, attempts to answer the

research question. For this, the theoretical model introduced in Section 1.6 (Figure 2) is filled with the findings from the literature review.

The literature review was planned and conducted using the guidelines presented in Keele (2007) in several phases. These phases and the applied approach are presented in this section.

2.1.1 General approach

The literature review was conducted using the databases of Google, Google Scholar, EBSCOhost and Science Direct. The research question and all sub-questions were used as input for the corresponding search queries, which were then executed on the named databases. In this regard, several *"search strings"* have been combined to find a maximum of all relevant articles. The identified articles covered a wide range of aspects of APM for example: adoption, working in a non-agile environment, using mixed methods and specific types of project (global, distributed, large-scale etc.). The used search strings are depicted at the beginning of each of the following literature Sections 2.3, 2.4 and 2.5. Although current literature was in focus, the search was not limited to a certain publishing date. If the results from the database were too large, the results were sorted by relevance, and only the first most relevant 250 sources were sighted. In the next step all sources were rejected which had no relationship to the corresponding search area, i.e. benefits, challenges, effectiveness, efficiency, Agile, FFP, project success or project management in their title or abstract. In addition, papers were accepted only where it could be assumed that the project environment was mature. I.e. projects and companies that have already successfully conducted projects with Agile/SCRUM and not those that were introducing Agile methods. The rest of the sources were then carefully read, and, if not rejected, analysed with NVivo. Papers were rejected during the analysis phase, if they did not contribute to the area of research. For example, a lot of papers mentioned Agile and FFP contracts in the title and abstract but did not examine the corresponding area of research of this thesis. The same applied to the sections where benefits and challenges of APM or FFP projects were reviewed. The breadth of literature, which covered the benefits and challenges, ranged from a focus on Agile adoption, to global and distributed projects, to mixed methods and to large-scale projects. These papers were not appropriate to answer the research question, as their focus was on a different research area. If papers referenced other relevant sources, these have been also included in the review and were treated as described above. This

literature process was maintained until no new papers were identified, i.e. new papers referenced the same or already knowns sources and were not contributing through new insights.

This literature review approach is depicted in the following Figure 3.

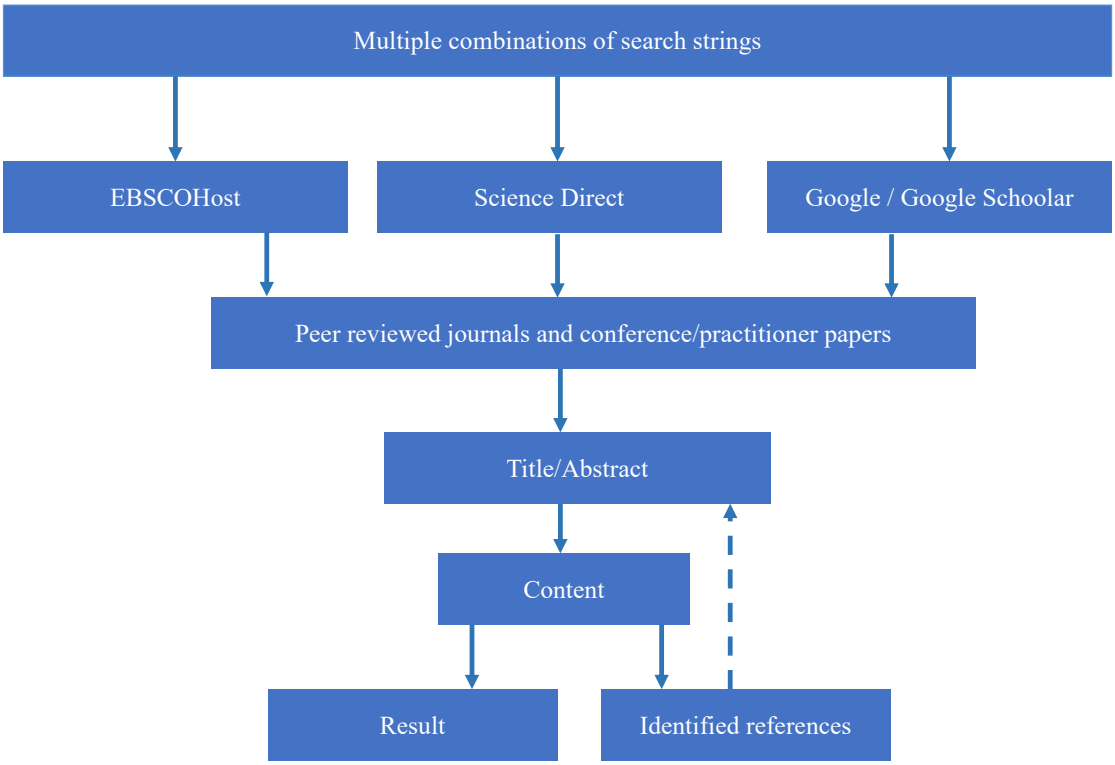


Figure 3: Applied literature review approach. Source: The author

The author is well aware that some databases, which may contain relevant articles, or different search engines, are not included in this selection. But this could not be avoided, as the access to these sources was not always granted. However, regarding the findings of the literature review there has been a subject-based saturation, concluding that all relevant information has been found in the articles, as the articles at a certain stage were referring to the same main authors and topics. Thus, the validity of the review is based on the assumption that saturation has been achieved as no new journals appeared within the chosen search strings.

2.1.2 Timeline

It has to be acknowledged, as practised in Agile, that new insights during the research process may lead to updates or refinements of the literature chapter. The same applied to this research. Therefore, the literature review has been updated and refined at several points of this research process. Initially, the literature was reviewed for APM and FFP. It became apparent

very quickly, that there are rarely papers which are concerned directly with the precise area of research. Therefore, the benefits and challenges and their impact on effectiveness and efficiency of Agile and FFP projects have been reviewed individually with the aim to identify specific aspects, which might be transferred to, or which might also arise in the area of research. The result of this literature review has then been used to formulate the interview guide. The preliminary findings were then used to conduct a refinement of the literature review, to include new papers or to refine nuances of aspects, mentioned by the interviewees. Based on the findings of the interviews and focus groups the literature was again reviewed, updated and refined while writing the discussion chapter to compare and validate the research results with the current state of research. The literature review process is depicted in Figure 4.

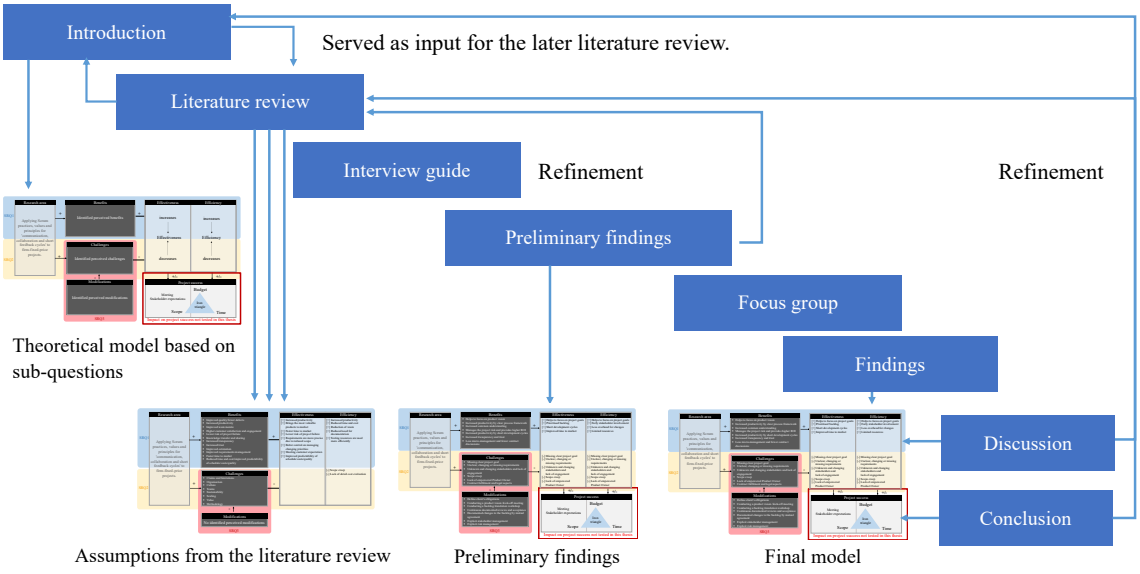


Figure 4: Literature review process and increments. Source: The author

2.2 Clarification of terminology

As every term might be interpreted in different ways, the nomenclature surrounding this study needs to be clear and unambiguous. In this section, the terms and definitions used in the research questions will be specified.

2.2.1 Agile project management in the software industry

As a reaction to the limitations of TPM in IT projects, new approaches have been researched. The idea of APM was first presented by Takeuchi and Nonaka (1986), who explained a holistic, people-centric approach for fast and flexible product development. In contrast to the plan-based, heavy-weighted document-centric processes, APM provides a flexible, lightweight and reactive process which meets *"the new challenges of fast software delivery and quick-change management"* (Ayed, Vanderose, & Habra, 2012, p.66). Cao et al. (2013) emphasise that Agile methods *"are appropriate when project scope and requirements change rapidly throughout the project life cycle"* (p.191), or *"when time-to-market constraints pressure organisations to quickly deploy IT solutions"* (p.191).

Since the mid-1990s, and especially after the Agile manifesto was published in 2001, APM approaches have evolved and taken the industry by storm (Duka, 2012, p.692; Stare, 2014, p.296). Several Agile approaches were established during this time to conduct complex software projects in the software industry (Lindvall et al., 2002; Qumer & Henderson-Sellers, 2008). Over the last decade, APM methods have become mainstream, gained higher management attention and have therefore been widely used in companies for project implementations (McAvoy & Butler, 2009, p.372). Furthermore, Duka (2012) stresses that APM is widely spread in the industry because, if compared to TPM, Agile projects *"enjoy higher success rates, deliver higher quality, have greater levels of stakeholder satisfaction, provide better ROI, and deliver systems to market sooner"* (p.692). According to Fernandez and Fernandez (2008), *"APM has proven to be a useful tool for today's knowledge worker and project managers […]"* (p.10) in complex and uncertain projects. Although APM was primarily intended for software projects, it is also gaining increasing attention in the broader area of project management. For example, in 2011 the term *"Agile project management"* surpassed for the first time the term *"Agile software development"* on Google, where the focus lies on software development, although both terms name the same basic Agile principles and values (Stettina & Hörz, 2014, p.140). In an interview with Jackson (2012), the authors of the Agile manifesto emphasise that Agile thinking is crucial for success in the 21st century, and that the Agile approach is applicable to all kinds of projects. Therefore, Agile methods have been increasingly used for software development in the software industry (Campanelli & Parreiras, 2015, p.85). Although it is difficult to introduce APM in a company as it requires a cultural change (Brosseau, 2004), management appreciates the benefits and confirms that it is worth doing (Cohn, 2010). According to the *"10th Annual State of Agile"* report of VersionOne (2015)

with 3,880 respondents, two-thirds of the respondents who were using Agile approaches worked in a firm with between 100 and 1,000 employees, and 31% in a firm with more than 1,000 employees, strongly suggesting that by 2015 APM was no longer limited to start-ups and had reached the IT industry.

2.2.2 Scrum

Scrum is considered to be the most widely adopted Agile method worldwide (Hoda, Noble, & Marshall, 2011, p.522), and the most Agile method at the practitioner's level (Qumer & Henderson-Sellers, 2008, p.289). Therefore, and for its structured process framework, it has been chosen as an Agile implementation method for this study. Scrum covers mainly project management issues (Dingsøyr, Dyba, & Abrahamsson, 2008, p.84; Hoda et al., 2011, p.522) and was formalised in the mid-1990s by Schwaber and Sutherland (Kautz, Johansen, & Uldahl, 2014, p.304). Scrum is a process framework which focuses on customer collaboration, communication, short delivery cycles for early stakeholder feedback and process improvement. This is achieved by a self-organising team divided into various Scrum roles and with different Scrum practices. The Scrum process framework is depicted in Figure 5. The numbers in Figure 5, marked as [#], are referenced and explained below.

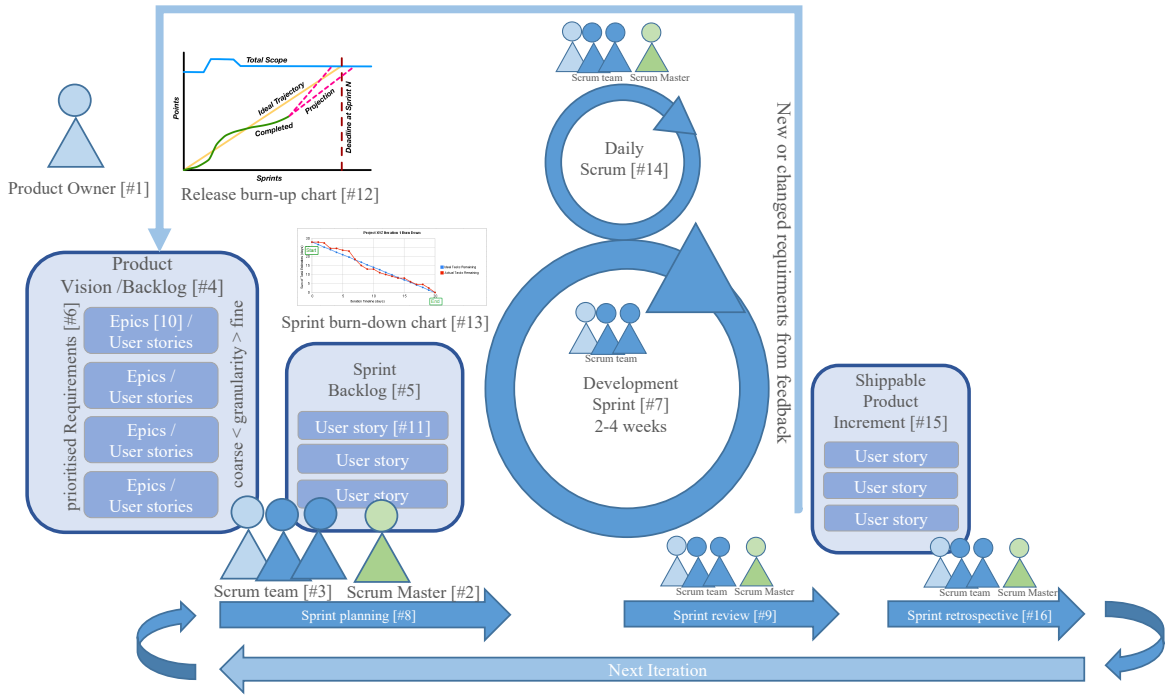


Figure 5: The Scrum process framework adapted from Deemer, Benefield, Larman, & Vodde (2010, p.5)

Scrum involves three roles, the Product Owner [Figure3: #1], the Scrum Master [Figure3: #2] and the development team (Deemer et al., 2010, p.5; Pichler, 2010, p.7; Schwaber, 2004, p.6). The Product Owner and the development team form the Scrum team [Figure3: #3]. In contrast to traditional development projects where business analysts, software developers and testers are usually functionally and spatially separated, the Scrum team comprises all of these roles in one self-organising, cross-functional team, preferably in one physical location (Deemer et al., 2010, p.5; Kautz et al., 2014, p.304). This Scrum team setup is needed for intensive collaboration and communication, as there is only minimal documentation.

Internally, the role of the Scrum Master is to supervise, support and teach the Scrum team in Agile practices, values and principles, and externally to protect the team by removing impediments to the team's progress (Deemer et al., 2010, p.6; Schwaber, 2004; Schwaber & Beedle, 2002). The Scrum Master is not responsible for the project/product as this is the responsibility of the Product Owner, but she[9] is responsible for the underlying Agile process, which helps the team to achieve its project goals. A Scrum Master should be seen as an Agile coach who supports the team to fulfil its work and shows the team members better ways to conduct their work in the most effective and efficient way within the Agile methodology.

According to Pichler (2010, p.3), Schwaber (2004) and Schwaber and Beedle (2002), the Product Owner is typically a customer representative or business analyst. She is responsible for the product and leads the project and comprises in one person TPM roles such as product marketer, product manager and project manager. The Product Owner represents the product and the project externally to all stakeholders including end users. She is the only person who manages and prioritises the tasks that appear in the product backlog [Figure3: #4] and the Sprint backlog [Figure3: #5] so that they become visible to everyone (Deemer et al., 2010, pp.5-6; Pichler, 2010, p.2; Schwaber, 2004; Schwaber & Beedle, 2002). The product backlog contains a list of required coarse-grained business and technical requirements [Figure3: #6] – the so-called epics[10] [Figure3: #10] – and more detailed requirements – the so-called user stories[11] [Figure3: #11]. The epics and user stories are prioritised according to the business value they add to the envisaged product. The backlog is maintained and refined regularly by the Product Owner, very often with the support of the development team. It changes during the project lifetime through new customer insights and needs. Requirements are sorted out, changed or

[9] Both genders are treated equally in this thesis. However, *"she"* or *"her"* is used instead of *"he or she"* or *"him or her"* for a better reading of the text, whenever it makes sense.
[10] An example for an epic would be: *"Implementing user management"*
[11] An example for a user story would be: *"As an administrator, I want to add users to the system, so that they can log in and work with the system"*

added whenever needed. In Scrum these requirements from the backlog are implemented in so-called Sprints [Figure3: #7]. A Sprint is a fixed-length development cycle, which typically lasts between two and four weeks and provides a potentially shippable product at the end (Deemer et al., 2010, p.6; Kautz et al., 2014, p.304; Schwaber, 2004). Each Sprint can be seen as a mini project, consisting of analysis, planning, development, review and delivery phases, and represented by different meetings, the so-called Scrum ceremonies[12]. Each Sprint iteration begins with a planning meeting [Figure3: #8] and closes with a Sprint review meeting [Figure3: #9], where the Sprint results are reviewed, and accepted or declined by the Product Owner. During the Sprint planning meeting, the Product Owner presents and discusses with the development team the most important tasks to achieve the Sprint goal, which should be implemented by the end of the Sprint. The Product Owner provides the user stories and decides *"what"* functionality is needed, and the development team decides *"how"* the functionality will be implemented technically in the product. As only coarse-grained documented requirements are provided by the Product Owner, intensive communication and collaboration among the Scrum team is needed to get a common understanding of what is needed. This is the reason why user stories are often regarded as a *'call for conversation'*. At the end of each Scrum planning meeting, there is a commitment to a Sprint goal from the development team, which contains all tasks on which the team has accepted to deliver at the end of the Sprint. During the planning meeting, the Scrum Master supervises the ceremony and ensures that no over-commitment is enforced (Pichler, 2010, p.9; Schwaber, 2004).

The project and Sprint lifecycle are visible and transparent to all stakeholders through a release burn-up chart [Figure3: #12], which shows how many Sprints remain to implement the current product backlog items. There is also a Sprint burn-down chart [Figure3: #13] that shows the current amount of work left in the Sprint versus the time remaining (Schwaber, 2004). Every day at the same time, the Scrum team and the Scrum Master come together in a daily meeting [Figure3: #14] to communicate their progress and to synchronise in a short 15-minute time-boxed daily stand-up meeting. Time-boxed means that there is a hard stop of the meeting once the 15 minutes are over. This forces the team to focus on the main points. If further clarification is needed, this will take place in a separate meeting. After the daily meeting, the Sprint progress is updated in the Sprint burn-down chart. Obstacles and challenges that might have prevented the team from carrying out its work without any solution are reported and

[12] Events or team meetings are called ceremony in Scrum, whereof Scrum knows four official ceremonies, namely planning, daily, review and retrospective. Sometimes, Scrum is enriched with an additional backlog refinement meeting.

discussed afterwards (Kautz et al., 2014, p.304). The Product Owner is co-located with the development team so that communication is possible all the time.

At the end of each Sprint the development team demonstrates live the product artefact to the Product Owner – and possibly other stakeholders – as it would be shipped to the customer. The Product Owner assesses the team's performance in relation to the committed Sprint goal (Schwaber & Beedle, 2002). The output of the iteration is a potential shippable product increment [Figure3: #15], which might be already used by the company. As a result of the Sprint review ceremony, the product backlog might be refined by the Product Owner based on input by her or the stakeholders, with new priorities and new and/or changed tasks. Finally, the Scrum team reflects on its performance under the moderation of the Scrum Master in a Sprint retrospective meeting [Figure3: #16] to adjust and improve the development process with identified actions. Once possible measures of the process improvement are identified, the next iteration starts.

Referring to the research question, the Scrum process framework contains several practices which implement Agile values and principles to promote communication, collaboration, short feedback cycles, effectiveness and efficiency. In summary, the Scrum practices consist of three roles: the Scrum ceremonies, the product backlog and burn-up and burn-down charts as depicted in the Scrum framework (Figure 3). The three roles are needed to organise collaboration within the project, i.e. who is responsible for what. As mentioned above, the Product Owner is responsible for *'what'* functionality should be implemented, the development team is responsible for *'how'* this functionality should be implemented technically and the Scrum master is responsible for the Agile process. The central practice in Scrum is the short development cycle, which consists of several Scrum meetings. These structured meetings, which can also be seen as a communication and collaboration plan, are used for planning, synchronising, asking for feedback or reflecting face-to-face with the Product Owner how the collaboration process might be improved. As a practice to steer the project and to provide transparency, the prioritised product backlog, which represents what has still to be implemented and what has the highest priority, and the burn-up and burn-down charts are used.

These Scrum practices implement practically the ideas of the Agile values and principles. Thereby the Agile values are emphasising more a mindset which should be followed, namely that valuing individuals and interactions is more important than sticking to tools and processes, that delivering working software is more important than comprehensive documentation, that customer collaboration is more important than contract negotiations and that responding to

change is more important than following a plan. These values are implemented in Scrum by short development cycles, which delivers frequently working software, and which allows adaption of the product backlog based on new insights or feedback. The collaboration is promoted within the Scrum meetings. In contrast to the Agile values, the Agile principles provide more precise examples of how agility can be achieved. For example, they emphasise that face-to-face conversation is the most effective way of communication, and that the businesspeople and the development team must work together daily throughout the project. Besides the importance of meeting stakeholder expectations, the Agile principles emphasise the importance of an empowered and motivated team and continuous deployment of valuable software. All these principles are promoted in the Scrum framework through its roles, meetings and possibilities of continuous delivering valuable software.

Applying the Scrum framework to industry projects often poses challenges in practice, as this new approach requires a change in the company working methods and culture, to which the organisation has to adapt first. To conduct Agile projects with Scrum in an organisation, the organisation should have a certain maturity in understanding Agile values and principles, not just the practices (Conboy, Coyle, Wang, & Pikkarainen, 2011, p.55). This includes commitment from the senior management and pro-activeness from the involved project members from the organisation, but which is often regarded as challenging (Kamei, Pinto, Cartaxo, & Vasconcelos, 2017, p.3). This is, because new project approaches are mostly introduced more quickly than the required transformation process of the organisation allows. As a consequence, the applied industry practice of Scrum is extremely divergent. For example, one main principle of Scrum is that “Businesspeople and developers work together daily throughout the project” (Fowler & Highsmith, 2001, p.3), but with regard to this research, in practice the Product Owner is often not available on the customer side, as she should be, and she has to be “proxied” by the supplier. This is very often to do with organisational culture (Gregory et al., 2016, p.9), as the role of an empowered Product Owner as it is defined in Scrum, does not exist in a traditional environment or is not as fully understood as it should be. Thus, the Product Owner, which should comprise in one person TPM roles such as product marketer, product manager and project manager (Pichler, 2010, p.3), is often seen as a classical project manager, who has less power to make decisions and who is mostly not available on site, as she is concerned with other internal organisational tasks. As a consequence, other than is intended in Scrum, more assumptions have to be made about the product, as the Product Owner is rarely available and this poses the risk that the assumptions made, do not fit with the

customer's expectations of the product. This means for this research, where it has to be accepted that customer organisations are not mature in Agile working methods, otherwise they would not demand FFP contracts, that a solution has to be identified as to how customer representatives can be empowered and involved to collaborate with the supplier team on a daily basis.

Another example from practice is related to the Scrum developer team, which is, in regard to this research, provided by the supplier. Scrum teams have to be mature to apply the Scrum methodology correctly (Kamei et al., 2017, p.3). If not, this can result in difficulties of working with an open scope, or with managing dependant requirements (Kamei et al., 2017, p.3) or in requirements prioritisation (Fitriani et al., 2016, p.159). Very often, immature teams stick to Scrum practices, without understanding the values and principles behind them. For example, the daily stand-up is sometimes misused as a meeting for clarifying open issues, but it should be used to synchronise the team. Related to this research, this means, that in a non-Agile customer environment the Scrum developer team from the supplier must be mature in applying Agile principles and values, to compensate for the deficits in Agile maturity on the customer side. Otherwise this could hardly work.

2.2.3 Communication

2.2.3.1 Definition of communication

Technically, communication can be depicted by the advanced communication model, which has evolved from the early work of Shannon, Weaver, and Schramm (1953, cited by Gibson, Ivancevich, Donnelly, & Konopaske (2012, p.434)). The communication model consists of eight basic elements, which are the *sender* (also known as the communicator), the *encoding*, the *message*, the *medium*, the *decoding*, the *receiver*, the *feedback* and the *noise* (Gibson et al., 2012, p.434; Holzmann & Panizel, 2013, p.68). According to Holzmann and Panizel (2013, p.68), the sender is the one with the intention of communicating. In the project context, the sender might be one of the stakeholders, e.g. the customer representative. The receiver is the one who accepts the message and acts as the message destination. In the project context, this might the supplier, for example. The sender and the receiver may interchange their personas during the communication process. A message is the verbal or non-verbal information that should be transferred from the sender to the receiver. On one side, the encoding of the message describes the process of encryption of the message in common symbols and signs. On the other

side, the decoding of the message refers to the process of decrypting the message from common symbols and signs, i.e. the interpretation of the original intended message. The medium refers to the method through which the message is transmitted. After each delivered message, feedback provides a bi-directional possibility to adjust the decoded meaning of the message with its originally intended meaning. The communication flow might go back and forth several times until the receiver and the sender have synchronised the meaning of the original intended message. Finally, *noise* refers to any issue which might disrupt the message transmission at each process state and cause communication failure.

Figure 6 below depicts this communication process.

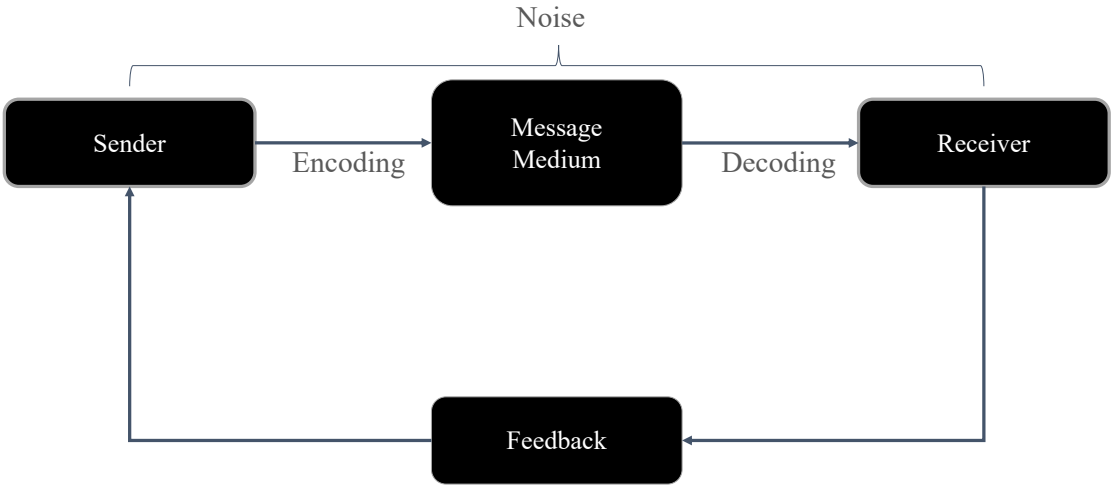


Figure 6: Communication model based on Gibson et al., 2012, p.434

Communication in the context of this research means implementing this model.

2.2.3.2 Relevance for Agile project management

According to Wysocki (2011, p.50), communication is a success factor and can be found in seven of the ten top reasons why projects succeed. This is supported by several studies that emphasise the importance of communication as a success factor in project management (Cockburn, 2006; Holzmann & Panizel, 2013, p.67; Mishra, Mishra, & Ostrovska, 2012, p.1068). Communication among stakeholders – e.g. customers and suppliers – is vital, as clients seem to have a different understanding than the supplier of what has to be delivered than the supplier. Wysocki (2011) points out that many problems during a project are originated *"in a disconnect between what the client says they want and what they really need"* (p.51).

Therefore, not only is it important to communicate with the customer to get feedback, but also with the right receiver, i.e. the customer representative (Inayat, Salim, Marczak, Daneva, & Shamshirband, 2015), to meet their expectations. According to Wysocki (2011), the biggest challenge in communication is *"to establish a repeatable and effective communications process"* (p.384). Considering the research area, effective and continuous communication management among all stakeholders is one of the core concepts of Agile development (Holzmann & Panizel, 2013, p.70) and promoted by Scrum practices, values and principles in the Scrum process framework. Several studies show that agile practices improve communication (Hummel, Rosenkranz, & Holten, 2015; Pikkarainen, Haikara, Salo, Abrahamsson, & Still, 2008, p.318; Sharp, Robinson, 2010, p.61) in and around the development team. This is due to the Scrum process framework that provides a clear communication plan for the Scrum team, when and what has to be discussed. For example, in the Sprint planning meeting the development tasks for the next Sprint are discussed within the Scrum team, while suggestions for improvements are discussed at the Scrum retrospective meeting. In addition, a distinction can be made between internal and external communication (Pikkarainen et al., 2008, p.318). The internal communication is improved between the development team and the project leader through the Scrum meetings and the presence of the on-site customer (Pikkarainen et al., 2008, p.318). The external communication is improved due to regular status reports (Pikkarainen et al., 2008, p.318), like the Sprint burn-down chart or the release burn-up chart. These reports are used to provide transparency about the project status, as they are also visible to external stakeholders. Furthermore, these charts are often sent to the senior management to report them about the status quo.

Usage of the advanced communication model is promoted in the Scrum meetings, for example, in:

- the Sprint planning meeting, where the team plans the next iteration. There, the Product Owner (sender) explains to the development team (receiver) on the basis of user stories (medium) which requirements (message) should be implemented. The development team responds (feedback), indicating whether the requirement is clear and what has to be taken into account to implement it, or whether further clarification or discussion related to the requirement is needed, which will result in a new communication loop. Once the requirement is clear, the development team commits itself to the requirement, which is an acknowledgment that there is a common understanding of what is needed and that the communication loop for this requirement is finished. All other requirements are then discussed in the same way, until the team gives the feedback that no further requirement can be implemented in the upcoming iteration.
- the daily stand-up meeting, where each member of the development team (sender) reports (message) what they have achieved up to yesterday, and what they want to achieve by tomorrow. The Product Owner, Scrum Master or members of the development team (receiver) can react (feedback) on this until the whole team is synchronised about the current status.
- the Sprint review meeting at the end of an iteration cycle, where the development team (sender) presents its product increment (medium) based on the committed requirements (message) to the stakeholders (receiver), i.e. the Product Owner and, optionally, further stakeholders. The Product Owner accepts or refuses (feedback) each requirement in a live demo (medium). The next Sprint planning is then conducted based on the feedback and insights of this meeting.

Related to this research, applying the communication model of APM seems to be beneficial for meeting stakeholders' expectations.

2.2.4 Collaboration

According to Wood and Gray (1991), collaboration *"occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared rules, norms and structures, to act or decide on issues related to that domain"* (p.146). With regard to the research study, collaboration describes the situation where the customer works together with

the supplier through steady project involvement and interaction to achieve the common project goal. Although customer representatives are not mentioned explicitly in the original Scrum guide (Schwaber, Sutherland, & Beedle, 2013), the customer plays an important part in the Scrum process as documented in several studies (Hoda, Noble, & Marshall, 2011, p.522; Lindsjørn & Moustafa, 2018, p. 1; Rigby et al., 2016, p.43; Sommer et al., 2013, p.1278). In the original Scrum guide, the Product Owner is vaguely defined as "one person, not a committee" (Schwaber, Sutherland, & Beedle, 2013, p.5) of an internal organisation, but who "may represent the desires of a committee in the Product Backlog" (Schwaber, Sutherland, & Beedle, 2013, p.5). However, in the specific case of a customer/supplier relationship, where software requirements are determined by the customer and implemented by the supplier, the role of the Product Owner is taken by the customer representative in Scrum (Hoda, Noble, & Marshall, 2011, p.522). The term collaboration refers to *"strong linkages and high levels of trust and knowledge sharing between team members"* (Nissen, Evald, & Clarke, 2014, p.1), which is promoted by Scrum through the different practices, values and principles, e.g. during the Scrum meetings, where the Product Owner and the Scrum team meet together, as described in Section 2.2.2. According to Inayat et al. (2015, p.926), customer involvement and interaction is one of the key success factors in project management. They emphasise that it is vital to collaborate with the customer representatives to ensure *"that requirements are appropriately defined, clarified and prioritised"* (p.921). The failure to collaborate with customer representatives can lead to misunderstandings, to false expectations and to wrong project results. Accordingly, APM relies on frequent collaboration with *"an accessible and available onsite customer"* (Inayat et al., 2015, p.921). Collaboration is required throughout all project stages. Franklin (2008) emphasises that the *"key to success is first-hand collaboration with members of the user community during the proposal and contract development process to ensure enough user story awareness to estimate the magnitude of scope themes and define tangible milestones that allow payment on delivery of theme components at each Sprint cycle as well as larger milestones as releasable software deliverables"* (p.273).

According to Sharp and Robinson (2010, p.61) the importance of collaboration in Agile teams is acknowledged by several studies. Related to this research, it can be stated that APM demands and promotes high levels of collaboration (Hoda, Noble, & Marshall, 2011, p.522) due to Scrum practices (Pikkarainen et al., 2008, p.304). For example, through the collaboration with the customer Product owner on a daily basis, the Sprint planning meeting or daily stand-up meeting with the Product owner (Sharp, Robinson, 2010, p.61). There, the

Scrum team collaborates to act or decide on issues related to their domain. This improved collaboration seems to be beneficial for meeting stakeholders' expectations, as represented by the Product Owner.

2.2.5 Short feedback cycles

In the context of this study, short feedback cycles mean fast and regular stakeholder reviews of the created business functionality, which provide the basis for possible course correction (Duka, 2012, p.692). Referring to the communication model described in Section 2.2.3, the difference for this study is that this communication model is strongly embedded in the Scrum framework and its practices, e.g. regular meetings. The feedback cycles are ensured at different stages by a time-pulsed communication plan which is determined by the framework. As depicted in the communication model, feedback is an essential part of the communication process and it is important to adjust the received message with the original intention. Software engineering is a complex process by nature, mostly based on incomplete or ambiguous requirements (Gaebert, 2014c, p.99), which requires the intensive collaboration of stakeholders (Mishra, Mishra, & Ostrovska, 2012, p.1068). Through short feedback cycles it is possible for the stakeholders to refine the desired business functionality. Cline (2015) stresses that *"shortening the feedback cycles and revising the product much sooner decreased the product's development cost and time to delivery"* (p.7) and thus has a positive impact on project constraints, i.e. project efficiency. Cline also reports that through shorter feedback cycles higher quality can be achieved. He states that short feedback cycles are intrinsic to Agile practices. Finally, Bernier et al. (2012, p.34) report that continuous feedback from the customer is seen as crucial to the project's success.

Related to this research, short feedback cycles are promoted through the Scrum process framework, which is advertised as being beneficial for meeting stakeholders' expectations.

2.2.6 Effectiveness and efficiency

Effectiveness is often referred to as *"doing the right thing"* (DeMarco, 2002, p.122; Drucker, 1973, p.36) and is an external measure of process output or quality. In the context of this research, effectiveness means that services or products are being provided as output of the software development project, which is expected by the stakeholders, i.e. meeting stakeholder

expectations. Therefore, the effectiveness of services or products should be evaluated from the stakeholders' perspective.

Efficiency is often referred to as *"doing things right"* and is an internal measure of process operations which has its focus on optimising costs (Drucker, 1973, p.36). DeMarco (2002) defines the term efficiency as doing something *"with minimum waste"* (p.122), which means with least resources. Improving efficiency leads to reduced cost or time to deliver services or products and may serve stakeholders as well as the internal organisation. In the context of this thesis, efficiency is the relationship between invested resources and output. Efficiency does not make a statement of how effective the output is.

According to Drucker (1973, p.36), efficiency is essential to an organisation as even the greatest effectiveness can be harmed by poor efficiency. At the same time, he stresses that even the most efficient organisation will have no success if it is doing the wrong thing. In addition, DeMarco (2002, p.125) affirms that there is an internal conflict between effectiveness and efficiency that must be resolved to make effective choices about what to do and then execute those decisions as efficiently as possible. Further, DeMarco (2002, p.123) observes that there are many organisations that are obsessed with improving only their efficiency; therefore, their responsiveness, effectiveness and success will suffer. He also points out that efficiency is a natural enemy of quality and must therefore be well balanced.

Combining both approaches, Drucker (1973) concludes that *"effectiveness is the foundation of success – efficiency is a minimum condition for survival after success has been achieved"* (p.36).

Related to this research, effectiveness means delivering the right functionality, i.e. business value, expected by the stakeholders, while efficiency means minimising waste. Waste is everything that is not needed to achieve the project goal, which is defined by the stakeholders. The relationship between delivering the right output (effectiveness) and the resources used (efficiency) is called productivity (Tangen, 2002, p.20). In the context of this thesis productivity means delivering the right functionality with high business value expected by the customer in relation to the effort used by the supplier. Productivity in Scrum is increased by its short development cycles. That means the effectiveness is promoted by the Product Owner as customer representative, who determines what has to be done. Efficiency is promoted in Scrum, as in one development cycle no more will be implemented than is demanded by the Product Owner. If more is needed, this will be steered through the feedback by the Product Owner. In

addition, the time-boxed development cycle, with its daily synchronisation meeting, provides the transparency that is needed to implement the demanded features with least possible waste.

2.2.7 Firm-fixed-price contract

A firm-fixed-price in a software development project is a contract model in which the scope of the software deliverables, the price and the delivery date are settled up front between the supplier and the customer (Khan & Roy, 2014, p.68), usually based upon comprehensive documents and specifications that are provided by the customer to the supplier. According to Lindsjørn and Moustafa (2018), current studies of software development projects show that *"approximately 40-70% choose fixed-price contracts […]"* (p.1). The circumstance that every parameter is fixed is often called the 'iron triangle', as there is no possibility to change one parameter without affecting another. The iron triangle consists of fixed cost, fixed time and fixed scope/quality (Dwivedi et al., 2013, p.76; Jørgensen, 2016, p.5). Once the contract is stipulated, neither cost, time or scope/quality can be changed without additional negotiations among both involved parties, which might lead to a contract modification and thus to an adjustment of the iron triangle. That means that both parties share some risk. The supplier has the risk that she cannot deliver the demanded scope within the estimated time or cost, and the customer has the risk that she has forgotten or misinterpreted something in the original specification, or her business need has changed since the contract specification. During the implementation phase, the communication and collaboration among both parties is normally reduced to a minimum such as project status reports, as everything is regulated up front in the documents and the product deliveries are typically scheduled at the end of the project. Thus, feedback is hardly possible before delivery at the end of the project. The underlying contract serves as a legal document supposed to cover the case when there is no communication between the involved parties (Deusan, 2014) or there is friction. The negotiated price is then paid at the end of a project or is sometimes paid in tranches with the achievement of a defined task or milestone (Gopal & Koka, 2010). With regard to quality, normally a term is used which indicates that a level of quality is expected, which represents the general agreed technical standards.

FFP contracts are often used in IT outsourcing projects as a lot of customers request FFP projects in order to reduce their financial risk, to facilitate their budget planning and to ensure that projects are chosen with the highest ROI (Ambler, 2008a; Gaebert, 2014b). As an FFP

project is determinable through the schedule, the budget and the scope, it can therefore be planned using project management. This transparency is often demanded by the project sponsors for their internal planning and scheduling. According to Khan and Roy (2014, p.73), FFP contracts have become common practice as they offer the perceived advantage of transferring the risk of project overruns to the supplier, especially in large and complex projects. According to Gaebert (2014a), the customer *"has the chance to exert pressure on the supplier by threatening to reject the system and to deny paying the agreed-upon price"* (p.5). Jørgensen (2017, p.1574) states that current surveys of software projects typically report that up to 70% of them use FFP contracts.

Král and Mildeová (2012, p.31) emphasise that an FFP contract should be viewed from the supplier's and the customer's point of view. On the one hand, the tender price is one of the main factors for the customer in evaluating the outsourcing of projects, and on the other hand the tender price and its calculated profit is a success factor for the supplier's business. That means that the customer might tend to take the cheapest offer, which is not always the best fit as the cheapest supplier is not always the best skilled. This might be because the supplier has missed something in the contract, has underestimated the effort or has failed to grasp the business domain. At the end, this might lead to frequent change request debates or poor quality as the cost pressure might motivate the supplier to deliver as soon as possible (Král & Mildeová, 2012, p.31). Conversely, the supplier might tend to add a big buffer on top of the margin as a security buffer, which makes the project much more expensive than it would be on a time and material basis (Khan & Roy, 2014, p.73). For both parties involved the price is essential and there might be tension without communication and collaboration as both sides might have different expectations as to what the project should deliver for the proposed price. The customer wants an *'all-you-can-eat'* mode, while the supplier follows a *'you-get-what-you-pay-for'* philosophy. Therefore, it is vital for a project to determine its scope and cost upfront as they have a huge influence on the effectiveness and the efficiency of project management, the decision on whether the project is a benefit or under which conditions the project might be implemented (Král & Mildeová, 2012, p.31). However, the cost estimates of FFP projects are based upon comprehensive documentation and specification which has been provided upfront by the customer. By evaluating these documents, the supplier tries to understand what the customer wants, derives the necessary requirements and estimates them with a buffer and a profit margin. Most of the time the supplier must rely on these provided documents, as little or no additional communication with the customer is possible up front.

This is especially the case in public tenders. Therefore, the accuracy of the project estimation is very dependent on the quality and completeness of these documents. Thus, in order to mitigate the risks on the customers' and the suppliers' sides, a considerable amount of upfront specification is needed, where the scope of the project is explained in detail (Dvir & Lechler, 2004, p.26). This approach has been assessed as unrealistic as it is impossible to predict every requirement (Gaebert, 2014a, p.540). De Bakker, Boonstra, and Wortmann (2010, p.500) point out that the requirements will almost certainly change during the project and therefore change the time plan and the project budget. De Bakker et al. (2010, p.500) continue that this makes it almost impossible to provide appropriate time and budget estimates at the beginning of a project. In addition, Torrecilla-Salinas, Sedeño, Escalona, and Mejías (2015, p.125) note that projects are estimated after an initial requirement gathering phase to freeze user needs, but that this approach makes it highly sensitive to uncertainties and change of customer needs. They conclude that *"the rise of the internet and the actual global and interconnected economy has increased the need for quickly adapting to changing customer needs"* (p.124). Savolainen, Ahonen, and Richardson (2012) argue that several publications confirmed that *"the requirements originally defined will almost certainly change, and this will influence the schedule and the costs"* (p.458). Thereby, FFP projects are prone to changes regarding the iron triangle, in terms of scope, schedule or costs, which might influence the project success.

In this regard, several authors report that the type of contract influences the collaboration between the two contractors (Gaebert, 2014a; Jørgensen, 2006; Moløkken-Østvold & Furulund, 2007; Müller & Turner, 2007; Sadeh, 2000). Beck and Fowler (2001, cited by Moløkken-Østvold & Furulund, 2007) state *"that a fundamental problem with fixed-price contracts is that they pit the interests of supplier and customer against each other"* (p.3). They conclude that customers may prefer FFP contracts in order to unburden themselves from their risk in large, complex projects. Furthermore, they report that many contract types used in the public sector have favoured, or even required, a sequential (e.g. waterfall) project management approach, which are more likely to lead to project overruns (The Standish Group, 2009). Gaebert (2014b, p.3) notes that the right choice of contract can influence performance, maintainability, reliability and other quality attributes. Furthermore, her survey reports that the customer determines the contract type. Her paper shows that, predominantly, FFP projects are used because of the customers' restriction of having a limited budget. Customers want to realise the projects with the highest ROI. In addition, Gaebert (2014a) stresses that *"in an ideal world, the requirement specification is complete, unambiguous and clear. In such a perfect world, the*

supplier has calculated all efforts for the implementation of the requirements before signing the contract. Based on the specification, the designers and developers will implement the needed system. No communication and no interaction between the parties will be necessary during the project" (p.3). On the contrary, her survey identifies that unclear, incomplete or changing requirements are usual, but the problem is that customers are not willing to change the price if they change the requirements. Thus, the flexibility for changing requirements is lost. In addition, money might be wasted, as there might be requirements in the contract that are no longer needed but which will be implemented as stipulated by the contract. Beyond that, a higher price might have been paid for this inflexibility (Balaji, 2013, p.244). Finally, the suppliers' cost estimates are crucial for the success of the project. Therefore, great emphasis must be placed by the supplier on the control of the accumulated costs. This cost pressure might motivate the supplier to deliver earlier (Král & Mildeová, 2012, p.31) and to be more efficient with the resources involved.

2.2.8 Software development projects

According to Kontio, Pitkanen, and Sulonen (1998), a software development project *"is a joint undertaking by two or more participants […] which requires commitment from all participants"* (p.486). Kontio et al. (1998, p.486) note that these participants are at a minimum users and developers, who might be from the same or different companies. They further emphasise that *"users need to commit to providing specifications and feedback, as well as financial compensation; developers must provide resources, technical skills and commitment to schedule."* (p.486). These commitments are mostly made up front where little or no information is available on many details which should be specified (Dvir & Lechler, 2004, p.26; Gaebert, 2014b, p.11; Kontio et al., 1998, p.486). In terms of this thesis, software development projects are projects where the focus lies on implementing requirements through programming or customising software. The participants are the customer (user) and the supplier (developer) who come from different companies.

2.3 Review of the literature on Agile project management and Scrum

This section provides an understanding about the benefits and challenges of APM using Scrum. The literature review was conducted as explained in Section 2.1. The search strings used for the literature review were:

- "literature review" AND ("agile" OR "software")
- ("challenges" OR "issues" OR "limitations" OR "disadvantages") AND ("agile" OR "software development")
- ("benefits" OR "advantages") AND ("agile" OR "software development")
- ("effectiveness" OR "effective". OR "efficiency" OR "efficient") AND ("agile" OR "traditional project management" OR "waterfall")

As *"Scrum"* implements Agile values and principles, the search term *"Agile"* has been used instead, as it is highly unlikely that articles using the term Scrum would not use the term Agile.

2.3.1 Benefits in Agile project management projects

The literature review identified fifteen main benefits of applying plain[13] APM, compared to plain TPM approaches, which have been studied and documented. The benefits reported by companies in the studies were improved quality and fewer defects due to smaller controllable-sized tasks and continuous integration (Eloranta, Koskimies, & Mikkonen, 2016, p.202). This benefit is intertwined with the benefit of minimising waste and focussing on high business value product features, which leads to increased productivity (Rigby, Sutherland, & Takeuchi, 2016, p.43). Communication is improved between the development and the project leader through the Scrum meetings and the on-site customer (Pikkarainen et al., 2008, p.318). Increased collaboration due to Scrum practices was reported (Pikkarainen et al., 2008, p.304), which promotes improved team morale and increased trust within the team (Rigby et al., 2016, p.43). This benefit is also intertwined with early feedback through frequent deliveries (Eloranta et al., 2016, p.202), which motivates the development team. Early delivery itself leads to higher customer satisfaction and engagement (Kamei et al., 2017, p.3; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1), lowers project risk due to faster time-to-market (Rigby et al., 2016, p.43) and increases transparency of the project status (Eloranta, et al., 2016, p.202). In addition, close collaboration leads to better knowledge transfer and sharing (Dybå & Dingsøyr,

[13] Plain agile projects are implementing the agile principles as mentioned in the agile manifesto without modification.

2008, p.850). Other benefits such as improved requirements management and estimation were reported (Eloranta et al., 2016, p. 202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488), which results in improved predictability of schedule/costs/quality (Vijayasarathy & Turk, 2008, p.1). The identified benefits and associated authors are depicted in Table 4.

Identified benefits	Cited in
Improved quality/fewer defects	Eloranta et al., 2016, p.202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488; Solinski & Petersen, 2016, p.15; Vijayasarathy & Turk, 2008, p.1
Increased productivity	Eloranta et al., 2016, p.202; Rigby, Sutherland & Takeuchi, 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Increased internal/external communication	Eloranta et al., 2016, p.202; Kamei, Pinto, Cartaxo & Vasconcelos, 2017, p.3; Petersen & Wohlin, 2009, p.1488; Pikkarainen et al., 2008, p.318
Increased collaboration	Dybå & Dingsøyr, 2008, p.850; Eloranta et al., 2016, p. 202; Kamei et al., 2017, p.3; Pikkarainenet al., 2008, p.304; Vijayasarathy & Turk, 2008, p.1
Improved team morale	Eloranta et al., 2016, p.202; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Early feedback through frequent deliveries	Eloranta et al., 2016, p.202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488; Rigby et al., 2016, p.43
Higher customer satisfaction and engagement	Kamei et al., 2017, p.3; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Lower risk of project failure	Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.5
Knowledge transfer and sharing	Dybå & Dingsøyr, 2008, p.850; Kamei et al., 2017, p.3; Vijayasarathy & Turk, 2008, p.5
Increased transparency	Eloranta et al., 2016, p. 202; Petersen & Wohlin, 2009, p.1488
Increased trust	Rigby et al., 2016, p.43; Solinski & Petersen, 2016, p.15
Improved estimation	Dybå & Dingsøyr, 2008, p.850; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488

Improved requirements management	Eloranta et al., 2016, p. 202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488
Faster time-to-market	Eloranta et al., 2016, p. 202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488; Rigby et al., 2016, p.43
Reduced time and cost; improved predictability of schedule/costs/quality	Vijayasarathy & Turk, 2008, pp.1-5; Rigby et al., 2016, p. 45

Table 3: Identified benefits and associated authors; Source: The author

The identified benefits from the literature review – *"communication, collaboration and early feedback through frequent deliveries"* – were assumed to be main benefits in this thesis, which might be transferred to FFP projects and were therefore part of the research questions. As someone may argue that e.g. it should be clear that applying principles, values and practices for communication will lead to *"increased internal/external communication,"* these benefits were not included in the theoretical model.

2.3.2 Challenges in Agile project management projects

The literature review also identified several challenges that arise when adopting APM. Fitriani, Rahayu, and Sensuse (2016, pp.159-160), in a systematic literature review, identified thirty challenge themes, while Kamei et al. (2017, p.3) identified twenty challenges. The granularity of the identified challenges reached from general terms such as *"team management"* (Fitriani et al., 2016, p.159) to very specific terms such as *"difficulty managing dependent requirements"* (Kamei et al., 2017, p.3). Unlike the benefits, it was difficult for the findings relating to the challenges to be grouped without aggregating them. Other papers such as Gregory, Barroca, Sharp, Deshpande, and Taylor (2016) came to a similar conclusion. They identified several challenges which they aggregated initially to twenty-seven sub-themes and then further to seven main themes. These main themes were:

- *claims and limitations*: dealing with areas where Agile does not fit well or has its shortcomings, e.g. public sector, as they require more plan-based approaches
- *organisation*: deals with organisational limitations, e.g. missing management support

- *culture*: deals with the attitude of the company regarding Agile, e.g. trusting more in people than in processes
- *teams*: deals with all people-relevant topics, e.g. finding motivated people
- *sustainability*: such as documentation or contracts
- *scaling*: e.g. Agile in large teams
- *value*: e.g. difficulty of showing progress

These themes have been adopted for clarity by the author and enriched the relevant themes/citations. In addition, one main theme *"methodology"* was added, as several challenges related to the Agile methodology were identified.

The main challenges are depicted in Table 5 below.

Identified challenges	Related theme / Cited in
Claims and limitations	• Misconceptions, shortcomings, hype, failure (Gregory et al., 2016, p.9)
Organisation	• Business & IT transformation, management buy-in and understanding, Agile in non-Agile environment, commitment/engagement, adoption, fear (Gregory et al., 2016, p.9) • Organisation, social (Fitriani et al., 2016, p. 159) • Requires maturity, commitment and pro-activeness (Kamei et al., 2017, p.3) • Education, experience and commitment, stakeholder communication and involvement, roles in Agile set-up, legislation (Nuottila, Aaltonen, & Kujala, 2016, p.52) • Lack of stakeholder involvement, management support (Vijayasarathy & Turk, 2008, p.1)
Culture	• Organisational culture, changing mindsets, national culture, distributed themes, trust (Gregory et al., 2016, p.9) • Developer fear caused by transparency of skill deficiencies, increased reliance on social skills, lack of developer motivation to use Agile methods, the need for Agile-compliant performance evaluation (Conboy et al., 2011, p.55)
Teams	• Team practices, leadership, finding good people, individual motivation (Gregory et al., 2016, p.10) • Team management, distributed team (Fitriani et al., 2016, p.159) • Difficulty working in large teams, increased specialisation of team members, interference of Product Owner with technical skills, difficulty working with a very closed person, difficulty working with non-Agile people, difficulty concentrating in co-location teams, increased pressure for delivery of work (Kamei et al., 2017, p.3)

	• The need for developers to be master of all trades, implications of devolved decision making, lack of Agile-specific recruitment policies and suitably trained IT graduates (Conboy et al., 2011, p.55) • Location of the Agile teams (Nuottila et al., 2016, p.52) • Need for significant on-site customer involvement (Vijayasarathy & Turk, 2008, p.1)
Sustainability	• Process improvement, documentation, contracts, knowledge sharing (Gregory et al., 2016, p.10) • Documentation, technical, deployment, architecture, product quality, sustainability, non-functional requirement, CMMI, cloud computing (Fitriani et al., 2016, p.159) • Little documentation, formalism on meetings can inhibit good communication, little focus on architecture development (Kamei et al., 2017, p.3) • Lack of business knowledge among developers (Conboy et al., 2011, p.55) • Documentation (Nuottila et al., 2016, p.52) • Opposition to pair-programming, reduced focus on code base (Vijayasarathy & Turk, 2008, p.1)
Scaling	• Large projects, governance (Gregory et al., 2016, p.10) • Increased time of activities, difficulty monitoring distributed projects (Kamei et al., 2017, p.3) • Complexity of software architecture and system integration (Nuottila et al., 2016, p.52)
Value	• Business value, measurement (Gregory et al., 2016, p.10) • Difficulty of showing progress in projects without GUI, difficulty identifying individual contributions (Kamei et al., 2017, p.3)
Methodology	• Requirement prioritisation, changing and over-scoping requirement, process, progress monitoring and feedback,

	familiarity with Agile, customer, planning, training, testing, communication, project management, decision making, budgeting, definition of done, product backlog (Fitriani et al., 2016, p.159) • Difficulty working with user stories, difficulty applying/adapting the method/practice, difficulty working with open scope, difficulty managing dependant requirements (Kamei et al., 2017, p.3) • The need to understand and learn Agile values and principles, not just the practices (Conboy et al., 2011, p.55) • Scope creep, lack of detail cost evaluation (Vijayasarathy & Turk, 2008, p.1)

Table 4: Identified challenges and associated authors; Source: The author

2.3.3 Effectiveness in Agile project management projects

Applying APM has some impacts on effectiveness, which have mostly been identified and documented in the literature as benefits, but which have not been explicitly distinguished as effectiveness. Although perceived as benefits, they have an impact on effectiveness as they help in doing the right thing (2.2.6). Therefore, and with regard to answering the research questions, these benefits from literature were mapped additionally to the category of effectiveness.

The main aspects were increased productivity due to minimising waste and focussing on high business value product features, which are directly related to delivering most valuable products faster to market (Rigby et al., 2016, p.43). In addition, an improved predictability of schedule/costs/quality lowers the risk of project failure (Vijayasarathy & Turk, 2008, pp.1-5). This is achieved through more precise requirements due to reduced scope (Petersen & Wohlin, 2009, p.1488) and better control on managing changing priorities (Eloranta et al., 2016, p. 202). Finally, this approach helps to meet customer expectations (Solinski & Petersen, 2016, p.15), which all means doing the right thing. The aspects related to effectiveness are depicted in Table 5 below.

Aspects related to effectiveness	Cited in
Increased productivity	Eloranta et al., 2016, p.202; Rigby, Sutherland, & Takeuchi, 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Brings the most valuable products to market	Rigby et al., 2016, p.43; Solinski & Petersen, 2016, p.15
Faster time-to-market	Eloranta et al., 2016, p.202; Rigby et al., 2016, p.43; Solinski & Petersen, 2016, p.15
Lower risk of project failure	Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.5
Requirements are more precise due to reduced scope	Petersen & Wohlin, 2009, p.1488
Better control on managing changing priorities	Eloranta et al., 2016, p.202
Meeting customer expectation	Solinski & Petersen, 2016, p.15
Improved predictability of schedule/costs/quality;	Vijayasarathy & Turk, 2008, pp.1-5
Reducing the time squandered on micromanaging functional projects	Rigby et al., 2016, p.45

Table 5: Identified aspects related to effectiveness and the associated authors; Source: The author

Related to the research question this means that plain APM literature is suggesting a positive impact on effectiveness, as identified by the studies.

2.3.4 Efficiency in Agile project management projects

Applying APM has some impacts on efficiency, which have also mostly been identified and documented in the literature as benefits or challenges, but which have not been explicitly distinguished as efficiency. Although perceived as benefits or challenges, they have an impact on efficiency as they help or prevent in doing things right (2.2.6). Therefore, and with regard to answering the research questions, these benefits and challenges from literature were additionally mapped to the category of efficiency.

The main aspects for a positive impact on efficiency were increased productivity due to minimising waste and focussing on high business value product features (Rigby et al., 2016, p.43), which is directly related to reduced time and cost (Solinski & Petersen, 2016, p.15) and reduction of waste (Petersen & Wohlin, 2009, p.1488). In addition, it was reported that APM uses test resources more efficiently (Petersen & Wohlin, 2009, p.1488). As a challenge with a negative impact on efficiency, scope creep was mentioned, which leads to a lack of detailed cost evaluation (Vijayasarathy & Turk, 2008, p.1).

The aspects related to efficiency are depicted in Table 6 below.

Aspects related to efficiency	Cited in
Increased productivity	Eloranta et al., 2016, p.202; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Reduced time and cost	Solinski & Petersen, 2016, p.15; Vijayasarathy & Turk, 2008, p.1
Reduction of waste	Petersen & Wohlin, 2009, p.1488; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1
Reduced need for documentation	Petersen & Wohlin, 2009, p.1488
Testing resources are used more efficiently	Petersen & Wohlin, 2009, p.1488
Scope creep	Vijayasarathy & Turk, 2008, p.1
Lack of detailed cost evaluation	Vijayasarathy & Turk, 2008, p.1

Table 6: Identified aspects related to efficiency and the associated authors; Source: The author

Related to the research question this means that APM literature is suggesting an overall positive impact on efficiency – except scope creep – as identified by the studies.

2.4 Review of literature on firm-fixed-price contracts

This chapter provides an understanding about the benefits and challenges of using FFP contracts in project management. The literature review was conducted as explained in Section 2.1. The search strings used for the literature review were:

- (“impact” OR “fixed-price”) AND (“project success” AND “software”)
- (“challenges” OR “issues” OR “limitations” OR “disadvantages”) AND (“traditional project management” OR “waterfall” OR “fixed-price”)
- (“benefits” OR “advantages”) AND (“traditional project management” OR “waterfall” OR “fixed-price”)
- (“effectiveness” OR “effective”. OR “efficiency” OR “efficient”) AND (“agile” OR “traditional project management” OR “waterfall”)
- (“collaboration” AND “fixed-price” AND “software”)
- (“success factor” AND “project management” AND “software”)

2.4.1 Benefits in firm-fixed-price projects

There are benefits from FFP contracts on the customer and supplier sides as identified in the existing literature. According to Ambler (2008b), Gaebert (2014a, 2014b), Hoda, Noble and Marshall (2009), Khan and Roy (2014) and Lindsjørn and Moustafa (2018), the benefits for the customers are that they are able

- to reduce their financial risk,
- to choose the supplier with the lowest offer,
- to make their budget planning, and
- to ensure that projects are chosen with the highest ROI.

In addition, the customer *“has the chance to exert pressure on the supplier by threatening to reject the system and to deny paying the agreed-upon price”* (Gaebert, 2014a, p.5).

The supplier has almost no benefits, except that of adding a big buffer on top of the margin as a security buffer, which she can earn if everything goes well (Khan & Roy, 2014, p.73).

2.4.2 Challenges in firm-fixed-price projects

In order to mitigate the risks on the customers' and the suppliers' sides, a considerable amount of upfront specification is needed, where the scope of the project is explained in detail (Dvir & Lechler, 2004, p.26). Gaebert (2014b, p.11) identified that unclear, incomplete or changing requirements are usual, but the problem is that customers are not willing to change the price if they change the requirements. This poses the risk of friction, as cost, scope and schedule might be affected. Accordingly, De Bakker et al. (2010, p.500) point out in their paper that the requirements will almost certainly change during the project and therefore have an impact on the time plan and project budget. They continue that this makes it almost impossible to provide appropriate time and budget estimates at the beginning of a project. In addition, the literature revealed that FFP contracts inhibited communication and collaboration (Gaebert, 2014a; Jørgensen, 2006; Lindsjørn & Moustafa, 2018, p.2; Moløkken-Østvold & Furulund, 2007; Müller & Turner, 2007; Sadeh, 2000), but at the same time communication and collaboration were identified as critical success factors (Wysocki, 2011, p.50). The result of no direct interaction and missing frequent increments, as intended in Agile, may lead to a lack of trust between the customer and the supplier, as the created customer value cannot be proven (Lindsjørn & Moustafa, 2018, p.3). This could then end in discussions as to whether the contract is fulfilled, since the customers *"have the final decision in acceptance testing"* (Lindsjørn & Moustafa, 2018, p.3).

2.4.3 Effectiveness in firm-fixed-price projects

Within an FFP contract adaptations to changing customer needs are hardly possible (De Bakker et al., 2010, p.500). Because of the comprehensive documentation and the contract type, little or no communication between the parties involved is needed (Deusan, 2014). Therefore, it is hard to be effective for two reasons. Firstly, if feedback is hardly possible before delivery at the end of the project, it is not clear if the supplier has understood the specifications as intended by the customer. Secondly, even if the supplier knows what the customer has originally specified, customer needs might have changed since the specifications were written, and the supplier risks delivering something which is no longer needed. As stated in Section 1.1, project success nowadays is no longer measured by being on time, on budget and within scope only, but also in value and customer satisfaction. Thus, continuous feedback from the customer

and adaptations to her needs is crucial for meeting her expectations, i.e. the project success (Bernier et al., 2012, p.34).

2.4.4 Efficiency in firm-fixed-price projects

There is some evidence in literature that the iron triangle can improve efficiency, as reported by Cockburn (2004, p.4) and Zulkefli et al. (2011, p.972). However, Zulkefli et al. (2011, p.972) conclude that within the constraints of the iron triangle team efficiency is likely to improve, as the team focusses more on the budget, scope and schedule. Beyond that, it is understandable that in a linear way of executing projects, if the scope, time and budget remain fixed, the project can be planned and executed in the most efficient way, as project constraints are predetermined up front. That is why TPM uses many project management techniques such as CPM, PERT, WBS or EVM to measure, optimise and control the project performance based on cost and schedule (Sone, 2008, p.5), as described in Section 1.2.

2.5 Linking the concepts of Agile project management and firm-fixed-price projects

This section provides an approach to conduct APM in an FFP context. The literature review was conducted as explained in Section 2.1. The search strings used for the literature review were:

- “fixed-price” AND (“agile” OR “software”)
- (“contract type” AND “agile” AND “software”)
- (“agile” OR "fixed-price") AND (“project success” AND “software”)
- (“agile” AND “vs” AND (“traditional project management” OR “waterfall”))

2.5.1 Scrum in firm-fixed-price projects

Several surveys – which can be regarded as reliable[14] – have been conducted, figuring out the benefits of plain APM, showing high improvements in productivity, quality, time-to-market, cost reduction and enjoying higher success rates (Ambler, 2008a; Rico, 2007; The

[14] For example, The Standish Group report (2015, p.13) contains the evaluation from about 50,000 projects around the world.

Standish Group, 2015; VersionOne, 2013). As APM has become mainstream (McAvoy & Butler, 2009, p.372) and highly accepted in large firms as the standard software development approach, the demand to also apply these techniques in FFP projects has risen. In general, APM contrasts with the idea of FFP projects (Hoda, Noble, & Mashall, 2009, p.188; Lindsjørn & Moustafa, 2018, p.1) because it assumes that requirements in a complex environment are nearly always unpredictable, and therefore only minimal planning, documentation and specification can be done up front. That is exactly the opposite of FFP projects, where everything is fixed in upfront specifications and upon which the price is calculated. Also, it can be challenging to follow the Agile value *"collaboration over contract negotiation"* in FFP projects where customers demand fixed-price, fixed-scope and fixed-schedule (Lindsjørn & Moustafa, 2018, p.1). Therefore, FFP projects have largely been avoided in APM literature and practice, and even Agile evangelists such as Ken Schwaber confirm that there are no simple recipes for handling such projects without reverting to traditional heavyweight project management methodologies (Schwaber, 2004). Furthermore, Fowler (2001) advocates avoiding FFP in APM projects, as there might be a negative impact on the sponsor and the supplier. FFP projects need clear initial user requirements and clear project goals, with a very low level of uncertainty (DeCarlo, 2004; Wysocki, 2011). Furthermore, Gupta and Dwivedi (2015, p.137) emphasise that plan-based approaches only work well if the requirements are static. This applies only to a few projects, as software development projects mostly act in turbulent business environments (Sone, 2008, p.9). However, Zulkefli et al. (2011, p.972) state that applying Agile principles is well suited to FFP projects. They report that applying APM within the constraints of the iron triangle can improve team efficiency, as the team focusses more on the budget, scope and schedule. Furthermore, unlike most of the authors of the Agile manifesto, Cockburn (2004, p.4) states that he applies Agile principles due to the need for efficiency and not due to the need for handling changing requirements. In this regard, Franklin (2008, p.273) reports that APM can be successful in FFP projects through first-hand collaboration, communication and by keeping the features streamlined to what is needed, and no more. She reports that the customer may change whatever she wants if the change stays within budget and the documented milestones can be achieved. Accordingly, Fowler (2001) and Schwaber (2002) mention that there might be an option to use APM in FFP projects when the scope is not fixed, i.e. can be exchanged under several preconditions.

Therefore, and because of the identified need for FFP projects (Balaji, 2013, p.248; Franklin, 2008, p.270), a conditioned combination of both approaches might represent a golden mean, if

certain trade-offs are acceptable given the project environment. For example, continuous feedback from the customer should be possible even if not on-site and with the intensity as intended by Agile. In return, the customer could discuss how her changed business needs might be reflected in the project without adding cost and affecting the schedule.

For a better overview of the field of tensions, the distinct characteristics of both approaches (APM and FFP), which are relevant to the research questions, are depicted in Table 7.

Characteristics	APM	FFP project
Communication	Strongly needed	Low requirement
Collaboration	Strongly needed	Low requirement
Short feedback cycles	Promoted throughout the whole process.	At the end of the project, or upon agreed milestones
Effectiveness	Promoted through communication, collaboration, and short feedback cycles	Strongly tied to the contract and thus to a project plan, which might be obsolete through new insights
Efficiency	Promoted through continuous process improvements (retrospective meeting), MVP, keep it simple principle	Iron triangle promotes efficiency
Iron triangle: scope	Flexible through emerging projects and continuous planning	Fixed through upfront specification and contract, must be clear and static
Iron triangle: budget	Flexible, but often limited	Fixed through the contract
Iron triangle: schedule	Flexible, but often limited	Fixed through the contract
Project implementation quality	High through applied Agile software techniques	Might be lower through cost pressure
Project environment	Uncertain and dynamic, iterative	Certain and static, plan-based

Table 7: The characteristics and differences between APM and FFP; Source: The author

The depicted characteristics will serve as input for the further research on how both approaches might be linked, and which trade-offs have therefore to be made. How this can be achieved is discussed later in Chapter 5.

2.6 Summary and conclusion of the literature review

The literature review has revealed that the core idea of Agile is assumed to deal in the most effective way with meeting customer expectations, through focussing on value generation by adapting to a changing business environment. This is achieved through intensive communication and collaboration by a self-organising cross-functional team, which includes the customer representative, relying on short feedback cycles based on regularly delivered working software. However, the literature review has confirmed that customers, especially from the public sector or larger firms, demand FFP projects to mitigate their risks, and to choose the projects with the highest ROI. FFP projects come along with the iron triangle and are mostly associated with a heavyweight project management approach. They require a lot of detailed upfront specification, which defines the project scope at the beginning of the project. As everything is fixed in the contract and in the specification, the need for collaboration and communication is less present. Thus, a higher risk of not meeting stakeholder expectations exists, as the product is delivered to the customer at the end of the project and hardly any feedback is available beforehand. In addition, the flexibility to adapt to new business demands can be lost. Because of the steady cost pressure, the quality might suffer, but on the other side the supplier might be more efficient with the limited resources.

Finally, the literature review has shown that APM and FFP projects are well-researched fields, but the combination of both fields is predominantly discussed in the practitioner community. Few academic papers that combine both fields were identified. The literature review has shown that APM and FFP both have their advantages and challenges related to their field of usage. For usage in software development projects, there is some evidence that APM can enrich FFP projects. The conclusion from the literature review is the assumption, for this thesis, that while applying Scrum to FFP software development projects, the benefits surpass the challenges. This is achieved through close communication and collaboration within short feedback cycles, which increase the perceived effectiveness and efficiency. By doing the right thing and avoiding waste the application of APM makes it possible to meet stakeholders' expectations within the project constraints. The literature review fortified the assumption for the theoretical model although it remains vague which benefits and challenges will arise in an FFP context and how they will affect effectiveness and efficiency. Thus, no statement can yet be made if those aspects might be transferred to FFP projects. However, fifteen perceived

benefits, from which twelve were taken for the theoretical model[15], eight perceived challenges, eight identified effectiveness aspects and seven identified efficiency aspects from APM have been added to the theoretical model.

[15] Communication, collaboration and short feedback cycles were left out, as they are part of the research questions.

This is depicted in Figure 7.

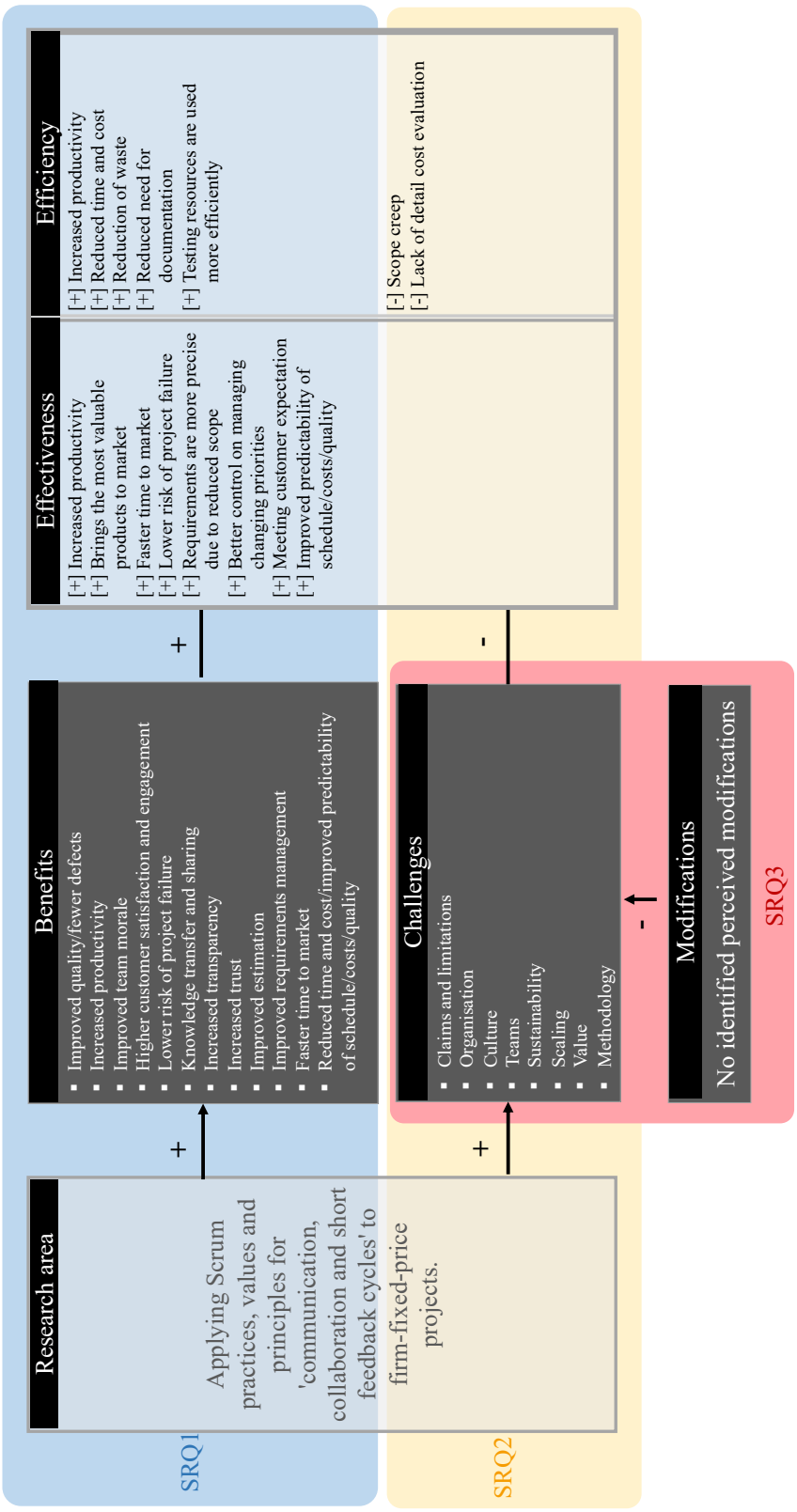


Figure 7: Sub research questions with identified benefits and challenges depicted in a theoretical model; Source: The author

The next chapter outlines the chosen research methodology and why it serves best to evolve the theoretical model and to answer the research objectives.

3 Methodology

Edmondson and McManus (2007) report that *"a growing number of scholars are engaging in field research, studying real people, real problems and real organisations"* (p.1155). They conclude that *"although the potential relevance of field research is motivating"* (p.1155), the research journey is a dynamic and challenging process, which can be very tortuous and inefficient. They identify the following challenges: complex relationships with sites, constraints on sample selection, timing of data collection and mid-project changes to planned research design. To overcome these challenges, they suggest using a *"framework for assessing and promoting a methodological fit as an overarching criterion for ensuring quality field research"* (p.1156). A research framework which guides the research through the process in a structured way is also recommended, as the philosophical approach, the data collection technique and the method of data analysis are dependent upon one another (Howe-Walsh, 2010).

For this research, the overarching research framework for the research design is based on the *"research onion"* from Saunders, Lewis, and Thornhill (2016, p.124). The research onion provides an effective process for defining an appropriate research paradigm. A paradigm consists of four aspects: ontology, epistemology, methodology and methods (Scotland, 2012, p.9). The following sections address the layers of the research onion and explain the particular decisions made for the overall research design. The chapter also discusses the limitations of the chosen approach as well as ethical issues.

Figure 8 depicts the research onion.

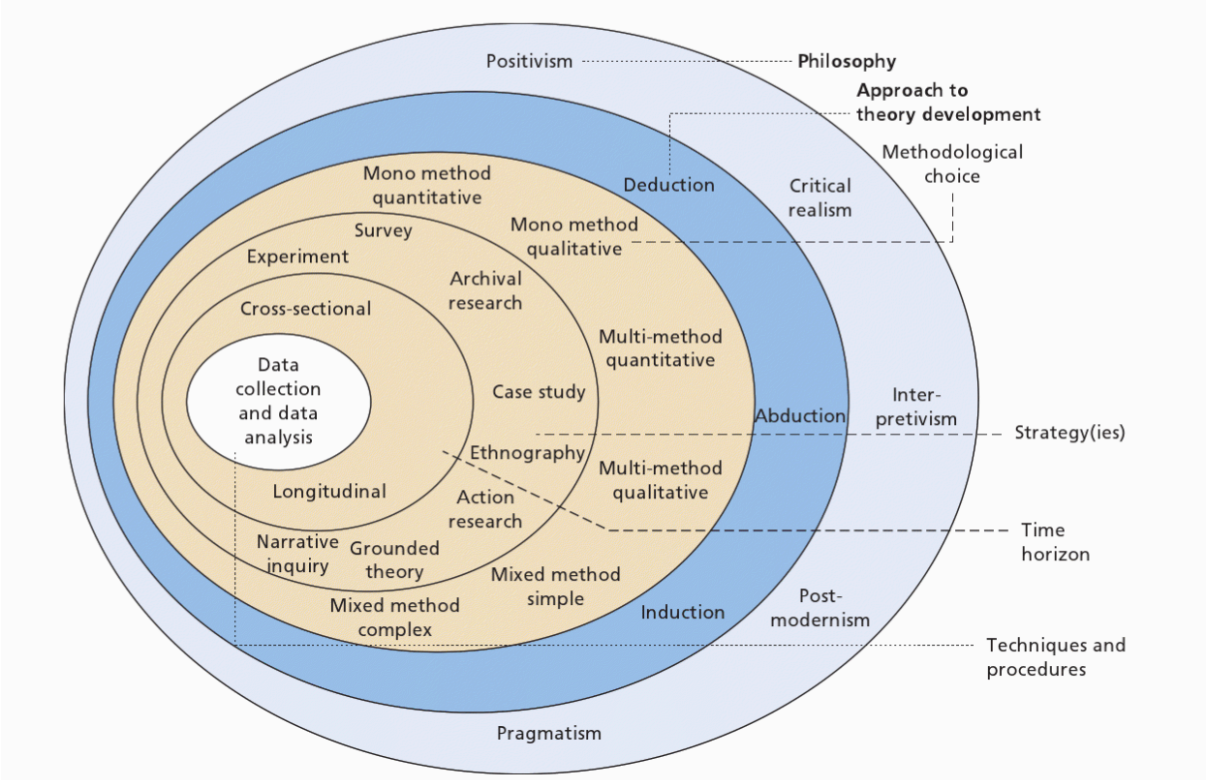


Figure 8: The research onion; Source: Saunders et al., 2016, p.124

3.1 Research philosophy

Different research philosophies *"are 'suited' to achieving different things."* (Saunders et al., 2012[16]; p.129). Saunders et al. (2012) conclude that one research philosophy is not better than another as *"[…] this depends on the research question(s) you are seeking to answer"* (p.129). To answer the research questions the debate on ontology and epistemology is unavoidable, as it influences the perspective of *"what is the nature of reality, what is considered acceptable knowledge and what is the role of values?"* (Saunders et al., 2016, p.129). Thereby, ontology addresses the nature of reality and existence (Easterby-Smith, Thorpe, & Jackson, 2015, p.46; Saunders et al., 2016, p.127), whereas epistemology is about the theory of knowledge

[16] An update to Saunders 2016 has been conducted at the end of the research. It figured out that some citations were missing in the 2016 version, although they were still valid and important. Therefore, an update has been conducted where possible, and the older citations have been kept, where appropriate.

(Easterby-Smith et al., 2015, p.46) and can be defined as the relationship between the researcher and the reality identified through ontology (Carson & Gilmore, 2006).

3.1.1 The nature of reality (ontology)

There are two aspects of ontology which *"are likely to be accepted as producing valid knowledge by many researchers"* (Saunders et al., 2012, p.131) – objectivism and subjectivism. The latter is also sometimes called constructionism (Bryman & Bell, 2015, p.32). Objectivism is an ontological position that asserts that certain things, such as that social phenomena and their meanings have an existence that is independent to those social actors who are concerned with their existence (Bryman & Bell, 2015, p.32; Crotty, 1998, pp.5-6), whereas subjectivism or constructionism assumes that *"social phenomena are created through the language, perceptions and consequent actions of social actors"* (Saunders et al., 2016, p.151). Regarding the field of this research, which explores how APM is perceived to be effective and efficient in the context of FFP software development projects, the ontological perspective is subjective, as the focus is on how the stakeholders perceive the effectiveness of Agile within FFP software development projects and its meaning for the project's success. The project context, i.e. the organisational context and the social actors, depends on individuals and their organisational environment. In this context, the researcher views the world as a subjective construction. A subjective view allows the acknowledgment and an appropriate consideration of individual perspectives, perceptions and interpretations of a specific project context (Pioch, 2017, p.40).

3.1.2 Considered acceptable knowledge (epistemology)

Epistemology is concerned with what constitutes acceptable knowledge in the field research (Saunders et al., 2016, p.127). Based on the ontological stance, the researcher has to choose an epistemological stance to derive an appropriate research design. Regarding the epistemological perspective, many authors differentiate between the choice of a positivist or an interpretivist research philosophy (Easterby-Smith et al., 2015; Saunders et al., 2012, p.129). Besides these, three further research philosophies have gained more attraction over the past few decades in business and management research (Saunders et al., 2016, p.125), namely pragmatism, postmodernism and critical realism, although positivism and interpretivism are still regarded as the two dominant paradigms (Saunders et al., 2012, p.129; Snape & Spencer, 2003, pp.8-9).

Positivist research adopts the stance of a natural scientist, i.e. that only an observable reality will lead to the production of credible data (Saunders et al., 2016, p.135). Becker, Holten, Knackstedt, and Niehaves (2003, p.8) emphasise that the ontological position of positivism is that there is an existing world, and therefore the epistemological point of view is that it is possible to gain knowledge objectively. Positivism tries to explain how and why things happen. Therefore, the focus lies on testing hypotheses, understanding and explaining cause-and-effect relationships and on formulating laws and theoretical models (Scotland, 2012, p.10). Hence, the data collection in positivism is mostly related to large samples of quantitative data, e.g. that gained from using standardised tests or closed-ended questionnaires (Scotland, 2012, p.10). In addition, qualitative data gathering, e.g. through interviews, is possible if the results can be quantified (Saunders et al., 2016, p.138). Regarding the underlying research question, the literature review showed there is little empirical data or literature to substantiate cause-and-effect relationships between APM and FFP and their impact on effectiveness and efficiency. Thus, another approach might be more appropriate to understand or even explain how APM might work in the FFP context and how it affects effectiveness and efficiency rather than focusing narrowly on causal relationships.

Interpretivism is regarded as the other end of a continuum of the research paradigm. Becker et al. (2003, p.8) emphasise that in interpretivism no objective world exists, and its epistemological position is that it is not possible to gain knowledge objectively. Interpretivism *"with its focus on complexity, richness, multiple interpretations and meaning-making"* (Saunders et al., 2016, p.141*) "is explicitly subjectivist"* and differs from person to person (Scotland, 2012, p.11) – i.e. reality is socially constructed. Regarding the same phenomenon, different people might construct meaning in different ways (Crotty, 1998, p.9). Knowledge is gained by focussing on the details of a situation. In contrast to positivism, interpretivism tries to understand why and how things happen in a complex environment. Thus, research questions are broad (Scotland, 2012, p.12). This approach is well suited to the underlying question of this research. Rather than testing a hypothesis as is done in positivism, the underlying research question is open-ended as the aim of this research is to explore if APM, using the Scrum process framework, is perceived to be effective and efficient in the context of FFP software development projects and, if the perception is positive, to understand why and how APM is perceived to be beneficial within an FFP context.

Positivism claims to be value-free; meanwhile, interpretivism is usually value-bound, and focuses on the understanding of human behaviour, while acknowledging human nature (Bryman & Bell, 2015, pp.28-30). The role of the researcher's values, which are applied to the research process, is important, as they influence the credibility of the research results (Saunders et al., 2016, p.128). These values will influence the research results, i.e. two researchers who apply different values to the same research process might get different results. Therefore, a critical evaluation of the corroboration process such as triangulation, member checking or peer review in this research process is necessary, as *"interpretive research cannot be judged using the same criteria as the scientific paradigm"* (Scotland, 2012, p.12).

As it is people who conduct projects, and because the success of a project is highly dependent on them, an understanding of human behaviour is practically relevant, and the research should therefore contribute to professional practice (Dent, 2002). The lack of testable data might be compensated with small samples of in-depth investigations as is offered by the interpretivism paradigm (Saunders et al., 2016, p.136) in order to create better insights in a complex area. As with the other paradigms, the interpretive paradigm has its strengths and shortcomings, but it is an appropriate philosophy for the chosen research topic as it promises valuable insights and understandings of behaviour and perceptions to explain actions from the participant's perspective. Consequently, the interpretative paradigm has been adopted for conducting this research.

Apart from positivism and interpretivism, realism – or more specifically critical realism – provides a third research paradigm. It provides a trade-off between positivism and interpretivism in combining certain aspects of both. Critical realism offers a wide range of possible research methods and mixed method approaches (Tashakkori & Teddlie, 2010). According to Becker et al. (2003), the ontological position for realism is that there exists an objective world as in the positivism stance, but mostly it is not possible to gain knowledge objectively, thus subscribing to an epistemological position reminiscent of the interpretivism stance. The axiology of critical realism is value-laden (Saunders et al., 2016, p.136). To be able to choose between different research methods and research approaches is tempting, but the underlying research work is better served by the chosen interpretative paradigm. An interpretative stance seems more appropriate, as for example to understand how and why APM works in an FFP context can differ from project context to project context and in the perception of the project members involved.

In the 7th edition of the Saunders et al. (2016) research onion, postmodernism has been added. Similar to interpretivism, postmodernists critique the positivist and objectivist stance, emphasising *"the chaotic primacy of flux, movement, fluidity and change."* (Saunders et al., 2016, p.141). According to Saunders et al. (2016, p.141), postmodernism credits the important role of language by recognising that any sense of order is provisional and only built through our language with its categories and classifications. They emphasise that there *"is no order to the social world beyond that which we give to it through language, there is no abstract way of determining the 'right' or the 'true' way to describe the world."* (p.142). The goal of postmodern research is to radically challenge the established ways of thinking and knowing (Kilduff & Mehra, 1997, pp.454-455). Therefore, postmodernism seeks to expose and question the underlying foundation of realities (Calás & Smircich, 1997) and tries to deconstruct instabilities of these realities to highlight what truth is missing. As the aim of this research is not to deconstruct realities to highlight what truth is missing but to understand and possibly explain realities, this research philosophy does not seem to be appropriate to answer the research questions and was therefore rejected.

A fifth paradigm which is mentioned by Saunders et al. (2016) is pragmatism. They emphasise that pragmatists recognise that there are many different ways of interpreting the world and undertaking research. They claim that no single point of view can reflect the whole truth. Thus, pragmatists use multiple approaches, depending on a given research question. Although this approach seems to be the most flexible, and using multiple philosophies is very tempting, this research focussed on a single choice of philosophy instead of changing between them and interpreting every situation in the manner of the philosophy used. This is especially relevant in a context where the field of research is highly subjective, as the projects are conducted by individuals who might all perceive the project context in their own view, which leads to a subjective perception.

3.2 Research approach

There are three approaches that link theory with research progress – deduction, induction and abduction (Saunders et al., 2016, p.145). With deduction, one or more hypotheses are developed and tested using reliable data (Bryman & Bell, 2015, p.23). In contrast to deduction, the inductive approach first collects data and out of that data analysis an untested theory is developed (Bryman & Bell, 2015, p.25; Saunders et al., 2016, p.146). Abduction includes both approaches. Data are first used to explore a phenomenon and to develop or modify one or more theories (inductive approach), which are tested afterwards (deductive approach), often through further data collection (Saunders et.al, 2016, p.148). Reichertz (2004, p.161) points out that on the basis of interpreted data, through assembling or discovering, new explanations might be invented or discovered by means of a mental process. He emphasises that this logical form of operation is abduction and that *"abduction is therefore a cerebral process, an intellectual act, a mental leap, that brings together things one had never associated with one another"* (p.161). The abductive approach is appropriate for a topic *"about which there is a wealth of information in one context but far less in the context in which you are researching* [...] *enabling you to modify an existing theory"* (Saunders et al., 2016, p.149), which is the case for this research. The literature review revealed that APM – specifically Scrum – and FFP projects are well researched fields, but their combination and how Scrum has to be modified is rarely researched. Therefore, the abductive approach was used with induction as the predominant approach. The chosen approach is suitable to answer the research question by exploring a phenomenon, identifying themes and patterns to possibly evolve the theoretical model and to modify the Scrum framework, and testing the modification through subsequent data collection. Saunders et al. (2016) argue that *"in practice, much qualitative research uses an abductive approach, where inductive inferences are developed, and deductive ones are tested* […]*"* (p.168).

3.3 Methodological choices

Methods are specific techniques and procedures which are used to gather and analyse data related to the research question or hypothesis (Crotty, 1998, p.3). The collected data can be either of a quantitative or qualitative nature (Bryman & Bell, 2015, p.37; Scotland, 2012, p.10) and their application depends on the chosen research paradigm. Scotland (2012, p.10) points out that all research paradigms can use both types of data. However, within the positivist paradigm quantitative data dominates, whereas for the interpretative paradigm qualitative data is more likely (Saunders et al., 2016, pp.166-168). Although there are only two types of data, it is possible to use one or several, or to mix them. This results in a methodological choice of mono-method or multiple methods, whereby multiple methods are again divided into multimethod using the same data type, or mixed methods mixing both types of data (Saunders et al., 2016, p.165), as depicted in Figure 9.

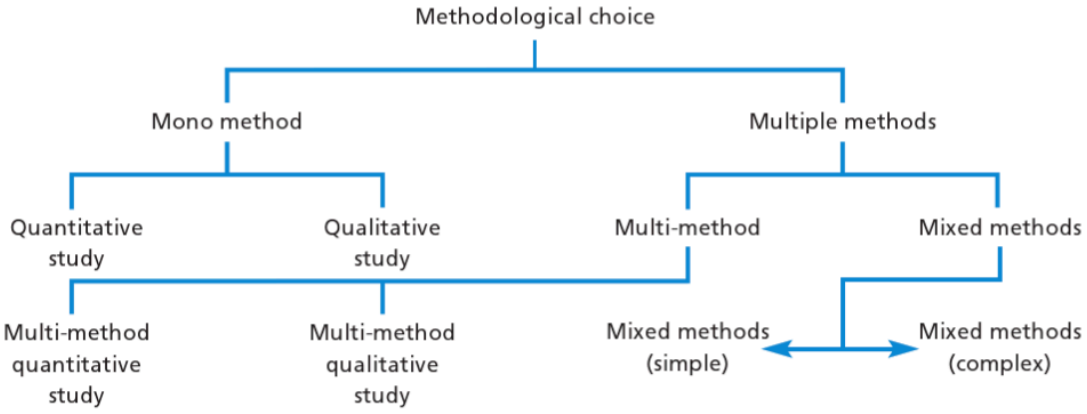


Figure 9: Methodological choice; Source: Saunders et al. (2016, p.167)

Multiple methods are increasingly advocated within business and management research as they promise a wider approach for data collection, analysis and interpretation (Saunders et al., 2016, p.166) within the investigation of complex phenomena. This explains the increasing number of variants of multiple research designs (Tashakkori & Teddlie, 2010), even though often narrowed down to mixed methods with the *"combined use of qualitative and quantitative methods"* (Morse, 2010, p.483) as the dominant research approach. Therefore, multiple methods are often called mixed methods (Creswell, 2014, p.43) and the terms are used synonymously. The timing within a multiple method research process might be either simultaneous or sequential. The characteristic of a multiple method design is that the design consists *"of a complete method (i.e. the core component), plus one (or more) incomplete method(s) (i.e. the supplementary component[s]) that cannot be published alone, within a*

single study." (Morse & Niehaus, 2009, p.9). Thereby, *"the supplementary component provides explanation or insight within the context of the core component, but for some reason the supplementary component cannot be interpreted or utilised alone"* (Morse, 2010, p.484).

Based on the philosophical position of interpretivism, a multi-method sequential qualitative approach was chosen for this research for the reasons set out below.

The literature review showed that the underlying field of research, namely the combination of APM and FFP, is nascent. Nascent means that *"little or no previous theory exists"* (Edmondson & McManus, 2007, p.1161). For a nascent research field, Edmondson and McManus (2007) recommend an *"open-ended inquiry about a phenomenon of interest"* (p.1160) with qualitative, initially open-ended data that have to be interpreted for meaning. Thus, this research is exploratory by nature, and rather than testing a theory based on quantitative data, the research questions were open-ended to create meaning and understanding in the field of research. Whilst quantitative data in general is able to provide a *"broad generalisable set of findings"* (Patton, 1987, p.9) based on large data populations, and to deduce general laws, the chosen qualitative approach is able to produce *"detailed data about a much smaller number of people and cases"* (Patton, 1987, p.9) to create meaning and understanding, with the emphasis on the generation of theories (Bryman & Bell, 2015, p.38). Qualitative research allows the researcher to make assumptions about the meaning and relevance of concepts (Willig, 2013, p.24). Qualitative research is associated with the chosen interpretive philosophy (Denzin & Lincoln, 2018), as *"the researchers need to make sense of subjective and socially constructed meanings expressed about the phenomenon being studied"* (Saunders et al., 2016, p.168). The qualitative approach allows an in-depth understanding of the participants' experiences (Willig, 2013, p.185).

The first qualitative data gathering phase with semi-structured interviews was used as the core component to explore the phenomenon and to identify themes and patterns. As an outcome, the theoretical model and the Scrum framework were preliminarily modified. After the analysis of the first phase, the second qualitative data gathering phase was then used as the supplementary component to corroborate the identified themes and patterns, the theoretical model and the modified Scrum framework through two semi-structured focus group interviews, with the goal of gaining a better understanding of why and how the modified Scrum framework is perceived to be beneficial within an FFP context.

3.4 Research strategy

As shown in Section 3.3 the underlying field of research is still nascent. For nascent research domains, Edmondson and McManus (2007, p.1160) recommend qualitative data collection through interviews and observations in order to identify patterns, which produces an untested theory. As the main research question is primarily of an explorative nature, seeking to understand *"how can applying the Agile practices, values and principles of 'communication, collaboration and short feedback cycles' used in the Scrum process framework help project stakeholders to increase the perceived effectiveness and efficiency in the context of fixed-price software development projects?"*, a research strategy must be used which helps to identify patterns. The research strategy is the methodological link between the chosen philosophy and the subsequent choice of methods to collect and analyse data (Creswell, 2014, p.5; Denzin & Lincoln, 2018). Thereby, the choice of the research method *"should be determined by the research interests, the circumstances of the setting or people to be studied, and practical constraints faced by the researcher"* (Bogdan, Taylor, & DeVault, 2016, p.104). Regarding the choices of research strategies in general, Saunders et al. (2016) provide several alternatives: *"experiment, survey, archival and documentary research, case study, ethnography, action research, grounded theory and narrative inquiry"* (p.178).

For the underlying field of research, a qualitative survey using in-depth semi-structured interviews followed by two focus group interviews was used to answer the research questions. The justification of the chosen strategy is addressed in Sections 3.4.1 and 3.6.

3.4.1 Survey

According to Saunders et al. (2016, p.181), a survey is normally associated with a deductive research approach and quantitative data. It is a common strategy in business and management research to answer the *"what"*, *"who"*, *"where"*, *"how much"* and *"how many"* questions within exploratory and descriptive research (Saunders et al., 2016, p.181). In contrast to Saunders et al. (2016), Bryman and Bell (2015), Creswell (2014), Fink (2003) and Jansen (2010) distinguish between quantitative and qualitative surveys. Jansen (2010) emphasises that a survey can also be of a qualitative nature using either an inductive (open) or a deductive (pre-structured) approach. He argues that qualitative surveys are widely used *"to study a population through observation of its members* [...]*"* (p.2), although they remain unmentioned in the methodological literature. Furthermore, Bryman and Bell (2015, p.186) clarify that surveys

usually make use of quantitative questionnaires and qualitative interviews as the data collection method. The differences between a quantitative and a qualitative survey are mainly the degree of standardisation, structure and the number of respondents involved (Pioch, 2017, p.43). Quantitative surveys are often related to a higher degree of standardisation, structure and respondents, whereas the qualitative surveys are associated with more flexibility, a lower degree of structure and a smaller number of respondents. Because of the exploratory nature of this research, a qualitative survey was chosen as the most appropriate research strategy to answer the research questions. An exploratory research strategy is useful to clarify the understanding of an issue, a problem or a phenomenon (Saunders et al., 2016, p.175). Thus, the aim of the applied strategy was to explore several completed Agile projects and how they were conducted within an FFP context to identify similarities and/or differences, if they worked well or failed, and their perceived effectiveness and efficiency. The advantage of this approach is that it is flexible and adaptable to change, as through the appearance of new data and insights the direction of the research might be influenced (Saunders et al., 2016, p.175). According to Fink (2003, p.61), qualitative survey analysis is well suited for the exploration of meanings and experiences. To achieve this, *"many empirical studies explore the diversity of certain behaviours or cognitions within a given population, based on some ten to fifty semi-structured interviews with members selected from that population."* (Jansen, 2010, p.2). Consequently, the qualitative survey was conducted using semi-structured interviews among a random sample of twelve experts and two semi-structured focus group interviews.

In the following sections, alternative strategies are briefly discussed and the reasons why they have been rejected for this research are reported.

3.4.2 Experiment

Experiments are used to test hypotheses rather than answering a research question (Easterby-Smith et al., 2015, p.69; Saunders et al., 2016, p.179). According to Saunders et al. (2016), an experiment is used *"to study the probability of a change in an independent variable causing a change in another, dependent variable"* (p.179). In an experiment a null hypothesis is tested statistically (Saunders et al., 2016, p.179), predominantly through the use of large quantitative data samples. An experiment is mostly used within a positivist paradigm. Experiments are rare in business and management research, because it is hardly possible to achieve the necessary level of control to deal with organisational behaviour (Bryman & Bell,

2015, p.53). As this study is of an exploratory nature, based on an interpretative philosophy, it should be clear that an experiment is inappropriate to answer the research question and is therefore rejected.

3.4.3 Case study

Case studies are among the well-known qualitative techniques and are suitable to answer the questions of *"why?"*, *"what?"* and *"how?"* within explanatory and exploratory research (Saunders et al., 2012). A case study is an empirical in-depth inquiry into a topic or phenomenon within its real-life context (Yin, 2014, p.16). This in-depth inquiry might refer to an individual, a group, an organisation, a process or an event (Saunders et al., 2016, p.185) or anything else which relates to a bounded system (Merriam & Tisdell, 2016, p.37). A case study is appropriate to study situations in which it is impossible to separate the phenomenon's variables from their context (Merriam & Tisdell, 2016, p.38). This might be done within a single case or multiple cases over time *"through detailed, in-depth data collection involving multiple sources of information (e.g. observations, interviews, audio-visual material, documents and reports), and reports a case description and case-based themes"* (Creswell, 2013, p.97). Although case studies are often used in software engineering research (Runeson & Höst, 2009), they were not chosen for this field of research, as they are normally focussed on a single critical or, alternatively, an extreme or unique case within a context (Saunders et al., 2016, p.186), which is not the case for this research. In addition, a multiple case study might be possible but was not chosen for this research, as multiple case studies search either for literal replication or theoretical replication of findings from one case (Saunders et al., 2016, p.187). For this research twelve in-depth interviews from different project contexts in different companies, followed by two focus groups interviews, were conducted, the results of which might not be replicated in different contexts. Hence, for this research a case study was not rated as the best approach to explore a context-independent phenomenon and transfer its conclusions to other Agile projects in general.

3.4.4 Ethnography

Ethnography strives to understand the interaction of individuals within the culture of the society in which they live (Merriam & Tisdell, 2016, p.24). Ethnography is used to study groups by joining them over a long period of time (Bryman & Bell, 2015, p.443; Saunders et al., 2016, p.188). Ethnographic research is appropriate for organisations that like to gain in-depth understanding of their markets and the experiences of their consumers (Saunders et al, 2016, p.189). For this research, ethnography was rejected for two reasons. Firstly, joining an organisation to describe and understand the social actions among their employees does not seem appropriate to answer the research questions. Instead of understanding the participants involved, the focus lies on the process of how Agile might work within an FFP context. Secondly, the time needed to join all Scrum meetings is impossible for a part-time study.

3.4.5 Action research

In action research the researcher and the client are jointly involved in the action for change and application of knowledge (Bryman & Bell, 2015, pp.418-419). According to Saunders et al. (2016, p.190), *"action research is an emergent and iterative process of inquiry that is designed to develop solutions to real organisational problems through a participative and collaborative approach"*. Action research is used in business and management to close the gap between researchers and practitioners (Bryman & Bell, 2015, p.419). This seems to be an appropriate approach to apply the findings of this research in a later study. However, at this explorative stage where different projects should be examined to get a better understanding of the researched phenomenon, this approach would be too early. In addition, the time needed to invest in an action research is not possible within a part-time study for the researcher.

3.4.6 Grounded Theory

'Grounded Theory'[17] is a well-known inductive approach, which is used to *"develop theoretical explanations of social interactions and processes in a wide range of contexts, including business and management"* (Saunders et al., 2016, p.193). Thereby, Grounded Theory is a research strategy, which provides a systematic approach to gather and analyse

[17] Grounded Theory as a noun is used as a research strategy and to distinguish this from grounded theory (no capital letters)

qualitative data and to generate or discover a theory (Bryman & Bell, 2015, p.584; Corbin & Strauss, 1994, p.273; Glaser & Strauss, 1967; Saunders et al., 2016, p.193). Typical sources for qualitative data are interviews, observations and documents of all kinds (Bryman & Bell, 2015, p.394; Corbin & Strauss, 1994, p.274). As Grounded Theory can be used to explore a wide range of business and management contexts this approach seems appropriate to undertake the research. Nevertheless, this research serves better with the qualitative survey approach, as Grounded Theory is very time-consuming and intensive (Saunders et al., 2016, p.197), which exceeds the natural limited resources of a part-time study. In addition, Grounded Theory relies mostly on present data and uses literature only as a complementary source instead of using the literature to categorise data (Saunders et al., 2016, p.197), which is not the case in this research. As a result, Grounded Theory does not seem to be the best approach in the context of the envisaged research. However, it must be acknowledged that elements of Ground Theory were used for this thesis, although the focus lay on the chosen research strategy.

3.4.7 Narrative inquiry

The last qualitative strategy is narrative inquiry. According to Saunders et al. (2016, p.197), a narrative inquiry involves a participant who tells a story in an interview. Afterwards, the interviewer tries afterwards to analyse such stories. Because of its intensive and time-consuming nature, this approach is mostly limited to a few meaningful stories. Stories are used to understand a certain situation, which might be used to a certain extent for this research. But a semi-structured approach, as is possible with the qualitative survey, is preferred as it offers the possibility to cover important themes and key questions. However, it must be acknowledged that elements of narrative inquiry were used for this thesis, although the focus lay on the chosen research strategy.

3.5 Time horizon

Regarding the time horizon, a choice between cross-sectional (snapshot) and longitudinal (diary) study must be made. Longitudinal research means that data are collected over a long time period on a continuing basis in order to map change (Bryman & Bell, 2015, p.66), whereas the cross-sectional approach is to study a specific phenomenon at a specific point in time (Saunders et al., 2016, p.200). The chosen approach for this study is cross-sectional as the study examines different accomplished Agile projects within an FFP context. Thereby, the research examines the status quo of successful, challenged or failed projects. Thus, a longitudinal study, which would mean accompanying a project throughout its life cycle, is not in the focus of this research. Firstly, the study is interested in different projects and environments, and not just in one. It would be unrealistic to take part in several projects at the same time over a long period, as it is not feasible in the time allowed for this research. Secondly, the research assumes that a cross-sectional examination of Agile projects gives a clearer picture about the challenges now, in a specific environment. During longitudinal research it is possible that the environment will change which might lead to an ambiguous picture of the researched phenomenon. For example, the underlying law or official practice in terms of warranty and acceptance of a product increment might be changed, which would have a direct influence on the underlying FFP contract and the outcome of a project. Lastly, as this study has limited resources a longitudinal research would not be applicable within the given setup.

3.6 Techniques and procedures

The aim of this section is to describe the techniques and procedures for data collection and data analysis including ethical considerations within this research. Based on the chosen strategy the data collection and analysis process are explained.

3.6.1 Data collection and survey population

As already addressed in Section 3.4, Edmondson and McManus (2007, p.1160) recommend qualitative data collection through interviews and observations in order to identify patterns. Within the chosen strategy, twelve semi-structured interviews and two semi-structured focus groups with experts were chosen as the most appropriate and best applicable data-gathering

methods to answer the research questions. These interviews and the focus groups were conducted with experts, i.e. specialists with a leading knowledge or power in their field. According to Harvey (2011, pp. 1-2), social scientists have increasingly turned their attention towards interviewing experts within one-on-one interviews and focus groups. For this study, experts are defined as follows: they have in-depth experience in Agile and FFP projects, they have conducted a minimum of three Agile projects within an FFP context, or have had a minimum practical experience of two years in that field and occupy, as a minimum, a senior level position at their current work-place. The chosen survey population was CEOs, managers or senior consultants who worked as Agile coaches, Scrum Masters or Product Owners in small, medium or large software development projects within an FFP constraint. As knowledge and perceptions about accomplished projects fade away over time, a time range of the past five years has been preferred, but older experiences were not rejected.

In qualitative research with an exploratory nature, in-depth or semi-structured interviews should be used (Saunders et al., 2016, p.392) and the questions should be open-ended rather than pre-coded (Easterby-Smith et al., 2015, p.129). It is generally advised to avoid asking experts pre-coded questions as they *"do not like to be confined to a restricted set of answers"* (Harvey, 2011, p.7), as pre-coded questions would limit their view within an explorative study. In addition, open questions help to avoid interview bias (Easterby-Smith et al., 2015, p.143), which is the risk that the interviewer asks the question in a manner that leads the respondent towards a certain answer. Based on the twenty years of professional experience of the author in TPM and Agile software development projects, from which ten years were as project lead and in senior management, the author is experienced in moderating interviews, listening and asking open questions without influencing the answers. Thus, mainly open-ended questions were asked, and a pilot interview was conducted with the intention of getting feedback as to what can be improved and how to avoid bias. The interview questions (see Appendix A) were related to the research questions (see 1.6). For example, in searching for answers to a part of SRQ2 *"What challenges are perceived to arise when applying Scrum […] within a firm-fixed-price […]?"*, one interview question related to this research sub-question was *"What would you say are the main challenges with combining APM with Scrum in a fixed-price project?"*. The interview questions thus covered, besides the working experience of the interviewee, the following areas: benefits, challenges, effectiveness, efficiency and recommended modifications while applying Scrum/APM to FFP projects. The feedback and learnings from the pilot interview led to a revised interview guide (see Appendix A). A challenge with this

approach is how to control the time, and therefore a more structured way or interview guide may help to obtain the focus (Bryman & Bell, 2011[18], p.467; Harvey, 2011, p.7). Therefore, semi-structured interviews with open-ended questions were chosen, which were separated in sections for a rough time management. Semi-structured interviews have the advantage that important themes and key questions are covered, but at the same time, questions may be reordered, added or omitted due to the organisational context where the interview takes place (Saunders et al., 2016, p.391). Thus, this approach provides enough flexibility to adapt to the interviewee's context and to ask new questions which derive from the conversation (Bryman & Bell, 2011, p.467), and to keep control over the time management. Thereby, face-to-face interviews provide the advantage of non-verbal communication (Easterby-Smith et al., 2015, p.135). Meanwhile, telephone interviews provide the opportunity to interview participants who are located elsewhere. However, as remote interviewing offers more flexibility, it also bears the risk that participants feel less committed (Easterby-Smith et al., 2015, p.135). Thus, for this study twelve interviews were conducted face-to-face which was the preferred interview mode, while only one interview was conducted remotely by phone. Finally, five more challenges needed to be overcome, namely obtaining trust, awareness of social interaction, getting access, location of the interviews and recording of the interviews (Easterby-Smith et al., 2015, p.144). For this research, trust was built through full transparency at each stage of the interview process for the interviewee about the background of the research and the researcher, why and how the interviewee has been selected, about the usage of the anonymised data, and the right for the participant to withdraw at any time. In addition, before the interview started, some information about the aims of the study, the interview, the position of the interviewee and some information about the interviewee's professional environment were exchanged. This helped the interviewer to obtain trust and to adapt to the social environment of the interviewee. The place and the time for the interview, whether the interview might be recorded and what happens to the data was explained and clarified beforehand.

By accepting that even late in the interview process interesting findings in a certain project context can arise, which were not mentioned by other interviewees, but which are perceived to be important in the context of this research, an approach for validating these findings is needed. Therefore, two focus groups were integrated as a validating step in the research process to present and clarify those findings and to get a better understanding of whether those findings

[18] An update to Bryman & Bell 2015 has been conducted at the end of the research. It figured out that some parts were missing or changed in the 2015 version, although they were still valid and important. Therefore, an update has been conducted where possible, and the old citations have been kept, where it seemed appropriate.

from the interviews are also perceived to be important for others. Interviewing a focus group is often used as an explorative tool in qualitative research (Easterby-Smith et al., 2015, p.137), where interviewees are asked in a group about their opinions, beliefs and perceptions on a specific theme or topic (Bryman & Bell, 2015, pp.512-513; Pioch, 2017, p.50; Saunders et al., 2016, pp. 416-417). The dynamic of a focus group helps in management and business to define business problems and to find solutions together in new and creative ways (Bryman & Bell, 2011, p.503). The interactive discussion also stimulates participants to reconsider their own position, and to focus on the phenomenon and construct meanings around it (Bryman & Bell, 2011, p.504). A focus group is not a process for getting people to come to a consensus (Krueger & Casey, 2002, p.6) but it can be used to validate previous research findings (Easterby-Smith et al., 2015, p.137; Krueger & Casey, 2002, p.6). Accordingly, two focus groups were conducted to validate the findings from the interviews, including the theoretical model and the modifications for an extended Scrum framework. All findings were presented to both focus groups in a structured way, i.e. the findings were presented according to the themes (3.6.8) based on the research sub-questions. For each theme, findings and the context were presented. The focus group was then asked to discuss how critical the finding was perceived to be in their project context, if they would agree or disagree with the finding, and if not, why it would not fit to their context, and finally, whether something is missing or whether they would like to add something.

According to Krueger and Casey (2002, p.4), good focus groups use carefully recruited participants, interact in a comfortable environment and are led by a skilful moderator, and are followed by systematic analysis and reporting. The participants from the focus groups were recruited using the same criteria as those for selecting the interviewees. Typically, a focus group involves four to twelve participants (Saunders et al., 2016, p.417). In this study eleven participants in the first focus group and four participants in the second focus group were interviewed. The focus groups were conducted face-to-face at two different locations. Except for one interviewee from the previous interview process, all focus group participants were new and chosen according to the filter criteria (3.6.2). In addition, the participants had similar work experience and seniority levels to avoid power imbalances among them (Krueger & Casey, 2002, p.4), which means that more inexperienced participants are afraid to convey their thoughts, as the experienced participants are more likely to dominate the focus group with their experiences and thoughts. To stimulate a trustful and open discussion, the focus groups were conducted at an appropriate and neutral conference room outside of the daily working places

of the participants. Both focus groups were conducted in German, which was the mother tongue of all participants. Each participant was able to see the other participants and their body language. This is important as there is always non-verbal communication, e.g. agreement or disagreement through moving the head for yes or no, which supports or not the argument. Non-verbal communication gives the moderator and the participants the opportunity to intervene without disturbing the current discussion. The moderation was done by the interviewer, who has conducted several similar meetings before, using a semi-structured interview guide to present the findings from the interviews with a direct open discussion for each finding and an overall open discussion at the end. The first focus group took two and half hours and the second one took two hours. The guide is explained below in Section 3.6.7. To be able to focus on the discussion, all interviews and the focus-groups were recorded with the permission of the interviewees and treated under the ethical regulations of the University of Portsmouth, which are explained in Section 3.6.3. For the focus groups a speech token was used, which means that only the participant who was holding the speech token was allowed to speak. The speech token is used to moderate the group discussion to be able to distinguish the different participants on the audio record. Therefore, when necessary, the speech token was handed over to a participant who then called his or her name before making their point.

Interesting topics or non-verbal communications were noted on paper during all one-to-one interviews and in the focus groups as a reminder for later. Making field notes during the interview makes the interviewee feel appreciated and more comfortable (Easterby-Smith et al., 2015, p.146). One interview was not recorded due to technical issues, thus notes of the interview were taken during the interview and a summary of the interview was created shortly after the interview and sent to the interviewee for a review. The taken notes from the other interviews were not reviewed by the interviewees, but all transcribed interviews were sent to them for final approval.

3.6.2 Sampling strategy and sample

A purposive sampling strategy was chosen to contact experienced participants at senior manager level who were from companies who regularly attend Agile conferences and/or regularly publish books and/or articles about Agile. Purposive sampling means *"that participants are selected according to predetermined criteria relevant to a particular research objective"* (Guest, Bunce, & Johnson, 2006, p.61). The companies and interviewees were

identified beforehand at Agile conferences, as authors in Agile books and/or articles and within a search in business network platforms LinkedIn or the German equivalent XING, using the search criteria *"Agile and fixed-price"*. They were contacted by email or through the business network platforms, and if they responded and met the filter criteria, they were invited to an interview. In the end, the sample (see Table 8) comprised authors of Agile academic and practitioner articles, personal contacts or speakers at Agile conferences who fulfilled the predetermined criteria described in Section 3.6.1. Easterby-Smith et al. (2015, p.78) point out that if the sample is systematically different in some criteria, then it is biased. To avoid bias, a snowball system was explicitly rejected by the author, as this study sought independent views in the researched field, which might not be the case within a snowball system, where people might only recommend others if they tend to share the same opinion as themselves on a subject. It seems obvious that participants at senior level do not have a lot of time to spend on non-business activities. Therefore, it needed good arguments to convince these experts to participate in the interviews. Thus, a detailed email about the research project was written, to be transparent and to build trust[19]. The participants were informed up front about the author's working background, the nature of the study, why the participant had been chosen and why the participant's expertise was important for the study, how long the interview was likely to take, how the data would be used and how it would be anonymised, the possibility of obtaining the findings of the study afterwards, and the opportunity to get more information up front by phone. As it happened, only those participants who were in middle management were interested in the findings, meanwhile the senior management only took part as they felt honoured to contribute with their expertise. The response rate of thirteen out of twenty-five responses was very satisfying; however, scheduling an appointment was the biggest challenge because of the participants' workloads. Thus, the interviews were scheduled from a couple of weeks to some months ahead, and sometimes the appointments were postponed several times due to business conflicts.

3.6.3 Ethics

The research project adheres to the six ethical principles from the University of Portsmouth[20], as stated on its website (Ethics, n.d.). Furthermore, Bryman and Bell (2015,

[19] The mail is attached in Appendix B
[20] The favourable ethical opinion for E453 was given on 11/07/17. See Appendix C

p.134) emphasise that there are four main areas in ethics which must be considered: whether there is harm to participants, whether there is lack of informed consent, whether there is an invasion of privacy, and whether there is deception.

Adherence to these principles in this research means, in particular, that all involved participants are informed before they contribute to the research about the professional background of the author, the subject of the research project, its goals, for what purpose the results might be used and by whom the results will be accessible. Anonymity and confidentiality were granted to every respondent through a double-signed agreement for the one-to-one interviews (see Appendix D), and through a signed agreement that has to be accepted (see Appendix E) before participating in the focus group. As with copyright issues, the rights of the participant, the recording of interviews and the further processing of the input were cleared up front. The gathered data is stored in a secured place and will be deleted according to the rules of the ethical principles. The research has not been sponsored, and no money or benefits were promised or given to participants. Personal meetings with participants were undertaken respecting the needs (time, environment) of the participant. Participants or firms who have a professional relationship with the author of this research were allowed as participants as well as long there were no conflicts of interest, i.e. current joint projects or line dependencies. For example, a conflict of interest would have occurred if the interviewee and the interviewer were both in the same project or active in the same department of a firm. Then bias from both sides – the interviewee's and the interviewer's side – would have been expected, as both sides might interpret the situation in their favour so as not to harm their own business interests. Finally, participants were informed that they were able to withdraw their participation or contribution at any time, at latest before the analysis of their data within the anonymised dataset.

3.6.4 Interview guide

The interview guide contained three different parts. The first part contained some background questions and was intended for the interviewee to get familiar with the situation, i.e. as warm-up and to build trust. It is very important to build a trustful atmosphere in order to collect high quality data (Harvey, 2011, p.5). The second part contained the main questions related to the research objectives. The questions covered the following areas: benefits,

challenges, effectiveness, efficiency and recommended modifications while applying Scrum/APM to FFP projects.

The third and final part gave the interviewee further space to add or amend things the interviewee would like to say or correct or things that the interviewee might have forgotten. As stated previously, the interview guide was designed with open questions to avoid bias and was semi-structured to cover important themes and key questions. The initial interview guide was peer reviewed by an academic person and then tested by a pilot (3.6.5). The semi-structured guideline for the interviews can be found in Appendix A.

3.6.5 Pilot study

The interview questions were tested in a pilot interview with the aim of refining the interview guide. The pilot interviewee was chosen using the same criteria as the other interviewees. The interviewee was asked at the end of the interview:

- what he thinks about the questions that were asked
- to what extent he thinks that the interview questions were open-ended and not biased
- what is his impression about the location, the type and the duration of the interview
- if he thinks questions are missing or questions should be avoided to answer the research questions

The pilot interviewee gave some helpful advice, which led to a slightly refined interview guide and interview procedure[21]. However, the researcher realised during the later interview process that new questions through new insights within a specific project context were of interest; meanwhile other questions could be dropped in specific situations because they seemed less relevant in this context. Thus, every interview followed the interview guide but had a different focus, which depended on the interviewee, the run of the conversation and the specific project context. The different focus of some interviews is not seen as problematic, as the later focus group was used to validate and rate the importance of each finding, no matter how many interviewees named a finding.

[21] The amended interview guide is attached in Appendix A

3.6.6 Representativeness and sample size

On the one hand, Buchanan, Boddy, and McCalman (2013, pp.53-54) emphasise that *"it is desirable to ensure representativeness in the sample, uniformity of interview procedures, adequate data collection across the range of topics to be explored, and so on. But the members of organisations block access to information, constrain the time allowed for interviews, lose your questionnaires, go on holiday, and join other organisations in the middle of your unfinished study. In the conflict between the desirable and the possible, the possible always wins."*. On the other hand, qualitative research is limited due to the available time and resources of undertaking the research (Patton, 2015, p.257). Thus, the question in this qualitative research is how many interviews are enough to ensure representativeness and good quality, considering scientific and ethical issues. According to Francis et al. (2010, p.1230) an adequate sample size is important to comply with scientific and ethical standards. They emphasise that *"the use of samples that are larger than needed is an ethical issue (because they waste research funds and participants' time) and the use of samples that are smaller than needed is both an ethical and a scientific issue (because it may not be informative to use samples so small that results reflect idiosyncratic data and are thus not transferable, and may therefore be a waste of research funds and participant time)"* (p.1230).

To ensure representativeness a common approach is to continue to collect qualitative data until data saturation is reached, which means that little or no new information or themes emerge (Saunders et al., 2016, p.297). Guest et al. (2006, p.60) emphasise that data saturation has become the gold standard for purposive sample sizes, citing Morse (1994) that *"saturation is the key to excellent qualitative work"* (p.60). Guest et al. (2006, pp.60-61) analysed different studies and found that at least six (Morse, 1994) or between five to twenty-five (Creswell, 1998) interviews in a phenomenological study might be enough for data saturation. They further cite Kuzel (1992, p.41) who distinguished between a homogeneous sample – recommending a sample between six to eight interviews – and a heterogeneous sample – recommending a sample of twelve to twenty interviews. However, Guest et al. (2006, p.74), in their study using semi-structured interviews with a purposive sample, achieved data saturation after twelve interviews were analysed. They emphasise that 80 codes (73%) were identified within the first six interviews, with 20 (93%) additional codes appearing within the next six interviews. Other papers, with a similar setup to this study, achieved data saturation after six

(Howe-Walsh, 2010, p.78) or seven (Pioch, 2017, p.56) semi-structured interviews, which corroborates the findings of Guest et al. (2006).

Based on their review of data saturation studies, Francis et al. (2010, p.1234) recommend four principles for specifying data saturation, which have been used for this study. The first principle is to specify an initial sample size a priori for the first round of analysis. The specific number depends *"on the complexity of the research questions and of the interview topic guide, the diversity of the sample and the nature of the analysis"* (Francis et al., 2010, p.1234). The second principle is to specify a stop criterion of how many additional interviews should be conducted without yielding new ideas or themes. The third principle is that the analysis is conducted by at least two independent researchers, which should come to the same conclusion to establish robustness and reliability within the field of research. The last principle is to document and report the data analysing methods and findings for transparency.

For this study, an initial sample size of eight interviews was chosen, with an additional four interviews as a stop criterion. The coding started after the collection of the first eight interviews, as intended by the first principle, and then again after the next four additional interviews. Two different researchers were briefed beforehand about the aim of the thesis and coded three interviews independently to corroborate the findings of the author. The data analysis methods and the findings were documented, using the data analysing approach explained in Section 3.6.8. Within this study data saturation was achieved after eight interviews, conducting twelve semi-structured plus one pilot interview in total, using open coding (Bryman & Bell, 2011, p.578). The analysis approach is described in Section 3.6.8. Figure 10 shows the code structure development based on the data analysing process explained in Section 3.6.8.

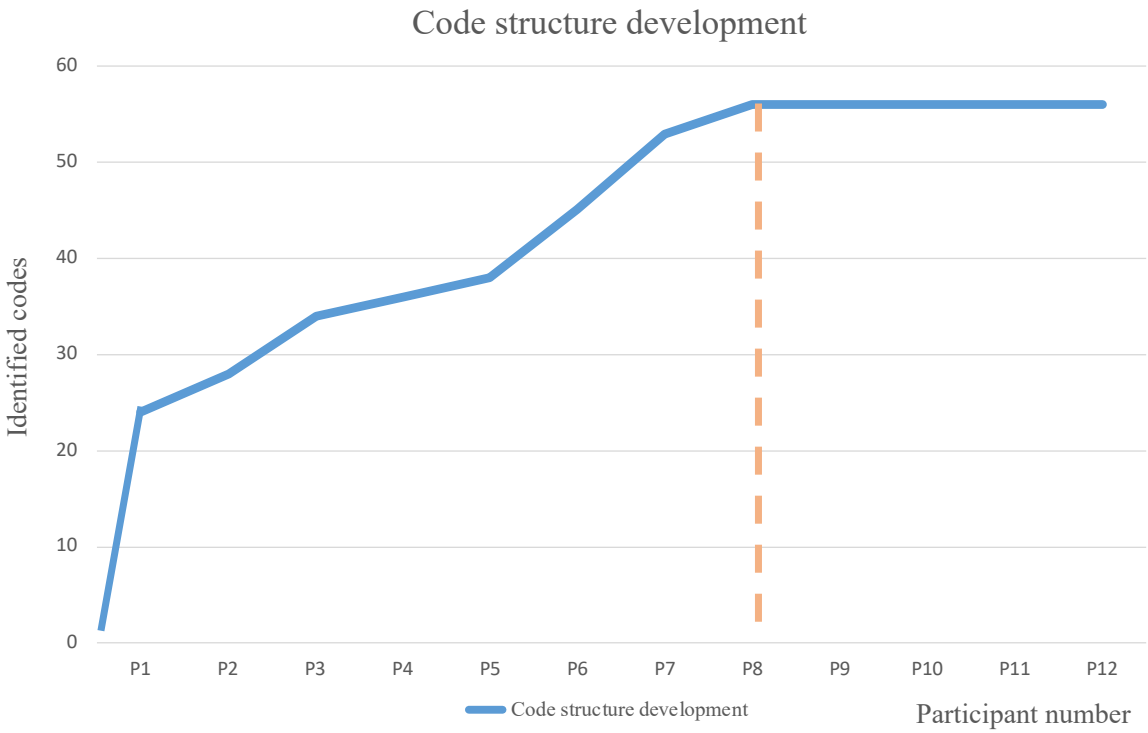


Figure 10: Code structure development; Source: The author

3.6.7 Focus group guide

Based on the findings from the interviews a semi-structured interview guide for use with the focus groups was developed (see Appendix F). The aim of the questions was to address important findings from the interviews, even though they were only mentioned from one or a few interviewees. This included perceived important and interesting themes and categories, with the goal to validate, to classify the importance in certain project contexts, to identify gaps in the findings' context or to reject the preliminary findings. First, the purpose of the study and the aim of the focus group were introduced. Every participant then briefly introduced himself or herself with their professional background to the group, with the intention of helping to warm up and build trust among the participants. In the main part the different findings and their context were presented one after another. For each category of a theme (3.6.8), the group was asked non-directive and open questions about their opinion, e.g. *"What is your perception about this finding?"*, to avoid bias and to promote the discussion (Krueger & Casey, 2002, p.8). Finally, based on the findings for SRQ3, modifications to the Scrum framework were presented. These modifications were discussed one by one and how critical the modification was perceived to be in their project context, i.e. on a range from not important to very

important, with a reasoning as to why in their context. At the end, an open discussion was added to conclude the focus group.

3.6.8 Data analysis approach

Easterby-Smith et al. (2015, p.187) suggest that there are seven approaches for analysing qualitative data, including content analysis, grounded analysis, visual analysis, discourse analysis, conversation analysis, argument analysis and narrative analysis. After reviewing all approaches, content analysis was chosen as the most suitable analysis approach because of its interpretative approach with its support for some quantification (Easterby-Smith et al., 2015, p.188). This might be helpful to quantify the importance of the qualitative findings from the interviews in the focus groups. Content analysis is an intuitive and open approach to analysing qualitative data, e.g. text, which might start by imposing external structures, based on ideas or concepts derived from the research questions or from the data themselves (Easterby-Smith et al., 2015, p.188). Content analysis can *"be used for hypothesis testing as well as for theory building"* (Easterby-Smith et al., 2015, p.188), which suits well to the chosen abductive approach (see Section 3.2). The content analysis for this research was conducted in two steps, as suggested by current literature (Mayring, 2014, p.96; Pioch, 2017, p.59; Stemler, 2015, p.3). First, themes and categories were built by deductively using the results of the theoretical analysis. For this research the initial themes were derived from the research questions, which were also taken for the theoretical model. Second, codes and categories were created inductively during the data analysis process and linked to themes with refinements of these. For the second step, the following emergent coding approach – also used in grounded analysis (Stemler, 2015, p.3) – was taken, which is depicted in Figure 11.

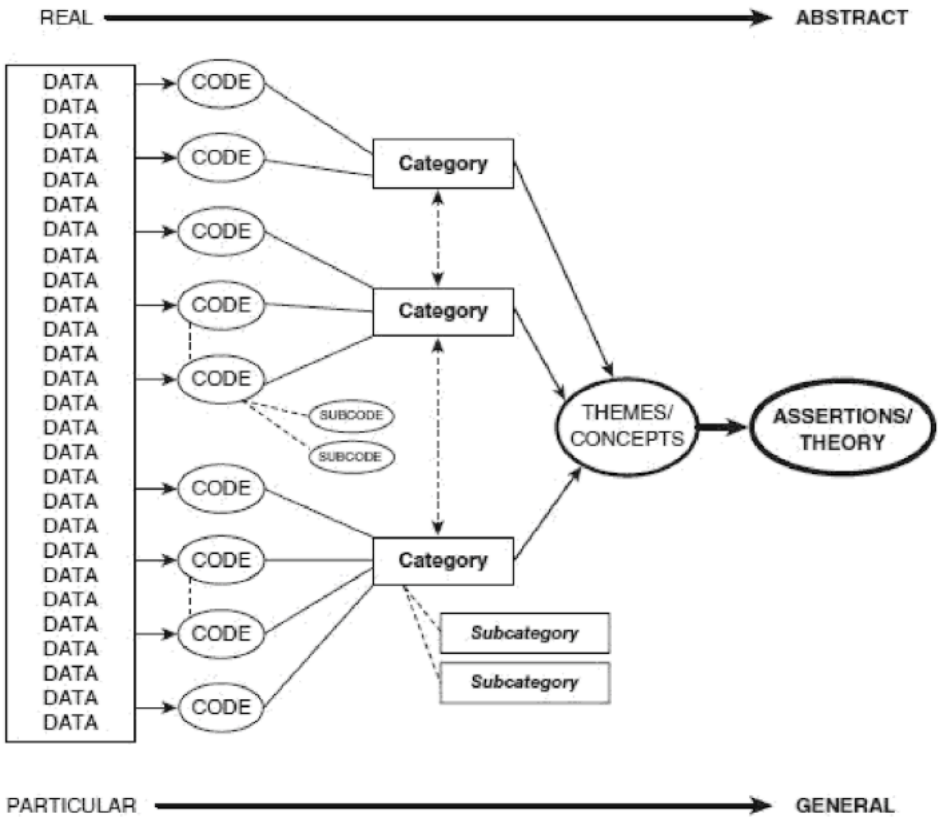


Figure 11: Codes to theory model; Source: Saldana (2016, p.14)

Easterby-Smith et al. (2015, pp.192-193) describe the approach depicted in Figure 11 in seven steps. An example for this thesis is given for each step:

1. Familiarisation – all available DATA are sighted, and notes are taken; the author printed the interviews and then read the printed interviews to get familiar with the data and made some initial notes on the papers for later reflection
2. Reflection – the DATA are pre-evaluated against the context of the study and previous work; all interviews were read a second time and the notes were pre-evaluated against the research questions, which resulted in further notes
3. Open coding – summarising the meaning of chunk DATA in CODES; all interview transcripts were read a third time within NVivo and open coding was applied, based on the previous taken notes and insights
4. Conceptualisation – discover CATEGORIES among CODES; categories within the codes were then identified

5. Focused re-coding – focus on significant CODES and CATEGORIES; the identified categories and codes were again reviewed and re-coded in significant codes and categories
6. Linking – CATEGORIES are linked to existing THEMES, or THEMES are identified by conceptualising key CATEGORIES; key categories were linked to existing themes from the research questions
7. Re-evaluation – evaluating the THEORY against critique; the key categories and themes were re-evaluated for consistency with the research objectives

The following Figure 12 shows a specific reduced example from the data analysis process applied to this research, using the theory model of Saldana (2016, p.14).

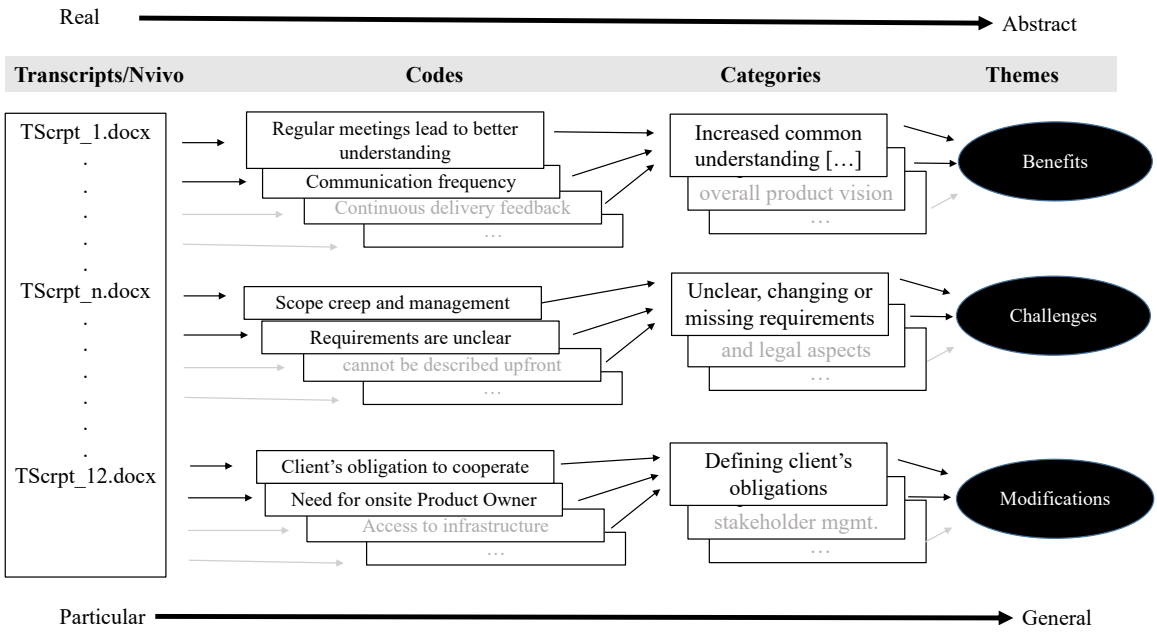


Figure 12: Example of emerging codes to themes from the findings. Source: The author, based on Saldana (2016, p.14)

In Figure 12 a reduced sample from the data analysis process is depicted to demonstrate how the codes and categories emerged from the data. As described above, firstly, the three themes *"**Benefits** of using Scrum in firm-fixed-price projects"*, *"**Challenges** of using Scrum without modifications in firm-fixed-price projects"* and *"Recommended **modifications** to the Scrum framework in firm-fixed-price projects"* on the right were derived from the research question. Then all transcripts were uploaded and analysed in NVivo. Relevant statements,

because they were related to the research questions, and facts from the interviewees were extracted to sub-codes (example screenshots for all three themes can be found in Appendix H). In a next step these sub-codes were further grouped to codes using similarities. Which then again were aggregated to a category. The final result of the analysis process can be found in the following Chapter *"Findings"*. There each theme (benefits, challenges, modification) is presented as a separate section (Section 4.1.1, 4.1.2 and 4.1.3), with corresponding sub-sections that present the identified categories. Each category contained the description of the category and the corresponding quotations are summarised in a table. The following Table 8 gives an overview about the themes, derived from the research questions; the identified categories which emerged from the codes, and the sample codes and sample quotes from the interviews.

Themes	Categories	Sample codes / Sample quotes
Benefits *of using Scrum in firm-fixed-price projects*	Helps to focus on product vision	focus, goal, customer needs, abstract level, rough scope, rough vision
	Increased productivity by clear process framework	method, clear ceremonies, regular joint meetings, clear communication and collaboration model
	Increased common understanding	communication, deciding criterion, promoting permanent communication, close feedback, feedback loop, short feedback cycle
	Manages the project risk and provides higher ROI	working on the business value, maximising business value, forced to prioritise things, highest business value, prioritising according to business value and also technical risk, pulling the ROI forward, 50 percent of the prioritised features yields 70 or 80 percent of the business value
	Increased productivity by short development cycles	Early adopters, people who use the product increments, develop what is needed, time to market, short feedback cycle
	Increased transparency and trust	transparency, communication transparency leads to trust, shows we are on track, shows the customer that we have been using his money carefully
	Less micro-management and fewer contract discussions	trust cannot be valued highly enough, less control and micro-management, emphasise the collaboration, personal trust, mitigates many crises

Themes	Categories	Sample codes / Sample quotes
Challenges *of using Scrum without modifications in firm-fixed-price projects*	Missing clear project goal	[…] if you put a product vision into 144 pages of PowerPoint and then expect the employees to understand what is meant and what really matters […]
	Unclear, changing or missing requirements	knowledge management, inquiries have to follow to understand the feature, variety of interpretation is high, customer was actually not clear about it, customer never knows what he really wants, different interpretations of the requirements
	Unknown and changing stakeholders and lack of engagement	changing environment of stakeholders, different customers, which stakeholders are key, people have changed, stakeholders not present, several stakeholders from several departments, client sends his employees
	Scope creep	better more than too little, scope creeping is the main challenge and there is no other main challenge, take everything they can get, wish what you desire, interpret this to their maximum benefit
	Lack of empowered Product Owner	giving a clear acceptance of the current state, giving a clear prioritisation of the next activities, rely on the expertise of the team, empowering the team
	Contract fulfilment and legal aspects	the ideas of what has to be done are extremely wide apart, interpretations of specifications are significantly different, new issues were raised at the final acceptance, don't even know the contract, something that can be accepted as contract fulfilment

Themes	Categories	Sample codes / Sample quotes
Recommended modifications *to the Scrum framework in firm-fixed-price projects*	Define client's obligations	in classic environments you have to describe your obligations to cooperate, without obligations to cooperate feedback would not exist, explicit obligations to cooperate, is part of the contract
	Conducting a product vision /kick-off meeting	do the work in the beginning, make it clear beforehand what the product vision is, quality gate
	Conducting a backlog translation workshop	translate the requirement specifications into a backlog, transform all these horrible documents into user stories, a workshop that lasts one to three days, invest time in workshops to clarify user stories, recommend a workshop, user story mapping, initial workshop
	Continuous documented reviews and acceptance	accepts the product increment after every Sprint, a lot of acceptances over time, tested their systems and gave feedback, accepted with documented errors, summarised acceptances, formally define the Sprint review as acceptance, acceptance meetings, acceptance protocol has been signed, continuous acceptance
	Documented changes to the backlog by mutual agreement	lightweight process to exchange user stories, which have been documented, bundled change requests, change management process, swap for equivalent requirements, practically recorded and documented, clarify in advance, contractual arrangement
	Explicit stakeholder management	greatest difficulty is the changing environment of stakeholders, stakeholder management, stakeholders to involve, stakeholders to push aside
	Explicit risk management	a fixed-price project needs risk management, risk management is important, explicit risk management

Table 8: Themes, categories and sample codes/quotes from the data analysing process. Source: The author

3.7 Research design application

Based on the described research philosophy, strategy, techniques and procedures the chosen research design was applied accordingly.

Data collection was done through a pilot interview followed by twelve regular interviews, and two focus groups involving eleven and four participants respectively. All interviews took place between August 2017 and February 2018 in Germany and were conducted in German. Each interview took between 40 and 70 minutes. The first interview, P0, was not evaluated for the

findings as it was the pilot interview, which had been used to amend the interview questions and guide. The final sample for the interviews comprised eight Product Owners and four Agile coaches who accompanied the projects directly. All of the interviewees were men between the ages of 35 and 52. Eleven interviewees were suppliers[22] and one interviewee came from the customer[23] side. All interviewees had a strong TPM background and had conducted one large or several medium-size projects[24] with APM within the last five years. Their experiences ranged from eight to over twenty years in TPM in multiple medium to very large projects, and from four to more than ten years in APM in multiple medium to some large projects. The participants reported that their Agile projects have generally been smaller than the traditional ones in terms of budget and duration, except for one very large scaled Agile project which comprised fourteen Scrum teams. Ten participants were also involved in senior management and had, therefore, a broader view and knowledge on all projects, which were conducted in a similar way in their company. Ten participants came from business consultancies with a focus on custom software development, from which four were from Agile consultancy companies in Germany. Another participant came from a product company with a focus on software customisation and custom extensions for their product, and one participant was representing the customer, who ordered a custom software solution. The areas in which the interviewees projects were conducted were the automotive sector, the finance sector, the engineering sector, the public sector and the energy sector. All of the reported projects were conducted within an FFP contract but were executed with Scrum and one was executed with Large Scaled Scrum. No other approaches like, DSDM, XP or SAFE were used. While some respondents reported that they used Scrum as intended, where the Product Owner came from the customer but the Scrum Master and the Scrum development team were provided by the supplier, the majority reported that they had had to adapt Scrum to the customer environment. For example, some respondents reported that they had to provide a Product Owner proxy on the supplier side, who represented the customer Product Owner in the daily stand-ups and made decisions in accordance with the customer Product Owner. This was needed, due to the limited time of the customer Product Owner, although she attended regularly the planning and the review meetings.

[22] Supplier in the context of this thesis means a company that offers software development or customization to external customers.
[23] Customer in the context of this thesis means a company which orders an external company to implement software after their specifications.
[24] According to Crawford, Hobbs & Turner (2002) there are different interpretations about how to categorise a project. In the context for this research, size is defined as cost, complexity, and duration. In this context this means: small (<500,000€, <=medium, <= 6 months), medium (<1,000,000€, <=medium, <=12 months) and large (everything else).

The overview of the participants' background[25] is depicted in Table 9 below.

Interview partner	Sex	Company's Position	Project Function	Experiences in Project Management	Project S	Experiences in Agile Project Management	Business Area	Comment
P0	m	*Project Manager*	*Product Owner*	*> 15 years*	*M-L*	*> 5 years*	*Product company*	*Public Sector*
P1	m	Senior Project Manager	Product Owner / Scrum Master	> 20 years	M-XL	> 50%	Consultancy	Cross Industry Projects
P2	m	Senior Divison Manager	Product Owner	> 15 years	XXL	One Agile	Energy supplier	Top 3 Energy Company
P3	m	Project Manager	Product Owner	>10 years	M-L	> 5 years	Consultancy	Cross Industry Projects
P4	m	Project Manager	Product Owner / Scrum Master	> 10 years	M-L	> 5 years	Consultancy	Cross Industry Projects
P5	m	Senior Project Manager	Product Owner	> 10 years	M-XL	> 10 years	Consultancy	Public Sector
P6	m	Head of Competence Center	Agile Coach / Scrum Master	> 15 years	M-L	> 3 years	Consultancy	Cross Industry Projects
P7	m	Director	Product Owner	> 8 years	XL	One Agile	Product company	Cross Industry Projects
P8	m	CEO	Agile Coach	> 20 years	M-XL	> 6 years	Agile Consultancy	Top Agile Company in Germany
P9	m	CEO	Product Owner	> 10 years	M-XL	> 10 years	Consultancy	Cross Industry Projects
P10	m	Senior Project Manager	Product Owner / Agile Coach	> 20 years	M-XL	> 3 years	Agile Consultancy	Established Company
P11	m	Senior Consultant	Agile Coach	> 15 years	M-XL	> 15 years	Agile Consultancy	Top Agile Company in Germany
P12	m	CEO	Agile Coach	> 20 years	M-L	> 15 years	Agile Consultancy	Top Agile Company in Germany

Table 9: The interviewees and their professional background; Source: The author

For this research all interviews were recorded in German and transcribed by two independent transcribers from a service provider. That means that the interviews were transcribed verbatim by one person, with additional information such as if the interviewee made special noises and double-checked by another independent person of the service provider. In addition, the author double-checked all transcripts a third time during the first familiarisation step, but no changes were necessary as the service provider transcribed the records word-for-word. The analysis process was started as described in Section 3.6.8 after an initial sample size of eight interviews. First, the author printed the interviews and then read and re-read the printed interviews to get familiar with the data and made some initial notes on the papers for later reflection. In the next step, all eight interview transcripts were read a third time within NVivo and open coding was applied. During the analysis and the coding of the first three interviews, these interviews were analysed and coded by two independent experts to corroborate the analysis process. After eight interviews were coded, four additional interviews were conducted, transcribed and coded using the same approach. Categories within the codes were then identified, after which significant codes and categories were re-coded. Finally, key categories were linked to existing themes, derived from the research questions, which were then re-evaluated. These categories and themes are presented in Chapter 3. Appropriate citations were translated from German to English by the author to support the findings, which were proofed by a peer reviewer. The original citations can be found in Appendix G.

After the analysis of the interview data, the themes and categories were presented to focus groups to confirm them. The aim was to find out if the focus group could agree that the findings were valid, and if so, how important the different findings were perceived to be in the context

[25] The data on the position and experiences of the individual persons were collected during the interview.

of their projects, and if they could not agree, why this is not perceived important in their project context. The findings were presented to different focus groups until a clear conclusion could be made as to how important the findings are to practice and theory. In the end, the stop criteria for saturation (3.6.6) were fulfilled within two focus groups. In these focus groups the findings were confirmed and no new insights were revealed, so that the findings were not presented to a third focus group. These two focus groups were conducted, in German, between January 2019 and February 2019. Each focus group took approximately two and a half hours. The first focus group comprised eleven Agile experts. The second comprised four Agile experts. One participant from the interviews was able to participate in the second focus group, which was interesting as he was able to assess the findings, some of which were new to him, in the context of his project situations, which he had mentioned in the interview. For him the findings were logical and, in his context, helpful. The other interviewees were not available for the focus groups. However, based on the responses from the interviewee and the other focus group participants, there was no indication that the findings would have been assessed in a different way if they were presented only to the interviewees. The sample from both focus groups fulfilled the same filter criteria as was demanded for the interviews. All participants were very experienced consultants or managers who were involved in project management. The sample finally comprised ten Product Owners and five Agile coaches who accompanied the projects directly. The participants comprised fourteen men and one woman between the ages of 35 and 50. All participants had a strong TPM background and had conducted several medium to large projects with APM within the last five years. Their experiences ranged from five to over twenty years in TPM in multiple medium to very large projects from three to more than fifteen years in APM in multiple medium to some large projects. Thirteen of the participants were also involved in senior management and therefore had a broader view and knowledge on all projects, which were conducted in a similar way in their company. All participants came from business consultancies with a focus on Agile consulting and custom software development projects. All respondents were conducting projects as service providers in many business domains. Their project experience ranged from using FFP, TM, Agile to Agile FFP projects. Some of them reported that they had had to adapt Scrum to fit the project environment, depending on the project type, i.e. on the size and type of contract. If Scrum was adapted, the respondents were mainly using artefacts from TPM, e.g. a documented change process.

The overview of the participants' background[26] is depicted in Table 10.

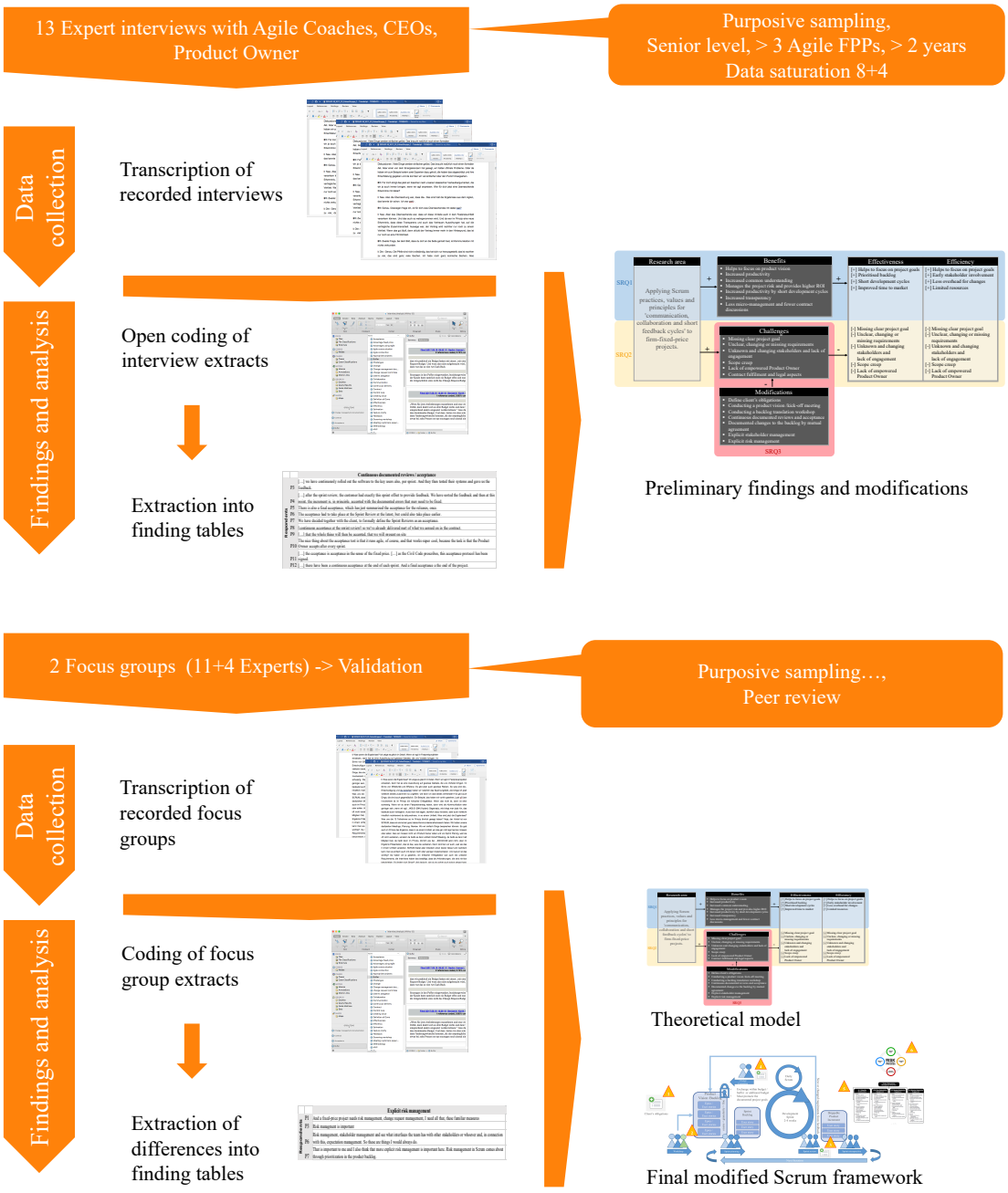
Interview partner	Sex	Company's Position	Project Function	Experiences in Project Management	Project S	Experiences in Agile Project Management	Business Area	Comment
Group A								
FGA1	f	Principal Consultant	Agile Coach	> 20 years	M-XL	> 8 years	Agile Consultancy	Cross Industry Projects
FGA2	m	Senior Business Solution Manager	Product Owner / Agile Coach	> 10 years	M-XL	> 5 years	Agile Consultancy	Medical Projects
FGA3	m	Business Solution Manager	Product Owner / Agile Coach	> 5 years	n/a	> 5 years	Agile Consultancy	Cross Industry Projects
FGA4	m	Principal Project Manager	Product Owner / Agile Coach	> 10 years	M-XL	> 6 years	Agile Consultancy	Cross Industry Projects
FGA5	m	Business Solution Manager	Product Owner / Scrum Master	> 10 years	M-L	> 6 years	Agile Consultancy	Cross Industry Projects
FGA6	m	Lead Project Manager	Product Owner / Scrum Master	> 5 years	M-L	> 5 years	Agile Consultancy	Cross Industry Projects
FGA7	m	Lead Project Manager	Product Owner / Scrum Master	> 5 years	M-L	> 2 years	Agile Consultancy	Cross Industry Projects
FGA8	m	Senior Head of Competence Unit	Product Owner / Agile Coach	> 20 years	M-XL	> 15 years	Agile Consultancy	Cross Industry Projects
FGA9	m	Partner / CEO	Agile Coach	> 10 years	M-XL	> 10 years	Agile Consultancy	Agile Transformation Projects
FGA10	m	Principal Consultant	Agile Coach	> 8 years	M-L	> 5 years	Agile Consultancy	Cross Industry Projects
FGA11	m	Principal Consultant	Agile Coach	>15 years	M-XL	> 15 years	Agile Consultancy	Cross Industry Projects
Group B								
FGB1	m	Head of Competence Center	Agile Coach / Scrum Master	> 15 years	M-L	> 3 years	Consultancy	Cross Industry Projects
FGB2	m	Project Director	Product Owner / Agile Coach	> 20 years	M-XL	> 10 years	Consultancy	Cross Industry Projects
FGB3	m	Business Solution Manager	Product Owner	> 10 years	M-L	> 15 years	Consultancy	Cross Industry Projects
FGB4	m	Principal Consultant	Product Owner / Agile Coach	> 7 years	M-XL	> 3 years	Consultancy	Cross Industry Projects

Table 10: Focus group participants and their background; Source: The author

The focus groups were also recorded in German and scientifically transcribed by two independent transcribers from a service provider as for the interviews. In addition, the author double-checked both focus group transcripts during the first familiarisation step, but again no changes were necessary as the service provider transcribed the records word-for-word. First, the author printed the two focus group transcripts and read and re-read the printed transcripts to get familiar with the data and made some initial notes on the papers for later reflection. The intention for the focus groups data analysis process was to validate the previous identified codes, categories and themes from the interviews, which can be found in Section 4.1.1, 4.1.2 and 4.1.3. Therefore, the author read both transcripts a third time within NVivo and the transcripts were analysed against the previous interview codes, categories and themes. Then, these data from the focus groups were used to re-evaluate the previous findings, which led to the final findings and the final adapted Scrum framework. Finally, the validated findings were discussed in comparing them to current literature, which then resulted in a final conclusion.

[26] The data on the position and experiences of the individual persons were collected before and after the focus group discussions.

The whole research process is depicted in Figure 13.



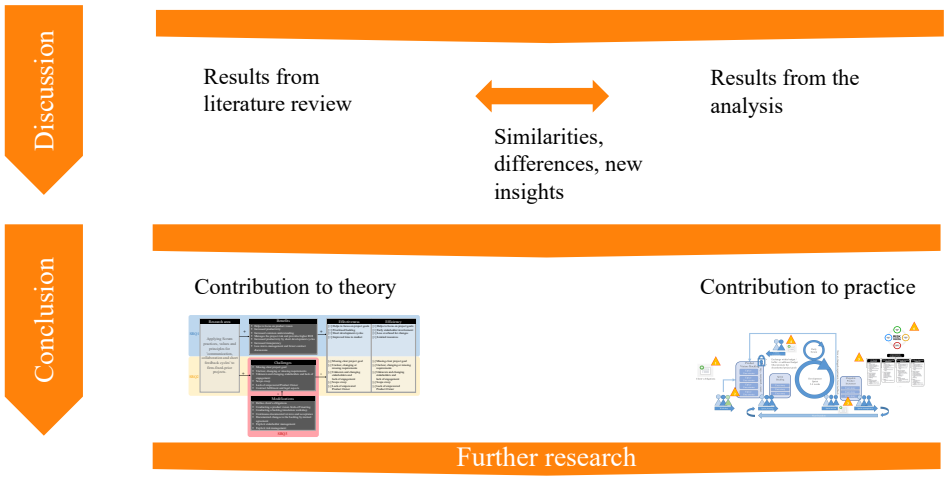


Figure 13: The applied research design; Source: The author

3.8 Summary

The chosen research philosophy for this research is an interpretative one. This interpretative philosophy suits well the exploratory and subjective nature of this research field. To answer the research questions, an abductive approach was used with induction as the predominant approach. This resulted in a multimethod sequential qualitative approach with semi-structured interviews with experts from Germany as the first phase of data gathering. The identified themes and patterns from the interviews were then discussed in two guided focus groups with participants from the interviews and different experts in the second phase. The whole study was conducted in a cross-sectional time horizon, to get a status quo in the researched field. Qualitative semi-structured interviews and two focus groups better suit the explorative nature of this study, which allows greater interaction with the participants as interesting new insights appear, rather than testing hypotheses through quantitative data. The target group of participants were experts from Germany who had, as a minimum, a senior level at their workplace, and who had conducted at least three Agile projects within an FFP context, and/or had a minimum of two years practical experience in that field. The sample size for the interviews was determined by the data saturation criteria, with four interviews after achieving data saturation. Respondents were chosen using these criteria, using a purposive sampling strategy, through social networks. An interview guide was developed based on the findings in the literature review and refined through a pilot interview. The ethical standards of this study were approved by the University of Portsmouth beforehand and were then applied at all times throughout this study. The findings from the content analysis process of the interviews were used to develop a focus group semi-structured interview guide. The findings were then discussed within the focus group to evaluate and to classify the previous findings, which led to the final findings and the final adapted Scrum framework.

The research design is depicted in Figure 14.

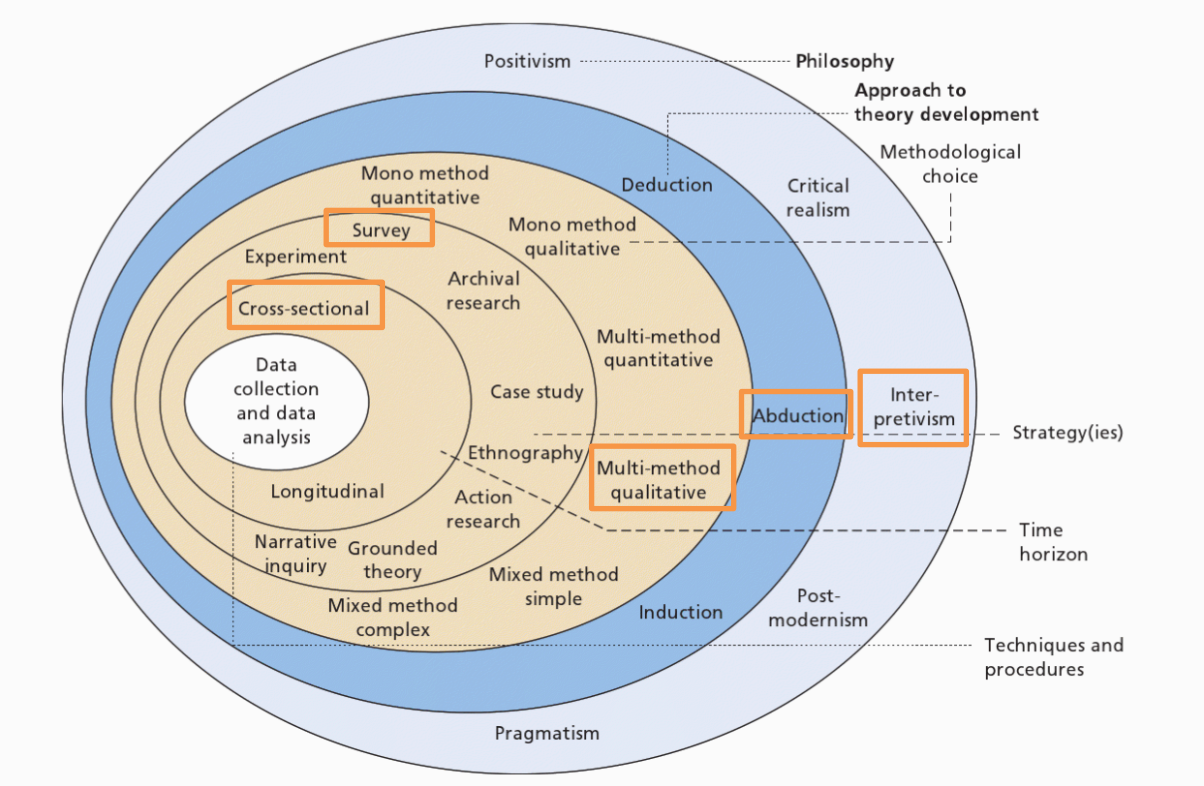


Figure 14: Chosen research approach, adapted from Saunders et al. 2016, p.164

4 Findings

This chapter collates the data of twelve of thirteen interviews, along with two focus groups involving eleven and four participants, based on the following aim:

The aim of the research was to explore if APM, using the Scrum process framework, is perceived to be effective and efficient in the context of FFP software development projects and, if the perception is positive, to understand why and how APM is perceived to be beneficial within an FFP context, which resulted in the following research question:

How can applying the Agile practices, values and principles of 'communication, collaboration and short feedback cycles' used in the Scrum process framework help project stakeholders to increase perceived effectiveness and efficiency in the context of firm-fixed-price software development projects?

To answer the research question, three research sub-questions were posed:

SRQ1: What are the perceived benefits of applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' to firm-fixed-price projects and how do they increase perceived effectiveness and efficiency?

SRQ2: What challenges are perceived to arise when applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' without any modifications within a firm-fixed-price context and how do they decrease perceived effectiveness and efficiency?

SRQ3: What modifications are perceived to be necessary to be implemented within the Scrum process framework to mitigate the conflict between these two approaches and to increase perceived effectiveness and efficiency?

For the analysing step in this chapter, a second theoretical model was filled with the findings from the interviews and focus groups. These findings are presented in this chapter, whereas the differences to the findings from the literature review and the discussion on what it means in relation to the research question is done in Chapter 5.

The findings are divided in two sections; the first section represents the findings from the interviews. There, main themes, categories and their codes evolved from the interviews are depicted with verbatim quotations. The second section represents the findings from the focus groups, based on the discussion about the findings from the interviews. For all verbatim quotations the original German quotation can be found in Appendix G. The last section summarises this chapter.

4.1 Findings from the interviews

The findings are structured in relation to the themes and categories which resulted from the interview data analysis under consideration of the research questions. Each category contains a brief description as to why this finding is important, a quote, and the meaning of the finding for the thesis.

4.1.1 Benefits of using Scrum in firm-fixed-price projects

In alignment to SRQ1, the following categories have been identified for the theme *"**benefits** of using Scrum in FFP projects"*, and their perceived impact on increasing effectiveness and efficiency.

4.1.1.1 Helps to focus on an overall product vision

One of the main benefits of applying Scrum to FFP environments is that Scrum helps to focus on what is needed by an overall product vision. The product vision in Scrum is represented by the prioritised product backlog with its coarse-grained specifications. A product vision outlines the overall goal of the project. The *'just enough'* planning approach defines, roughly, what needs to be achieved by the project to meet stakeholder expectations without specifying requirements that are overly detailed in advance. This is because details of the requirements might change by gaining new knowledge during the project time, while coarse-grained requirements are less likely to change in this context. Having a product vision is essential to be effective, i.e. doing the right thing. Without a product vision, the overall goal is lost, for example, in lots of individual requirements, which poses the risk of delivering the

wrong product. One interviewee (P8) has expressed this referring to the terms *"focus"* and *"goal"*, others have referred to it, using terms such as *"customer needs", "abstract level", "rough scope"* and *"rough vision"*.

"The most important thing is to keep the focus. That you always know what are we really working on? What is our goal that we want to achieve? And that is just defined by the product vision." (P8)

What makes focussing on a product vision a benefit is that on one side, every decision in Scrum is evaluated against overall project goals, which makes it effective as only things which meets the customer needs are implemented. On the other side, this approach promotes efficiency in the context of staying within the iron triangle, as resources are only used to fulfil the project goals. By implication, a high-level description of the objectives, which represents the product vision, is needed to work effectively in the context of a firm-fixed-price contract, as reported by P2, P3, P6, P8, P9, P10 and P12. Therefore, the product vision has to be clear to all stakeholders at the beginning of the project so that requirements can be derived and implemented in alignment with the product vision.

The relevant responses from the respondents are depicted in Table 11.

Documents should comprise the product vision, instead of specifications that are overly detailed		
Respondents	P2	[…] if the customer is clear about his needs, then he is also able to derive his requirements accordingly.
	P3	[…] It would be better if we could meet the needs of the customer, [instead of implementing a lot of predefined requirements]
	P6	So, in the contract, there was only a rough scope.The aim of the whole project was shown on an abstract level, and what functionality should be included. But that was not specified in detail, to keep some latitude.
	P8	The most important thing is to keep the focus. That you always know what are we really working on? What is our goal that we want to achieve? And that is just defined by the product vision.
	P8	[...] you have to do the work in the beginning and make it clear beforehand what the product vision is. And that's hard. This is really a hard, constant listening, making suggestions what it could be. Listening, making suggestions, listening, making suggestions. But always from the perspective of the end customer.
	P8	A product vision is a kind of quality gate for me in the beginning. The very first, we always call it Sprint Zero, the very first thing that needs to be present is the product vision, we have to have a focus.
	P9	[…] the main contract has not described any functionalities, except of a rough vision of the project.
	P10	[…] This exploration concept included a vision. The exploration concept included the major features that they envision and even a technical architecture.
	P12	The customers don't know in detail what they want in the beginning. Therefore, it is better to focus on a product vision.

Table 11: Quotations which emphasise the need for a product vision; Source: The author

4.1.1.2 Increased productivity by clear process framework for communication and collaboration

One of the main benefits mentioned by the interviewees is the increased productivity[27] among the stakeholders, as Scrum provides a clear communication framework with dedicated meetings such as planning and review, as emphasised by P10 (Table 12). As stated in the introduction (p.14), project success is nowadays defined by meeting stakeholder expectations

[27] Productivity is the relation of output (effectiveness) to input (efficiency) (Tangen, 2002, p.20). Related to the thesis this means, accepted user stories in relation to the used effort.

within the iron triangle, which can be expressed by the term productivity. At the same time, meeting stakeholder expectations is getting more difficult, as projects are getting more complex in dynamic environments. For this, Scrum provides a process framework with clear rules for meetings and responsibilities for communication and collaboration to close these requirement gaps in alignment with the product vision. The responsibilities are clear, who is responsible for what, and when and how it is communicated. This has been reported by P2, P9, P10, P11 and P12, who referred to the *"method"*, *"clear ceremonies", "regular joint meetings"* and *"clear communication and collaboration model."*

The relevant responses from the respondents are depicted in Table 12.

		Clear process framework for communication and collaboration
Respondents	P2	There were 14 teams, who worked in parallel and always worked at the same pace. Again, the method offers so much, referred to communication and coordination, etc.
	P9	[...] that one consciously takes those times, sitting together, discussing the results, and above all, discussing what to do next. This is usually not that, what has been planned to be done for the next month before. And that, I think, is the central strength that I see.
	P10	Scrum has very clear ceremonies and if you stick to it, you already have a base of what other agile approaches do not have. If you strictly stick to these three meetings, three roles, you have a lot of success. And I think, if you would take another agile approach that this would not be so stringent. And that's why it's so important to hold these ceremonies that way. […] It is very clearly defined what the content of these ceremonies is. It is very clear who is the owner and it is very clearly defined what should be the outcome. And that makes the whole thing successful, in my view.
	P11	Regular joint meetings, i.e. every 14 days a Sprint and not only once during a commissioning and then there will be a delivery.
	P12	Scrum provides a clear communication and collaboration model.

Table 12: Quotations related to a clear process framework for communication and collaboration; Source: The author

What makes it a benefit is that by this structured communication and collaboration plan the productivity within the overall project goals is increased. Effectiveness is achieved by the different ceremonies, i.e. planning meeting, daily stand-up and Sprint review meetings where the team members synchronise with each other and decide what has to be done next. Efficiency is achieved in two ways. Firstly, by effectiveness, that the overall resources are used efficiently

related to the overall project constraints. Secondly, by the Sprint retrospective meeting, where the process is inspected, and the process is adapted to necessary improvements.

As identified in the introduction (p.16), communication is one of the most critical success factors for project success. The findings reveal that in non-Agile projects, communication and collaboration are not governed, and therefore less common within these projects. In contrast, by using the meetings and roles of Scrum within an FFP context, the responsibilities and ways of communication are predefined and clear to all project stakeholders. As a result of this structured communication and collaboration, all stakeholders are more likely to focus on the product development, and on the clarification of what is needed, which results in increased effectiveness and efficiency within the overall project goals.

4.1.1.3 Increased common understanding of business requirements by continuous communication

Among all the interviewees, communication is seen as a critical success factor for achieving project goals, by continuous communication, which is highly promoted by the Scrum framework. Asked what the most critical success factor has been while using Scrum in an FFP context, P11 responded:

> *"First communication, communication and again communication".* (P11)

The interviews confirmed that continuous communication is essential to close requirement gaps, to validate current business needs with the original specification and to get a common understanding of what is needed. One interviewee (P8) has expressed this referring to the terms *"deciding criterion"* and *"promoting permanent communication"*; others have referred to using terms such as *"close feedback", "feedback loop"* and *"short feedback cycle".*

The quotations which emphasise the importance of continuous communication are depicted in Table 13.

		Continuous communication
Respondents	P1	Through the close communication, through the close feedback, we have managed to obtain planning security.
	P2	[...] Cooperation, feedback and communication are mandatory prerequisites and ultimately always the final result in Agile projects.
	P3	Through this continuous feedback loop. Communication, understanding the requirements, that is actually a core element.
	P4	So I have this short feedback cycle, both on project management level and on development level, that is the main point. And that includes communication, talking to each other and transparency.
	P5	Communication is a must!
	P6	One is regular feedback loops with the customer, whereby regular means every two weeks.
	P7	Communication then does it [Transparency]
	P8	So, communication is the deciding criterion that determines whether a project fails or succeeds. And agility has a lot to do with promoting permanent communication. To promote continuous communication. And also, to catch up with the voices, which were perhaps ignored before due to excessive division of labour or too rigid a phase thinking. Communication is the alpha and omega. It's about communication, it's about cooperation and it's about quality.
	P10	And this conversation with the developer that the customer has really made it clear to the developer what he actually wants.
	P11	First communication, communication and again communication.
	P12	Continuous communication is definitely an important success factor.

Table 13: Quotations which emphasise the importance of continuous communication; Source: The author

What makes continuous communication a benefit is that it helps the stakeholders to get a common understanding of what is needed and to synchronise continuously with each other. It helps the stakeholders to be more effective on the one hand, as continuous communication helps to clarify which business requirements are needed, and it promotes efficiency on the other hand, as it clarifies the level of quality or complexity that is needed to fulfil the requirement. In non-Agile projects continuous communication and collaboration is not governed and therefore less common as everything is specified upfront. As a result, assumptions are made as to how the requirements should be interpreted, without involving the relevant stakeholders, which results in a higher risk of not meeting stakeholder expectations. Therefore, continuous communication must be ensured at all times in the project, as would be the case when implemented within the Scrum framework. A further benefit is that by the communication process, further stakeholders might be identified and involved in the process. As P8 emphasised, communication helps *"to catch up with the voices, which were perhaps ignored before due to excessive division of labour or too rigid a phase thinking"* (P8), so through an open communication culture some hidden stakeholders might be identified and motivated to share their opinions.

4.1.1.4 Manages the project risk and provides higher ROI by prioritising the backlog according to business value and technical risk

The continuous prioritising of the tasks to be executed by highest business value and biggest technical risk is seen as an important benefit to control the project risk and to deliver the maximum business value, as emphasised by P7 (Table 14). Interviewees have expressed this referring to the terms *"work on the business value", "maximising business value", "forced to prioritise things", "highest business value", "prioritising according to business value and also technical risk", "pulling the ROI forward"* and *"50 percent of the prioritised features yields 70 or 80 percent of the business value".*

What makes it a benefit is that it implements the requirements with the highest business value first. This is effective and efficient at the same time, as this approach yields the most value for the invested resources to achieve the overall project goals by the stakeholders. The same applies to technical risks. The sooner it is clear whether the requirement can be technically implemented in this way the better the decision can be made on how to proceed further. These measures lower the risk at the beginning of a project that it will fail in the end,

due to unfinished important features, and thus not meeting stakeholder expectations. At the same time, parts of the product might be already delivered and used, which helps to accelerate the ROI. This suggests that prioritising of the tasks to be performed based on business value and technical risk is even more important in an FFP environment than in a normal Agile setup, as emphasised by P6, noting that in FFP environments it is important to *"stay within a certain time and budget window".* In that case, prioritising *"pulls the ROI forward"* (P7) and lowers the risk that if the budget and time frame are exceeded, important features with high business value are missing. Therefore, besides an earlier ROI, prioritising can be seen as a risk management tool to stay within the boundaries. In addition, if *"the best solution for the client with the highest business value"* (P7) is delivered within the iron triangle, this is effective on the one hand, as requirements are delivered which are highly needed, and efficient on the other hand, as a higher business value output can be generated with the same resources. Accordingly, P8 emphasised:

"[…] if I have 50 percent of the features and I sort it by business value, then I don't have 50 percent of the business value, but 70 or 80 percent of the business value." (P8)

The quotations which emphasise the importance of prioritising according to business value and technical risk are depicted in Table 14.

Prioritising the backlog according to business value and technical risk		
Respondents	P3	And then one really prefers to work on the value, on the business value, with absolutely good quality from the user's point of view.
	P4	I mean maximising business value is definitely a point, because I always make sure at the time X that the software delivers the greatest possible benefit with the next successful sprint.
	P6	But due to the Agile fixed price I am forced to prioritise things, because things can change in boundary conditions, requirements, yes, but you want to stay within a certain time and budget window, so I have to prioritise.
	P7	We focused on and agreed that the budget should be considered as fixed and that within this budget we would achieve the best solution for the client with the highest business value.
	P7	It was prioritised according to the typical Scrum topics you have there, business value, what is most important to the company, dependency, risk, also technical risk, that's why we were on board from the very beginning. […] From the view of business administration then I'm first and foremost pulling the ROI forward. I have business value in mind and only deal with the flood of requirements, which are of course included in such a large specification.
	P8	[…] if I have 50 percent of the features and I sort it by business value, then I don't have 50 percent of the business value, but 70 or 80 percent of the business value.

Table 14: Quotations related to prioritising according to business value and technical risk; Source: The author

4.1.1.5 Increased productivity by short planning and feedback cycles

The interviews identified several benefits that are promoted by the short planning and feedback cycles. Among the interview participants the continuous delivery of minimal viable products (MVPs) is perceived as an effective method to steer the project, which has several benefits. These are:

1. Early key user involvement: continuous delivery of MVPs provides early feedback from key users and offers the possibility for users to test the software in their environment. *"Involvement of key users and early adopters; people who use the product, even if it is still buggy."* (P4)

2. Increased effectiveness: the stakeholders' feedback on each development cycle helps to focus the Scrum team on the right product functionality. *"What I personally like about agility is that we don't implement features that are not desired."* (P9)
3. Increased efficiency: the stakeholders' feedback on each development cycle helps assess, if more effort has to be spent by the Scrum team on a feature or that it is already sufficient for the end user. *"The efficiency results again from the fact that we develop only what* [functionality] *is needed and nothing else which is never used in the end."* (P9)
4. Increased transparency and trust: with every development cycle relevant stakeholders can see if the requirements were understood and if the project is still on track, which leads to a higher trust in the supplier that it can deliver what is needed within the iron triangle. *"*[...] *also in the fixed-price project this makes absolute sense* [continuous delivery]. *In order to create trust with the customer when he sees something* [working product increment]*, that's always positive already."* (P7)
5. A project steering tool: based on the short feedback cycles the project status and outstanding tasks are clear to all stakeholders. Therefore, possible impediments and divergences from the remaining plan can be addressed early. *"So, all concerns are effectively addressed there in a very simple form. And taking away some of these things would lead to a gap that was formerly there, where the project was just set up and the specifications were set up, and then a big gap opened up, yes? What's next? How do we communicate the wish, the specification to the implementer? How does he communicate back? Daily during work? There was nothing there. There was simply no steering option."* (P1)
6. Improved time-to-market: the continuously delivered product artefact can be released before the final product is available. *"The typical driver for Agile fixed price projects or agility at all is time-to-market"* (P11)

For a better overview of the benefits, these are presented in Table 15, which contains paraphrased statements of the benefits, the codes of the interview partners who mentioned this as a benefit, and one corresponding example quote.

Increased productivity by short planning and feedback cycles		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Early key user involvement	P1, P3, P4, P6, P7, P9	But the first success we had was actually that at some point I noticed a key user saying, "Yes. That still has mistakes here and there. But I've been using it for three weeks now to calculate my projects." So he used it in principle already, although it was actually still relatively shaky, because he said it works much better than the old solution, I think it's really cool.
Increased effectiveness	P1, P3, P4, P6, P8, P9, P10, P11, P12	There's a Standard Group International investigation. They have found out which features are used in a finished product. They found that 45 percent of the features that were implemented were not used at all, even though they were specified before. If you develop Agile and get the customer feedback early, you will be able to find these 45 percent again quickly. And that in turn makes agile fast, because I immediately find these features that you don't need.
Increased efficiency	P4, P6, P8, P9, P10, P12	The efficiency results again from the fact that we develop what is needed and nothing that is never used in the end in functionality. Of course, that's not one hundred percent either.
Increased transparency and trust	P2, P4, P7, P9, P11, P12	Creates trust, shows the customer that we are on track. You can show them something, the customer can show something internally, just makes it more relaxed.
A project steering tool - planning, controlling, early escalation	P1, P2, P4, P6	Through the close communication, through the close feedback, we have managed to obtain planning security. So we were able to communicate possible bottlenecks more quickly. We were also able to justify them. So I was also able to say: Why I can't deliver that? Because I had this steering tool. Technical feedback also came back faster to the customer, with these weekly meetings: "It's in the specifications, but watch out! We have found out the following."
Improved time-to-market	P1, P7, P9, P10, P11, P12	What you manage to do is to start relatively quickly to the market with small features, yes, but not with a complete product, but only with small features. And gets very fast customer feedback.

Table 15: Quotations related to benefits of short planning and feedback cycles; Source: The author

As a consequence of this finding, the short planning and feedback cycles have to be maintained within an FFP environment. For adequate and prompt feedback it has to be ensured that the relevant stakeholders participate in the regular meetings and that they can provide feedback promptly. This is discussed further in Section 4.1.2.3, which addresses stakeholder involvement in detail.

4.1.1.6 Increased transparency and trust by continuous delivery

One result of the findings is that Scrum promotes transparency, and this transparency again leads to trust, as P11 emphasised: *"communication transparency leads to trust".* The customer has full transparency about the project status. This transparency is achieved by the continuous delivery of product increments in Scrum. Based on the feedback on the product increment by the stakeholders after each cycle, it is transparent what has been achieved so far, what comes next, which challenges have still to be overcome and finally if the project objectives can still be achieved. One interviewee (P12) has expressed this referring to the terms *"transparency"* and *"shows the customer that we have been using his money carefully*"; others have referred to using terms such as *"empirical data", "shows we are on track" and "significantly increases acceptance by the customer".*

The quotations which emphasise the importance of transparency and trust are depicted in Table 16.

		Transparency and trust
Respondents	P2	Transparency is important, it is also important to make the disturbances that are there transparent, no matter in what environment or where they come from, what they are caused by, in order to be able to do something about them. However, there is a danger that what is going well will be taken for granted, because that is always the goal, if that is actually appreciated again, and ultimately people work together.
	P4	And that includes communication, talking to each other and transparency. That you make this transparent, talk about it and rely, so to speak, on empirical data.
	P7	Creates trust, shows the customer that we are on track. You can show them something, the customer can show something internally, just makes it more relaxed.
	P9	But none of this is measurable. And in our Agile approach it's really the case that we usually have a system up and running after just a few weeks, sometimes even days, that the customer can access. Still very rudimentary, but where he has at least something in his hand. And this significantly increases the acceptance by the customer, but secondly it also maintains the desire for cooperation.
	P11	The second is trust. Communication transparency leads to trust.
	P12	This transparency shows the customer that we've been using his money carefully.

Table 16: Quotations related to transparency and trust; Source: The author

The findings suggest that this project transparency is needed for two reasons. Firstly, as a project management and risk management tool, to steer the project with the possibility of early escalation of problems, which is a very effective and efficient way to steer the project as it helps to focus on doing the right things in the project. Secondly, the trust gained helps to promote productivity in the project, as P10 emphasised that without trust there "*is a lot of control and micro-management – it just does not work*". Therefore, this finding supports keeping the named Scrum practices, principles and values in an FFP environment, which promotes transparency and trust. Specifically, these are the prioritised product backlog, the release burndown chart and the continuous delivery for receiving feedback.

4.1.1.7 Less micro-management and fewer contract discussions by transparency and trust

Another finding is that besides transparency, close collaboration leads to trust. Close collaboration leads to less micro-management and fewer contract discussions as it promotes a better understanding of what the other wants. One interviewee (P10) has expressed this referring to the terms *"trust cannot be valued highly enough"* and *"less control and micro-management"*; others have referred to using terms such as *"emphasise the collaboration", "personal trust"* and *"mitigates many crises"*.

In Agile projects, the common understanding increases through each iteration when the customer sees the artefact which has been built upon the earlier discussions and provides feedback on it. Consequently, P6, P7, P9 and P10 reported that good collaboration is effective as it leads to a better understanding between the supplier and the customer, which leads finally to more trust so that the other understands what is needed. Trust is the prerequisite for good collaboration. In a trustful environment, stakeholders can focus on the project goals. If conflicts arise stakeholders will solve them by communication and not by citing the contract. This avoids a lot of overhead due to fewer contract discussions. As a result, the interpretation of whether a contract is fulfilled or not changes. In a trustful environment, the contract is fulfilled if the requirements implemented contribute to the product vision and meet stakeholder expectations.

The quotations related to close collaboration and trust, which lead to fewer contract discussions, are depicted in Table 17.

		Close collaboration and trust lead to fewer contract discussions
Respondents	P6	I would emphasise the collaboration again because that allows me to build a much more common understanding, understanding the project subject, the scope, but also things that may be problematic. Just to take the example again: If I create my user story map together with my client in an early period and have a close collaboration, then that is, let's say, a very, very good basis for the rest of the project.
	P7	On the personal level, it was a very important point to be able to interact well on a personal level. That is a win-win, a running win-win, or a win-win situation that remains during the project.
	P9	The more people talk, the better is the personal trust between each other. And it is important to me that we are not perceived as anonymous service providers and that you always have this face-to-face communication - that you know, on the other side there sits a human. I know that. That also mitigates many crises in projects.
	P10	So, trust cannot be valued highly enough in agile projects, because it creates the following situation. The client gives money and hopes that the one who takes the money builds a great feature out of it. And if you do not trust them, then there is a lot of control and micro-management - it just does not work. This leads to displeasure and dissatisfaction. This is then visible and then the productivity is going clearly down.

Table 17: Quotations related to close collaboration and trust lead to fewer contract discussions; Source: The author

What makes close collaboration and trust a benefit is that the project's effectiveness and efficiency are increased by fewer contract discussions. This working mode is a *"win-win situation that remains during the project"* as P9 reported, as it is possible for the client and the supplier to focus on what is needed, and not what has been written in the contract. As a consequence, close communication and collaboration is vital and should be kept within an FFP environment through the corresponding Agile practices and principles provided by the Scrum framework to meet customer expectations without modifications.

4.1.1.8 Summary of benefits

Summarised, the empirically identified benefits of using Scrum in FFP contexts are:

- Helps to focus on product vision
- Increased productivity by clear process framework for communication and collaboration
- Increased common understanding of business requirements by continuous communication
- Managed project risk and provides higher ROI by prioritising the backlog according to business value and technical risk
- Increased productivity by short planning and feedback cycles
- Increased transparency and trust by continuous delivery
- Less micro-management and fewer contract discussions by transparency and trust

These benefits are depicted within the theoretical model in Figure 15.

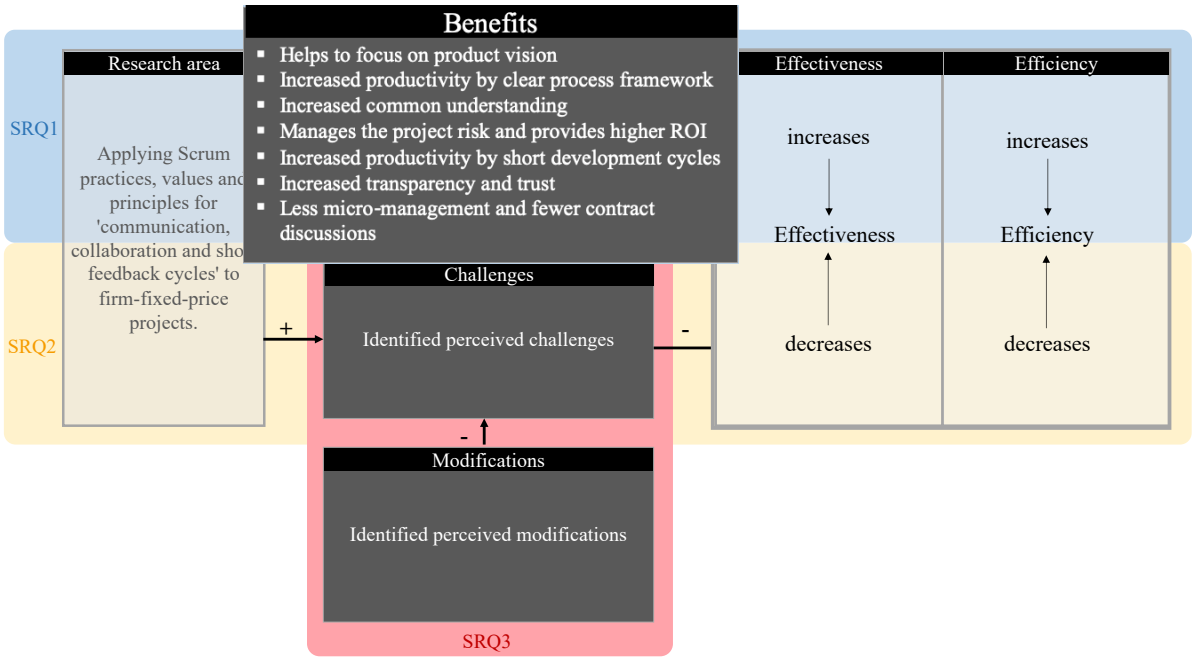


Figure 15: Theoretical model with identified benefits; Source: The author

4.1.1.9 Impact on effectiveness

All interview participants confirmed in general a positive perceived impact on effectiveness through the utilisation of Scrum practices, values and principles in FFP projects.

Scrum effectiveness is promoted, in the sense of we do the right thing, in any case. This already starts with the product vision. […]. *And effectiveness is the prerequisite for me being able to become efficient at some point.* (P8)

The perceived effectiveness is mainly promoted by the following benefits:

1. Helps to focus on product vision/project goals: A product vision helps all stakeholders to focus on the overall project goals rather than on single requirements, i.e. all project work is only executed in alignment with the project goals. *"*[…] *if the customer is clear about his needs, then he is also able to derive his requirements accordingly"* (P2)
2. Prioritised backlog according to business value: Prioritising the development by implementing according to the highest business value ensures that the product will have the highest possible business value at any time in the project. *"*[...] *if I have 50 percent of the features and I sort it by business value, then I don't have 50 percent of the business value, but 70 or 80 percent of the business value"* (P8)
3. Short planning and feedback cycles by continuous delivery of MVPs: The development in short feedback cycles helps the Scrum team to focus on what is really needed based on instant feedback, rather than on anticipating needs. *"Regular feedback loops with the customer, whereby regular means every two weeks. Present the result and have it evaluated by the customer. That was very, very important."* (P6)
4. Improved time-to-market: The early delivery to end customers and their feedback helps the Scrum team to focus on what is needed by the market. *"*[…] *it is much more effective for the client, of course, because he can already use the software."* (P11)

The benefits which have an impact on effectiveness are presented in Table 18, which contains paraphrased statements of the benefits, the codes of the interview partners who mentioned this as a benefit, and one corresponding example quote.

Benefits which promote effectiveness		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Focus on project goals / product vision	P2, P3, P6, P8, P9, P10, P12	First, the effectiveness must be ensured. I can only achieve this by setting a clear product vision, a clear goal.
Prioritised backlog according to business value	P3, P4, P6, P7, P11	And that has the very, very big advantage - the old 80-20 rule - that the customer estimates the business value he has with it - he can say: "If I have 50 percent of the features and I sort it by value, then I don't have 50 percent of the value, but 70 or 80 percent of the value."
Short planning and feedback cycles by continuous delivery of MVPs	P1, P3, P4, P6, P8, P9, P10, P11, P12	I think that in general, the best thing about Agile is these short feedback cycles. That's actually the introduction of a feedback cycle that gives me exactly what I need. I'm not anticipating too much, I'm doing it, delivering what's necessary to create a basis for discussion, and then briefly gathering feedback beforehand on how to proceed.
Improved time-to-market	P4, P7, P10, P11	The typical driver for Agile fixed-price projects or Agile in general is "time-to-market". But "time-to-market" means that I want to earn money as quickly as possible. "Time-to-market" does not mean that I want to keep my costs as low as possible.

Table 18: Quotations related to impact of benefits on effectiveness; Source: The author

The findings supported that applying the Scrum framework to FFP environments is perceived by the interviewees to increase effectiveness, as it promotes the delivery of what is needed by business, i.e. meeting stakeholder expectations. Effectiveness is the prerequisite for being efficient (DeMarco, 2002), as P8 stated: *"And effectiveness is the prerequisite for me being able to become efficient at some point."* (P8)

As a result, Scrum increases the likelihood that the project is perceived as successful, as it addresses critical success factors as mentioned in the introduction (p.15). There is evidence in the data that Scrum in an FFP context increases the effectiveness, but certain modifications are needed. These modifications are explained in Section 4.1.3.

Figure 16 depicts the empirically identified impacts on effectiveness.

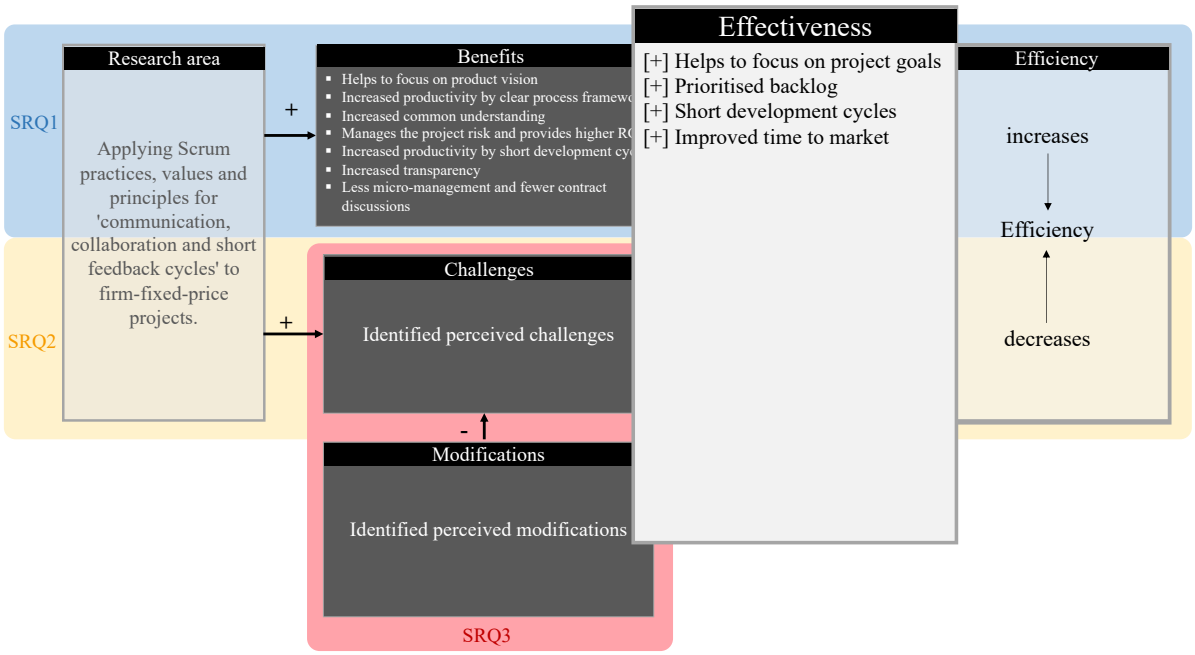


Figure 16: Theoretical model with the empirically identified factors that promote effectiveness; Source: The author

4.1.1.10 Impact on efficiency

The majority of interview participants reported that Scrum focusses on effectiveness and not on efficiency but noted that applying Scrum to FFP projects might have a positive impact on efficiency. Some interviewees have expressed this referring to the terms *"effectiveness must be ensured […] then efficiency emerges"*, *"develop only what is needed"*, *"quicker project execution"* and *"limited resources"*.

The benefits which have a perceived impact on efficiency are:

1. Improves focus on product vision / project goals: the focus on the product vision with the stakeholders' feedback after each development cycle helps the Scrum team to focus on the important things and to save resources. *"The efficiency results again from the fact that we develop only what is needed and nothing else what is never used in the end."* (P9)
2. Early stakeholder involvement: the continuous delivery approach, which means early stakeholder involvement and live testing of the product increments, yields important feedback on the one hand – if and where more resources have to be invested in the product – and familiarises the users with the system on the other hand, which makes the later introduction of the system easier. *"*[...] *45 percent of the features that are implemented are not used at all. Even though they used to be specified before. And I believe that if you develop Agile and get customer feedback on requirements relatively quickly, you'll be able to find those 45 percent which are not need very quickly."* (P10)
3. Less overhead for change request and specification: in Scrum, less documentation is needed to be able to implement product features as the communication and feedback among the project stakeholders and the team is more important. *"In a plan-based project, you invest a lot of time in the initialisation phase and the planning phase, until you really get to execution. And only to perhaps determine that something has changed completely. So, I have to change everything again. And then you start planning everything again from the beginning. And that just doesn't apply to Agile here."* (P4)
4. Limited resources promote efficiency: if only limited resources are available, the development team will more likely focus on what is really needed and will avoid gold-plating. *"If you give a developer a certain time budget and communicate it, then he will use up that time budget. This is already the case psychologically."* (P7)

The benefits which have an impact on efficiency are depicted in Table 19.

Benefits which promote efficiency		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Help to focus on product vision / project goals	P8, P9	And that was absolutely amazing for me to see what a channelling effect a common goal can have. And this channelling is an absolute efficiency booster. And that's why for me the order is to produce effectiveness in the sense of a clear product vision. Efficiency will follow automatically through this clear goal.
Early stakeholder involvement	P2, P4, P9, P10	But in itself, I have a speed advantage, I have efficiency advantages, which I have gained through the way of working with a Go-Live system. I have very well educated people on this system.
Less overhead for change requests and specification	P2, P4, P7	Yes, efficiency at any rate, we've already had that. Especially because the whole overhead for changes is omitted and also partially, Scrum also has the approach that documentation is omitted, that is also an approach of Scrum, to a certain extent of course, is then of course also beneficial for efficiency.
Limited resources promote efficiency	P6, P7, P8, P10	Well, it's definitely right when I say I somehow need a module X and I give you 100 person days for it, then you get the thing in 100 person days. And if you say that you only have ten person days for it, then you will get module X in its simplest form in 10 person days.

Table 19: Quotations related to impact of benefits on efficiency; Source: The author

As the findings show, being effective does not mean to be efficient by default, but it is a prerequisite of efficiency. This poses a risk to fulfilling the iron triangle, and therefore to the project success. As a consequence, every effective project action must be evaluated against fulfilling the iron triangle in an FFP project, which in reverse promotes efficiency, as reported by the interviewees. However, the majority of the interviewees perceived an increased efficiency by applying the Scrum framework to FFP projects. The framework can be applied to FFP environments, with the restriction to stay within the iron triangle. This is achieved by

modifications to ensure the efficiency, which are explained in detail in Section 4.1.3. Figure 17 depicts the empirically identified impacts on efficiency.

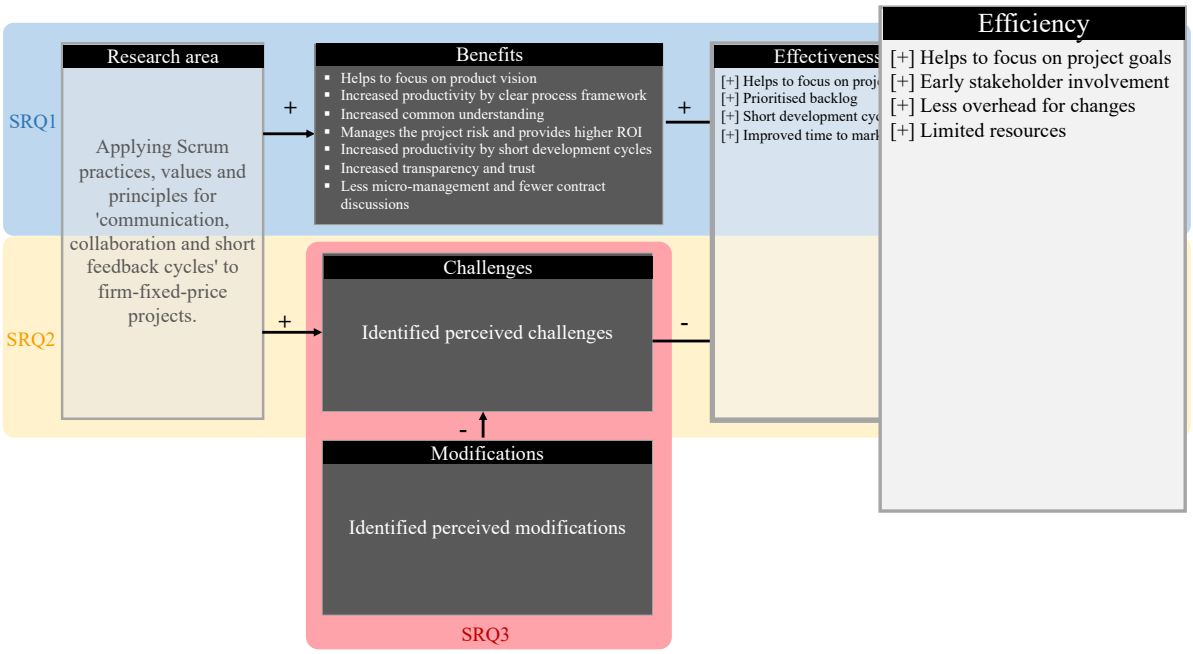


Figure 17: Theoretical model with the empirically identified factors that promote efficiency; Source: The author

4.1.2 Challenges of using Scrum without modifications in firm-fixed-price projects

In alignment to SRQ2, the following categories have been identified as the main challenges of using Scrum within an FFP context, and their perceived impact on effectiveness and efficiency.

4.1.2.1 Missing clear project goal

Although the majority of participants acknowledged the importance of a clear project goal, one participant specifically raised the topic that often the project objectives are not clear and cannot be stated, as requirements are only provided in the contract and for a plan-based approach this would normally be enough. This is why the customer often has only large specification documents or PowerPoints which have several hundreds of pages, but a clear product vision statement cannot be derived. One interviewee (P8) emphasised:

[…] *if you put a product vision into 144 pages of PowerPoint and then expect the employees to understand what is meant and what really matters* […] *That couldn't work from the beginning.* (P8)

This lack of clarity has huge impacts on the effectiveness of the project. As he continues:

"First, the effectiveness must be ensured. I can only achieve this by setting a clear product vision, a clear goal." (P8)

Therefore, it is clear that it is possible to have an efficient team that is not effective as it develops a product that does not meet the client/stakeholder expectations. What makes it a challenge is that despite the detailed requirements the overall project goal might not be clear, and therefore it will be difficult to meet stakeholder expectations, especially when the relevant stakeholders are not available for feedback. Therefore, an unclear project goal is likely to decrease the effectiveness within the project. This finding again suggests the very strong need for a clear and agreed product vision at the start of the contract. A derived modification for using Scrum in FFP projects is: *"conducting a product vision workshop/kick-off meeting"* – this is one adaptation to Scrum which resulted from this research and is further described in Section 4.1.3.2, which addresses how to clarify the product vision.

4.1.2.2 Unclear, changing or missing requirements

Even if the product vision is clear, requirements might be unclear, missing or not fully understood by the supplier. The main challenge seems to be knowledge management as emphasised by P10 (Table 20). He expressed this referring to the terms *"knowledge management"*; others having referred to using terms such as *"inquiries have to follow to understand the feature", "variety of interpretation is high", "customer was actually not clear about it", "customer never knows what he really wants"* and *"different interpretations of the requirements".*

Implementing the right requirements is vital for meeting the project objectives and finally for meeting stakeholder expectations, as mentioned in Chapter 1. On the one side, the Standish Group report emphasises that unclear, frequently changing or missing requirements are one of the main reasons why projects fail or are challenged in FFP environments, as they have an impact on the effectiveness and the efficiency. On the other side, they clarify that a *"clear*

statement of requirements" (Clancy, 2014, p.8) is one of the critical success factors for project success.

The quotations related to unclear or missing requirements are depicted in Table 20.

		Unclear, changing or missing requirements
Respondents	P1	Of course, this is always the case that requirements are contractually fixed in advance, as good as it can be. But then it actually turns out, through the work, that inquiries have to follow to understand the feature and from new changes are created. This is completely normal.
	P2	It is held very woodcut-like in the bidding phase. The service provider writes down his solution path in a nutshell, and then it comes relatively fast again towards: "This is a change request, this is an extension of the requirement, there is an additional attribute added to it, or we have not meant it like this." So, the variety of interpretation is high and there must be a tender with a really high degree of precision so that a service provider is really able to make reasonable estimates here.
	P4	We had more or less a huge catalogue of requirements, but the customer was actually not clear about, where should the journey go? What else has to be done, what is really important? And then we decided to act Agile.
	P5	No. The customer never knows what he really wants. He always has such a basic idea and quite often in the tender documents you can find half-sentences in it, again and again. And there stands: "This must be further specified". But it is fixed-price; this is typical for the public sector.
	P10	It comes from knowledge management and says that when you look at a specification, what knowledge do we have there. […] From my point of view, you can divide it into four groups. The first group of explicit knowledge is uninteresting knowledge. So, something written down where you say you do not need fulfilment. One of them wrote a nice text. The second is, you have knowledge, there is a common understanding about it. So, if I took that, and give it to developers, they will always be programming exactly what I need. The third big block is that there is knowledge, there is no common understanding about it. As a stakeholder, a specialist has written down something and the developer does not understand what he should implement there. Well, and this point is sometimes quite large. And then we still have implicit knowledge where things have not been written down, because they say the developer has to know that on his own. So, and this group is so big in the software development field, that if you only translate a requirement document one-to-one, you will not get what you really want. And that, I believe, was the first basic knowledge where one was told that we are not able to write everything on paper so that someone else understands it well. We call that shared knowledge, that is the golden principle. And that is what distinguishes Agile, that is why Agile makes a lot of sense.
	P11	There are not only specifications but also functional specifications, which are likely to be written. [...] And that is the standard problem, that at the transition from the specification to the functional specification one does not understand or talking at cross purposes. In the specifications there is always a maximum desire between the lines and in the functional specification there is always a minimum desire between the lines. This sometimes goes so far apart that although similar documents exist, the ideas of what has to be done are very extremely wide apart. There is this ancient saying: "Kennel or skyscraper - what do you want now?" So, in the specifications and in the functional specifications there are things in it, which can be interpreted both as a kennel and as a skyscraper and that is just significantly different.

Table 20: Quotations related to unclear or missing requirements; Source: The author

What makes this a challenge is that unplanned effort for new or unclear requirements will certainly arise, as reported by the interview partners. Usually this effort has not been calculated within the FFP contract, and it is often not clear if the customer will accept and pay for the change that has arisen as a change request. If the supplier is not paid for an additional change,

this will decrease the supplier's overall project efficiency, based on the iron triangle. This leads to the following conflict, which has to be solved. As one of the core values of Scrum is identifying iteratively the needs and adapting to change, which is effective, but at the same time this approach is problematic in an FFP environment as this might contradict the iron triangle, as demonstrated in the introduction. As a consequence, changes to the product backlog have to be controlled within an FFP environment to fulfil the iron triangle. Therefore, the process of adapting the product backlog in Scrum has to be adapted to stay within the iron triangle. Derived modifications for using Scrum in FFP projects are: *"conducting a backlog translation workshop", "definition of ready / definition of done"* and *"documented changes to the backlog by mutual agreement"*. This finding directly relates to Section 4.1.2.4, which addresses 'scope creep'.

4.1.2.3 Unknown and changing stakeholders and lack of engagement

One challenge which was reported is to identify the right stakeholders, which is vital to meet their expectations and to motivate them to participate in the project, as emphasised by P10 (Table 21). In this context P5 has referred to meeting at the end of the project, where *"during the final acceptance the IT operations were involved, and then new issues raised"*. Others have referred to using terms such as *"changing environment of stakeholders", "different customers", "which stakeholders are key", "people have changed", "stakeholders not present", "several stakeholders from several departments"* and *"client sends his employees"*.

What makes it a challenge is that, firstly, there are mostly different stakeholders from different departments with different requirements on the product, which are sometimes contrary. Secondly, changing stakeholders who often raise new or different requirements than the previous stakeholders, i.e. with another focus on what is needed in the product. Thirdly, previously unknown stakeholders who appear late in the project. All of which can mean that it is nearly impossible to identify all the necessary requirements because not all of the stakeholders are known upfront. In addition, this can decrease the overall project efficiency regarding the iron triangle if such unknown stakeholders identify late requirements that have to be implemented.

This is also reported by other interviewees as depicted in Table 21 below

		Stakeholder involvement
Respondents	P2	The greatest difficulty is the changing environment of stakeholders.
	P3	They were only involved in the project setup. So they wanted things like fixed price and warranty and so on. And the rest is not interesting anymore. For the rest comes the department. So this is also a very typical scenario that you don't have only one customer. But that you have different areas with different customers, with which you get to deal at different times of the project. And the purchasing department often determines the structure of the payment, which determines the modalities. But then the department makes completely different demands on the project. In this case, this was not so important to them now.
	P7	Of course, I also have to evaluate internally which of the stakeholders are the key? Which stakeholders do I have to involve in the project and how? Which stakeholder do I prefer to push a little aside? Which ones bring in trouble?
	P9	That we initially discussed functionalities that were no longer up to date at the end. Because either the business has changed or, even more frequently, the people have changed, and we then had other contact persons who had completely different ideas.
	P10	One day the stakeholders were not present in the review meeting, but the requirement was accepted by the Product Owner anyway and finally there was a dispute between stakeholders and Product Owners. So, the success criterion is really that they are present in the planning and in the review.
	P10	So, where we did the project, one was designated as a product owner who had a business overview and was able to see what has actually to be done. And the others came from the company's specialist departments, which had requirements for the product, so to speak. Well, there were several stakeholders, from several departments and there was actually the difficulty.
	P11	There are fixed-price projects where project managers have a high interest in communicating. So that's what happens when things go stupid. So the classic of a fixed-price project is as follows: As long as I'm still in the process of finding a contract, the stakeholder, i.e. the one who pays for it, comes and makes the contract with me. That's a contract, I say - I'll make it simple now - he has ten pages, there are ten requirements in it - which means that each requirement can be a maximum of one page long - and it's described there. So, then an offer comes out and then the contractor says "Yes, it costs 100,000 euros", yes? That's it. The communication continues now and if I order "Let's go" now and from now on the client sends his employees who have to use, yes, should use this software. And they now interpret these ten pages, these ten feature descriptions for their maximum benefit.

Table 21: Quotations related to stakeholder involvement; Source: The author

On the one hand, this finding indicates that an explicit stakeholder management approach, which identifies the key stakeholders within the customer organisation, is needed to clarify the business needs with the right stakeholders and to meet their expectations, i.e. to be effective. Scrum implies that the relevant stakeholders are already working within the project but within an FFP context this is not the case. Therefore, an adaptation to the Scrum framework which implements an explicit stakeholder management approach is needed to ensure effectiveness. On the other hand, this finding implies that there is a great risk of overrunning the project restrictions of the iron triangle, as by changing or evolving stakeholders with changing or different requirements scope creep might appear, as described in the next section. Finally, in an FFP environment it must be ensured that the relevant stakeholders are involved in the project. Derived modifications for using Scrum in FFP projects are: *"presence of customer*

representatives at regular meetings in client's obligations", "explicit stakeholder management" and *"explicit risk management"*. These solutions are discussed in sections 4.1.3.1, 4.1.3.6 and 4.1.3.7, which address the client's obligations and explicit stakeholder management to solve the issues with the lack of stakeholder involvement and management.

4.1.2.4 Scope creep

One main challenge which emerged is that through intensive communication and collaboration within Agile, the scope creeps if it is not controlled. Scope creep is the main challenge as it directly affects the iron triangle in all dimensions, i.e. negatively, in overall project efficiency. One interviewee (P5) has expressed this referring to the terms *"better more than too little", "scope creeping is the main challenge and there is no other main challenge"* and *"take everything they can get"*; others have expressed referring to terms such as *"wish what you desire"* and *"interpret this to their maximum benefit"*.

This challenge is directly related to the three other findings above: *"missing clear project goal"*, *"unclear, changing or missing requirements"* and *"unknown and changing stakeholders and lack of engagement"*.

Table 22 depicts the answers from the interviewees.

		Scope creep
Respondants	P5	Better more than too little, because then they'll see if you're thinking in the right direction. Whether you have understood that too. As I said, they take everything they can get. And if you don't cooperate, then there are mostly, "oh yes, why doesn't that work? Yes, it's not in the scope. And not that? But we need that". [...] Scope creeping is the main challenge and there is no other main challenge. I'm afraid to say so.
	P10	Stakeholders from the specialist departments then came up with their wish lists, so it was already partly a "wish what you desire" list. And they have now formulated these wishes.
	P11	From now on, the client sends his employees there, who must, yes, should use the software that is created there. And they now interpret the specifications for their maximum benefit. [...] So now in this case this leads to the fact that the contractor likes to go broke, because the users of course interpret this to their maximum benefit and nobody looks at the costs anymore, yes? It's a fixed-price project.

Table 22: Quotations related to scope creep; Source: The author

This finding reinforces the need for a controlled product backlog within an FFP environment, otherwise it would not be possible to stay within the iron triangle, which is inefficient in terms of fulfilling the contract. Derived modifications for using Scrum in FFP projects are: *"conducting a backlog translation workshop/refinement"* and *"documented changes to the product backlog by mutual agreement"* which are discussed in Sections 4.1.3.3 and 4.1.3.5.

In addition, this challenge has a direct impact on the perception of effectiveness by meeting the expectations of stakeholders, as the feedback from P5 shows:

"And then you stand in front of them and say, yes, I'd love to implement it, but I can't get it implemented within the timetable and I can't get it implemented within the budget either." (P5)

This means that continuous expectation management must be conducted to guide the stakeholders through the project in alignment with the product vision and the project constraints, i.e. the iron triangle. Transparency, such as is provided by the Scrum release burndown chart, helps the stakeholders to visualise the impact of additional features on project constraints.

4.1.2.5 Lack of empowered Product Owner

Another challenge identified from the interviews is that an empowered project lead (in Scrum this is the 'Product Owner') with a certain authorisation is needed from the customer side. The customer representative has to be empowered as a decision-maker to prioritise the product backlog, to give feedback, to legally accept deliveries and to make changes including change requests to the scope of the ordered product, if necessary. Furthermore, the development team should be empowered to decide how to implement the functionality technically, i.e. they have the freedom to decide, based on their expertise. This leads to the following division of tasks, which is also provided for in Scrum: the Product Owner decides what is to be done and the development team decides how it is technically implemented. One interviewee (P9) has expressed this referring to the terms *"giving a clear acceptance of the current state"* and *"giving a clear prioritisation of the next activities";* others have referred to using terms such as *"rely on the expertise of the team"* and *"empowering the team"* .

The quotations which emphasise the need for an empowered team and organisation are depicted in Table 23.

		Need for an empowered Product Owner / team
Respondents	P4	Going away from this 'Command & Control' structure to enabling and empowering the team, and also giving up some responsibility, to ultimately rely on the expertise of the team and individuals. That's an important point, I think. That gets lost very often.
	P8	But then again, it's very important this part that the Product Owner has this great freedom […]
	P9	It's just: I'm[the Product Owner] in the review meetings, and I'm giving a clear acceptance of the current state, and I'm giving a clear prioritisation of the next activities.

Table 23: Quotations related to the need of an empowered team and organisation; Source: The author

This finding has two outcomes. Firstly, empowering the team is necessary to increase the productivity by letting the team members decide, based on their expertise and the current situation, rather than the line managers who are not fully involved in the project, as interviewee P4 (Table 23) emphasised.

Secondly, an empowered Product Owner from the customer is needed, who is enabled to steer the project. Otherwise, the development cycle within Scrum would hardly work, within short development cycles, as important decisions could often not be made by the person involved in the project in time, which would slow down the effectiveness. Therefore, a Product Owner, i.e. an empowered customer representative, who is empowered to steer the project with all its important decisions and consequences within the Scrum process, is strongly needed to be effective and efficient. What makes this a challenge is that Scrum implicitly needs a Product Owner from the customer side who is a real decision-maker, but this is not intended in an FFP project. In FFP projects decision-making by the customer is not intended, as everything is decided by clear statements of requirements in the contract. There will be a customer representative who participates in steering committees but very often this person changes over time and is not authorised to make fundamental decisions. Therefore, this strong role of the Product Owner has to be ensured explicitly in the contract within an FFP environment. A derived modification for using Scrum in FFP projects is: *"client's obligations"*. This solution is discussed in Section 4.1.3.1, which addresses the client's obligations. The empowering of the Product Owner is directly related to the next finding *"contract fulfilment and legal aspects"* in Section 4.1.2.6.

4.1.2.6 Contract fulfilment and legal aspects

Contract fulfilment is one of the most critical issues, as the supplier only gets paid if the final delivery is accepted by the customer. But there are different views on the contract, i.e. what is in and what is not in it, and finally what is needed to fulfil the contract, as emphasised by P11 (Table 24). Other interviewees have expressed this referring to the terms *"the ideas of what has to be done are extremely wide apart", "interpretations of specifications are significantly different, "new issues were raised at the final acceptance", "don't even know the contract"* and *"something that can be accepted as contract fulfilment"*.

Related to this, the purchasing department is specifically mentioned by the interviewees, as it is responsible for the contracting. The purchasing department is only involved in the beginning and for the acceptance of the delivered product within an FFP environment. Thus, its employees are not involved in the software development project itself and therefore often do not understand software development, which results in a lack of control and trust as they cannot judge whether the software is complete and working or not.

The quotations related to contract fulfilment and legal aspects are depicted in Table 24.

		Contract fulfilment and legal aspects
Respondents	P5	It has been a complete final acceptance, where then often the IT operation has also been involved. And then new issues were raised up.
	P8	And the question is, that's at least from our point of view here, what you can offer to the purchasing department instead, so they can say, okay, I've got something here that I can accept as contract fulfilment. Because that's what they need. If they even have a fixed price criterion.
	P10	If you go to a large company and make such a fixed price project, it is always so the purchasing department has made the pre-negotiation, the contract. And at times I always have the feeling that those who then implement it don't even know the contract.
	P11	In the specifications [written by the customer] there is always a maximum desire between the lines and in the functional specification [written by the supplier] there is always a minimum desire between the lines. This goes sometimes so far apart that, although similar documents exist, the ideas of what has to be done are very extremely wide apart. There is this ancient saying: "Kennel or skyscraper - what do you want now?" So, in the specifications and in the functional specifications there are things in it, which can be interpreted both, as a kennel and as a skyscraper and that is just significantly different.

Table 24: Quotations related to contract fulfilment and legal aspects Source: The author

What makes it a challenge is that the supplier fully bears the risk that the delivered product is not accepted at the end, as the stakeholders with whom the product has been developed are not those who might be concerned with the acceptance of the contract, which might result in extra effort and a decrease in efficiency. Thus, there is again the need that key stakeholders are identified and involved in the development process with their feedback (4.1.2.3) to increase the likelihood of fulfilment of the contract, i.e. the developed product is accepted by the customer. As stakeholders might change over time (4.1.2.3), each development increment should be legally accepted by the empowered customer representative, i.e. the Product Owner, after each Sprint if it fulfils their demand, as a base for the final acceptance. Therefore, a legal acceptance with a signed document for each Sprint of what has been accepted seems important. Derived modifications for using Scrum in FFP projects are: *"empowered Product Owner in client's obligations"*, *"continuous documented reviews"* and *"documented changes to the backlog by mutual agreement"*. These are further discussed in Sections 4.1.3.1, 4.1.3.4 and 4.1.3.5, which address the need for an empowered Product Owner, documented reviews and documented changes to the product backlog.

4.1.2.7 Summary of challenges

Summarised, the empirically identified challenges of using Scrum in FFP contexts are:

- Missing clear project goal
- Unclear, changing or missing requirements
- Unknown and changing stakeholders and lack of engagement
- Scope creep
- Lack of empowered Product Owner
- Contract fulfilment and legal aspects

These challenges are depicted within the theoretical model in Figure 18.

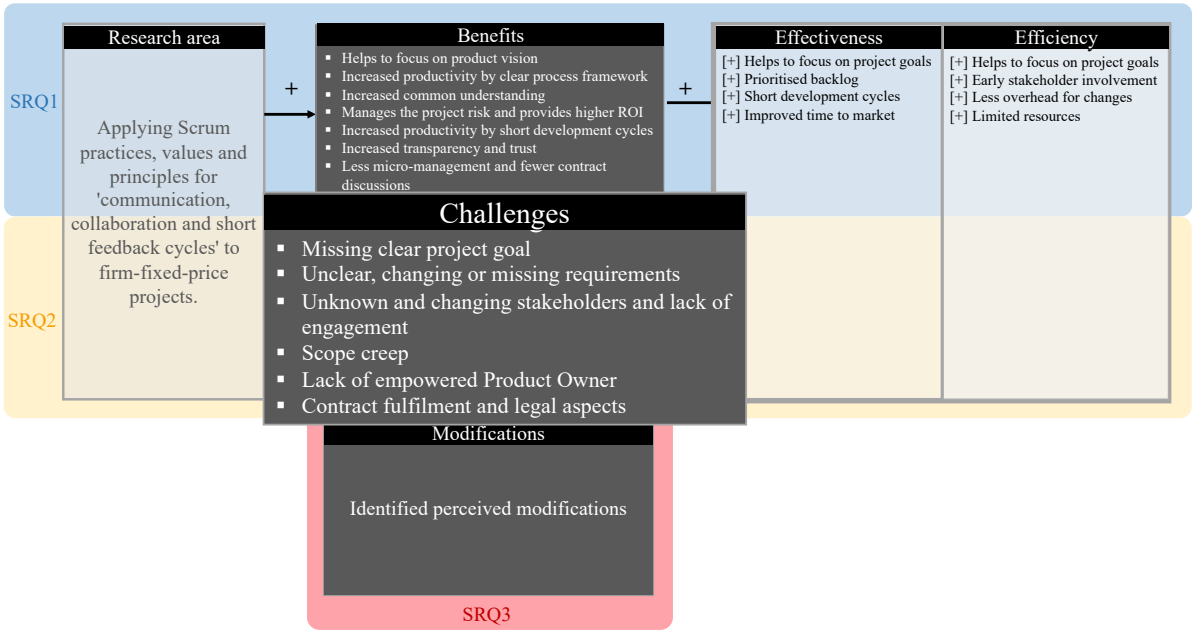


Figure 18: Theoretical model with the empirically identified challenges; Source: The author

4.1.2.8 Impact on effectiveness

The findings supported that Scrum is perceived to be effective in FFP environments as long as its prerequisites are fulfilled. However, the identified challenges, which might appear by applying Scrum to FFP projects, demonstrate that the contrary is possible if Scrum cannot be applied as it should be. Then a loss of effectiveness and efficiency is likely to appear.

The empirically identified challenges which have a perceived negative impact on effectiveness are:

1. Missing clear project goal: as previously identified in Section 4.1.1.1 a clear product vision is necessary to keep the focus, to be effective. Without one, effectiveness can hardly be achieved. *"First, the effectiveness must be ensured. I can only achieve this by setting a clear product vision, a clear goal."* (P8)
2. Unclear, changing or missing requirements: unclear requirements make it difficult to meet the stakeholders' expectations and therefore to be effective. *"In the specifications* [written by the customer] *there is always a maximum desire between the lines and in the functional specification* [written by the supplier] *there is always a minimum desire between the lines*. […]" (P11)
3. Unknown and changing stakeholders and lack of engagement: identifying the right stakeholders and getting feedback from them is vital to be effective. *"One day the stakeholders were not present in the review meeting, but the requirement was accepted by the Product Owner anyway and finally there was a dispute between stakeholders and the Product Owner. So, the success criterion is really that they are present in the planning and in the review."* (P10)
4. Scope creep: it is necessary to manage the expectations in cooperation with the stakeholders and to be transparent about the impact these additional functionalities may have on the project objectives, the project timeline and the budget. Otherwise the unfulfilled wishes might be interpreted as meaning that the project is not effective. *"*[…] *from now on, the client sends his employees there, who must, yes, should use the software that is created there. And now they interpret these ten pages, these ten feature descriptions for their maximum benefit."* (P11)
5. Lack of empowered Product Owner: as identified in 4.1.2.5, without an empowered Product Owner it is hardly possible to be effective. *"Going away from this 'Command & Control' structure to enabling and empowering the team* [the Product Owner]*, and also giving up some responsibility, to ultimately rely on the expertise of the team and individuals. That's an important point, I think."* (P4)

Figure 19 depicts the empirically identified impacts on effectiveness.

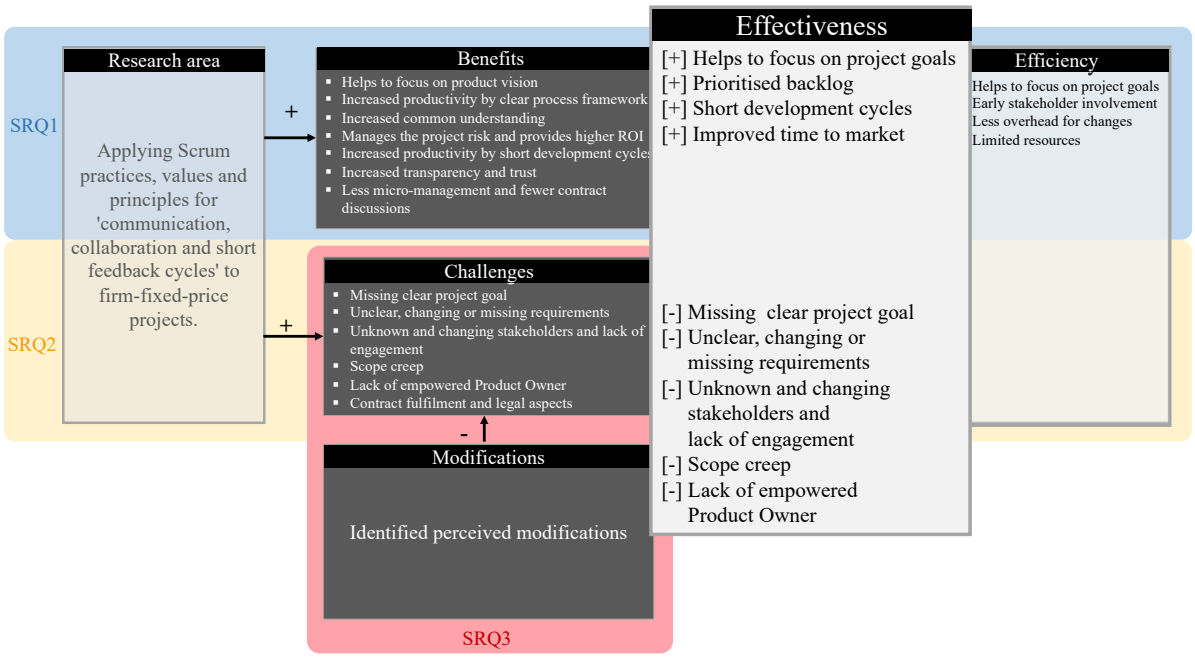


Figure 19: Impact of challenges on effectiveness; Source: The author

4.1.2.9 Impact on efficiency

The empirically identified challenges which have a perceived negative impact on efficiency are:

1. Missing clear project goal: without a product vision it is hardly possible to be effective (4.1.2.1), but one might still be efficient by implementing the wrong requirements. On the other hand, this would not be efficient in the context of the overall project goal, which means meeting stakeholder expectations within the iron triangle, at best with the use of fewest resources. *"*[...] *Efficiency will follow automatically through this clear goal."* (P8)
2. Unclear, changing or missing requirements: again, as with the missing project goal, implementing the wrong or further requirements is not perceived as efficient in the overall project context. *"The customer never knows what he really wants. He always has such a basic idea and quite often in the tender documents* […] *there stands: 'This must be further specified'. But it is fixed-price; this is typical for the public sector."* (P5)

3. Unknown and changing stakeholders and lack of engagement: identifying the right stakeholders and getting feedback from them is vital to be effective, and again to be efficient in achieving the overall project goal.
4. Scope creep: as the resources in FFP projects are limited, fulfilling extra wishes without getting paid for it has a direct impact on project efficiency (4.1.2.4)
5. Lack of empowered Product Owner: as identified in 4.1.2.5, without an unempowered Product Owner it is hardly possible to be effective, and again hard to be efficient in achieving the overall project goal.

Figure 20 depicts the empirically identified impacts on efficiency.

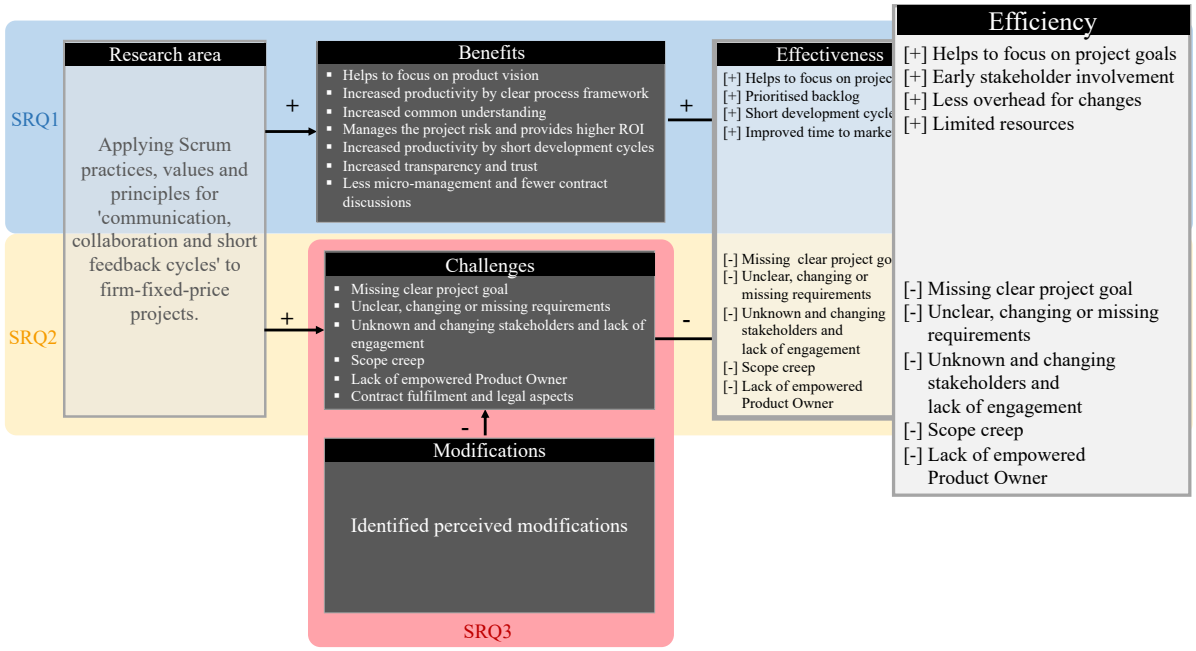


Figure 20: Impact of the empirically identified challenges on efficiency; Source: The author

4.1.3 Recommended modifications to the Scrum framework in firm-fixed-price projects

In alignment to SRQ3, the following categories have been identified as recommended modifications to the Scrum framework based on the project experiences of the interviewees, if using Scrum within an FFP context, to increase the perceived effectiveness and efficiency. Depending on the nature of the project, one modification might be more important than another. This has to be evaluated depending on the project situation.

4.1.3.1 Defining client's obligations

A critical finding is that somehow the important points for collaboration must be legally defined. The findings revealed that this is possible within the client's obligation to cooperate[28], i.e. within a document which is part of the FFP contract. The client's obligations to cooperate are the only part of the contract that is normally accepted and expected by the customer as input from the supplier under German law. They provide the legal base to define some of the required changes in the next sections. One interviewee (P11) has expressed this as *"in classic environments you have to describe your obligations to cooperate"*; others made similar comments such as *"without obligations to cooperate feedback would not exist", "explicit obligations to cooperate"* and *"is part of the contract"*.

The importance of this contractual obligation has been mentioned by all interviewees, except P10 who said that they have never had problems with customer collaboration. Without assuring customer collaboration, it would hardly be possible to promote agility, as the prompt input from the customer representative (Product Owner) is needed, e.g. feedback on product increments.

[28] Although cooperation and collaboration are often treated synonymously in practice, theory distinguishes between both (Nissen, Evald & Clarke, 2014, p.1). According to (Nissen, Evald & Clarke, 2014) collaboration refers to *"strong linkages and high level of trust and knowledge sharing between team members"* (p.1), while cooperation refers to *"transferring of knowledge among team members"* (p.1). In the context of this thesis, cooperation is seen as the minimal working mode between the customer and supplier, i.e. exchanging information, which should be extended to a trustful and close working mode, i.e. collaboration with a common understanding.

The responses from the interviewees are depicted in Table 25.

		Client's obligations to cooperate as part of the contract
Respondants	P1	[client's obligations to cooperate] Well, that's a change, of course, that's interesting, just right.
	P2	[client's obligations to cooperate] Timely grooming. Sufficient testers, ie. staff, premises, infrastructure…
	P3	So without the obligation to cooperate the cooperation of the client, that means the possibility of feedback, would not exist […]
	P4	At our project it was like that, of course, in the contract [...]
	P5	[client's obligations to cooperate] That's what we do
	P6	[client's obligations to cooperate] Exactly, that was part of the contract
	P7	[…] it had also been contracted and that was also a precondition of mine.
	P8	But then again, it's very important this part that the Product Owner has this great freedom […]
	P9	In the contracts we have them for Agile practices, even in the templates that we use, there are explicit obligations to cooperate.
	P10	That is - we have never had problems, I have to say honestly
	P11	I agree. Sure, absolutely, they have to be putted in. In a classic environment, you always have to somehow describe your obligation to cooperate.
	P12	Of course client's obligations to cooperate is a part of the contract

Table 25 Quotations related to client's obligations to cooperate as part of the contract; Source: The author

The interviewees suggested the following points to be included or evaluated in the client's obligations:

1. Empower a customer representative as Product Owner, which addresses the challenges *"lack of empowered Product Owner"* and *"contract fulfilment and legal aspects"* in Sections 4.1.2.5 and 4.1.2.6. It is the most important point to have one customer representative in the project who is empowered:
    a. as a decision-maker: *"*[…] *the decision makers must ultimately sit in this meeting and that the topics are also discussed."* (P7)
    b. to prioritise the product backlog: *"*[…] *giving a clear prioritisation of the next activities."* (P9)
    c. to give feedback: *"without the participation of the client, the possibility of feedback would not exist."* (P3)

   d. to legally accept deliveries: *"*[…] *giving a clear acceptance of the current state* […]*"* (P9), and
   e. to make changes, including change requests, to the scope of the ordered product, if necessary: *"if the Product Owner agrees, for example to a change request, then the change is automatically accepted. The only thing we have to do is to document."* (P8)

2. Conduct an initial product vision workshop or kick-off meeting (4.1.3.2), which addresses the challenge *"missing project goal*" in Section 4.1.2.1: the product vision must be clear and communicated to all project stakeholders to have a common view of the project objectives. *"*[a common agreed product vision] *is a kind of quality gate for me in the beginning. The very first, we always call it Sprint Zero, the very first thing that needs to stand is the product vision, we have to have a focus"* (P8)
3. Conduct an initial backlog translation workshop (4.1.3.3), which addresses the challenge *"unclear, changing or missing requirements"* in Section 4.1.2.2: after the product vision is clear to all project stakeholders, the initial specification must be translated together into a prioritised product backlog. This happens very often in an initial workshop. *"Agile projects always mean to transform 'specifications' into a backlog with user stories."* (P11)
4. Definition of ready/definition of done, which addresses the challenge *"unclear, changing or missing requirements"* in Section 4.1.2.2: as best practice in Scrum it is recommended to define the prerequisites (definition of ready) which are needed for a specification up front to start its development. This means which criteria must be fulfilled so that the implementation of a requirement can be estimated or started. For example, the specification must be specific, measurable, achievable, relevant and time-bound. Once a specification has been implemented, it must be clear what are its acceptance criteria so that the requirement can be labelled as finished (definition of done). For example, the implemented specification must be documented, reviewed by a peer member or assured by automatic tests. *"How good the requirements must be specified, so that the team can estimate and implement them."* (P11)
5. Provide protected work places, which addresses the challenge *"lack of empowered Product Owner"* in Section 4.1.2.5: in a command and control structure a protected project workplace might be needed to empower and protect the team members so

that they can concentrate on their work. *"We have rented from this customer now our own office space, where the employees of this customer and our employees can create such MVPs then, but they are in a protected area."* (P8)

6. Ensure continuous delivery and acceptance (4.1.3.4), which addresses the challenge *"contract fulfilment and legal aspects"* in Section 4.1.2.6: the continuous delivery of feedback in Sprint cycles and a deadline for feedback/acceptance is very important to steer the project, and a systematic approach should be defined. "*We provide the product increment one Sprint in advance, which was then shown in the next review again, so that the customer has a certain amount of time to have a closer look at the product increment, to get it tested."* (P7)
7. Presence of customer representatives at regular meetings, which addresses the challenge *"unknown and changing stakeholders and lack of engagement"* in Section 4.1.2.3: *"*[…] *the decision makers must ultimately sit in this meeting and that the topics are also discussed."* (P7)
8. Access to the client's infrastructure: it is vital for the supplier to have access to the client's infrastructure and test systems for early integration of the whole system. *"Sufficient testers, i.e. staff, premises, infrastructure…"* (P2)

The recommended points of the client's obligation to cooperate are in Table 26.

Content of client's obligation to cooperate		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Empower a customer representative as Product Owner	P4, P8	Going away from this 'Command & Control' structure to enabling and empowering the team, and also giving up some responsibility, to ultimately rely on the expertise of the team and individuals. That's an important point, I think
Conducting an initial product vision workshop / kick-off	P2, P3, P6, P8, P9, P10 , P12	[a product vision] is a kind of quality gate for me in the beginning. The very first, we always call it Sprint Zero, the very first thing that needs to stand is the product vision, we have to have a focus
Conducting an initial backlog translation workshop	P2, P4, P6, P7, P8, P9, P10	Agile projects always means to dissolve the topic of "specifications" against a backlog with user stories.
Definition of ready / definition of done	P11	[it's important] how good the requirements must be specified, so that the team can estimate and implement them
Provide protected work places	P8, P10	We have now rented from this customer own office space where the employees of this customer and our employees can create such MVPs then, but they are in the protected area
Continuous delivery and acceptance	P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	We provide the product increment one Sprint in advance, which was then shown in the next review again, so that the customer has a certain amount of time to have a closer look at the product increment, to get it tested.
Presence of the customer representatives at regular meetings	P3, P7	Without the participation of the client, the possibility of feedback would not exist.
Access to all necessary infrastructure, etc.	P2	Sufficient testers, ie. Staff, premises, infrastructures

Table 26: Content of client's obligation to cooperate; Source: The author

As a consequence of these findings, the supplier has to evaluate up front what is needed in the project context and what should be included in the client's obligations so that the collaboration with the customer, the project goal and the acceptance criteria are ensured. The points *"conducting a product vision workshop"*, *"conducting a backlog translation workshop /refinement"* and *"continuous documented reviews and acceptance"* were considered as very important by the interviewees and will therefore be explained further in Sections 4.1.3.2, 4.1.3.3 and 4.1.3.4.

4.1.3.2 Conducting a product vision / kick off meeting

Related to the challenge *"missing clear project goal"* in Section 4.1.2.1, the findings revealed that the product vision must be ensured beforehand. One interviewee (P8) expressed this referring to the terms *"do the work in the beginning", "make it clear beforehand what the product vision is"* and *"quality gate".*

This suggests that some effort has to be invested and planned at the beginning of the project to deduce a product vision in alignment with the relevant stakeholders. In addition, P8 emphasised that without a product vision the project should actually not start. He further stressed that a product vision

"is a kind of quality gate for me in the beginning. The very first, we always call it Sprint Zero, the very first thing that needs to be present is the product vision, we have to have a focus." (P8)

Therefore, a high-level description of the objectives, which represents the product vision, is needed at the beginning of the project, which is sufficient to work effectively in the context of a firm-fixed-price contract. It has become clear that the product vision is mostly not clear at the beginning or to all relevant stakeholders and it is hard to develop together with the customer. Thus, the identification of the product vision must be ensured at the beginning of the project and should therefore be ensured by the client's obligations (4.1.3.1). Best practice is to derive the product vision in an initial workshop with all relevant stakeholders. At the very least, however, it must be contractually ensured that a clear product vision is available at the project start and, if necessary, it must be worked out jointly. This quality gate is an important recommended adaptation to the Scrum framework.

4.1.3.3 Conducting a backlog translation workshop/refinement

The majority of the interviewees mentioned that in alignment to the product vision it is necessary to translate the specifications from the contract into user stories for a prioritised backlog. This might happen in an initial workshop. One interviewee (P8) has expressed this referring to the terms *"translate the requirement specifications into a backlog"*, *"transform all these horrible documents into user stories" and "a workshop that lasts one to three days"*;

others have referred to using terms such as *"invest time in workshops to clarify user stories", "recommend a workshop"*, *"user story mapping"* and *"initial workshop"*.

Besides a clear product vision, a prioritised and coordinated backlog in coordination with the customer is crucial for the project success, i.e. being effective and efficient within a fixed environment.

The quotations which emphasise the need for translating the requirement specifications into a prioritised product backlog are depicted in Table 27.

		Specifications must be translated into a prioritised backlog with user stories
Respondents	P2	[...] it makes sense to invest time in workshops to clarify user stories
	P4	[...] I would recommend a workshop
	P6	We conducted a workshop with the customer, to get a user story mapping, where we specified things together for each point that was listed in the contract, what does the whole thing look like, what does the case look like, how is it designed, what user stories do we have.
	P7	The customer was really well prepared and developed a requirement specification with us in advance, which was 300 pages short. However, in coordination with us, it was written in such a way that it was prioritised and following the typical Scrum user stories.
	P8	Agile projects always mean to transform the requirement specifications and technical specifications into a backlog with user stories. That means, if I find something like this [written specification document], then there is a workshop that lasts one to three days, where the people who write the requirement specifications and who write the technical specifications do not leave the room until we have transformed all these horrible documents into user stories.
	P9	An initial workshop is the condition for doing this project. So, without that we don't do it.
	P10	There was such a workshop. Three, even four hours, really long. There, every single user story, which had also sometimes the character of an epic, i.e. a much higher abstraction, was discussed.

Table 27: Quotations which emphasise that requirement specifications must be translated into a prioritised product backlog; Source: The author

This finding implies that in alignment with the product vision a mutually agreed prioritised backlog must be derived from the initial specifications. This has to be ensured as a further quality gate within the client's obligations and is a prerequisite before the development cycle can start. The initial agreed product backlog, also sometimes called the project baseline, can then only be changed with mutual agreement (4.1.3.5). This quality gate is a further

recommended adaptation to the Scrum framework, which addresses the challenge *"unclear, changing or missing requirements"* in Section 4.1.2.2.

4.1.3.4 Continuous documented reviews and acceptance

This modification is derived from the findings in relation to the challenge *"contract fulfilment and legal aspects"* in Section 4.1.2.6 as the continuous delivery, review and legal acceptance of the product increments is very important in terms of feedback and in fulfilling the contract. Continuous legal acceptance should be part of the contract, e.g. client's obligations (4.1.3.1) and is emphasised as very important by P3, P4, P5, P6, P7, P8, P9, P10, P11 and P12. After each acceptance a legal document has to be signed, as is demanded by law, as P11 (Table 28) stated. P11 mentioned that there is not one big acceptance at the end of the project, but many acceptances during the project following Agile principles, which is an advantage as the development team can react earlier. He expressed this referring to the terms *"accepts the product increment after every Sprint"* and *"a lot of acceptances over time"*; others have referred to using terms such as *"tested their systems and gave feedback"*, *"accepted with documented errors"*, *"summarised acceptances", "formally define the Sprint review as acceptance", "acceptance meetings" , "acceptance protocol has been signed"* and *"continuous acceptance"*.

A side effect of the continuous documented reviews is that the legal obligation for acceptance is perceived to lead to a higher motivation in participating in the project and to give feedback, as the customer is now responsible for the product acceptance, which she cannot change afterwards.

The big advantage is, when it becomes clear to the customer that after the acceptance has happened and the service provider gets his money, that they cannot change anything any longer, because it is done. Then the motivation is always higher to participate in the meetings because they are responsible for a certain functionality. And there, the stakeholder says very quickly, yes, but I want to be there, I want to see what is delivered there, because I am in charge of it at the end. You have to get them a bit under pressure, I'd say so. (P10)

The quotations related to continuous delivery and acceptance are depicted in Table 28.

		Continuous documented reviews and acceptance
Respondents	P3	[…] we have continuously rolled out the software to the key users also, per Sprint. And they then tested their systems and gave us the feedback.
	P4	[…] after the Sprint review, the customer had exactly this sprint offset to provide feedback. We have sorted the feedback and then at this point, the increment is, in principle, accepted with the documented errors that may need to be fixed.
	P5	There is also a final acceptance, which has just summarised the acceptance for the releases, once.
	P6	The acceptance had to take place at the Sprint review at the latest, but could also take place earlier.
	P7	We have decided together with the client, to formally define the Sprint reviews as an acceptance.
	P8	[continuous acceptance at the sprint review] so we've already delivered part of what we agreed on in the contract.
	P9	[…] that the whole thing will then be accepted, that we will present on site
	P9	This is also one of the conditions of cooperation, that in these acceptance meetings the whole thing is accepted, that we present, as it is, on the spot, what we have. Gladly give the customer opportunities to test afterwards. […] You build a lot of small modules practically, and at the end of the project you build them all together. And that's of course an extra acceptance.
	P10	The nice thing about the acceptance test is that it runs Agile, of course, and that works super cool, because the task is that the Product Owner accepts after every Sprint.
	P11	[…] the acceptance is acceptance in the sense of the fixed price. […] as the Civil Code prescribes, this acceptance protocol has been signed.
	P11	The Product Owner accepts the product increment after every Sprint. That is an acceptance. Frankly speaking: I do not get an acceptance at the end [of the project], but I get a lot of acceptances over time [after each sprint], which makes it much, much better, yes? Because, let's assume, the customer does not accept something, then the development team can improve it earlier, which is much better than late in the project when the time runs away.
	P12	[…] there have been a continuous acceptance at the end of each Sprint. And a final acceptance a the end of the project.

Table 28: Quotations related to continuous delivery and acceptance; Source: The author

In the context of an FFP contract, this has two outcomes. Firstly, continuous deliveries and reviews, i.e. feedback on the product increment are vital within an FFP contract and must therefore be ensured e.g. by demanding it in the client's obligations. Secondly, a formal

document must be signed after each Sprint setting out what has been accepted, which is part of the later final acceptance. This is a further adaptation within the Scrum framework.

4.1.3.5 Documented changes to the backlog by mutual agreement

This modification addresses the challenges *"unclear, changing or missing requirements"*, *"scope creep"*, and *"contract fulfilment and legal aspects"* in Sections 4.1.2.2, 4.1.2.4 and 4.1.2.6. This modification is needed as all interviewees confirmed that even if everything is well specified up front it is highly likely that changes to the scope will arise due to unclear, missing or changing requirements, which is not intended in an FFP context. Some participants reported that with an Agile approach in an FFP context this is even more likely than in a plan-based approach. All interviewees reported that they had to deal with requirement changes in their projects. For them, a common approach is to exchange one user story with one or more others, as long it supports the product vision and the effort stays the same or there is an additional payment, as P3 emphasised:

"If you now remove requirements and add new requirements of the same size, then nothing changes in the budget and then this requirement can be implemented accordingly." (P3)

User stories in the backlog can only be exchanged by mutual agreement, however, which has to be legally documented as it is part of the contract. To keep the change management process lightweight, an important demand is that the Product Owner is empowered to do so from the customer side. The mutual agreement can happen at the end of the Sprint review or in a subsequent meeting. One interviewee (P12) has expressed this referring to the terms *"lightweight process to exchange user stories"* and *"which have been documented"*; others have referred to using terms such as *"bundled change requests"*, *"change management process", "swap for equivalent requirements", "practically recorded and documented", "clarify in advance"* and *"contractual arrangement"*.

This depends on the impact of the change request.

The quotations related to documented changes to the backlog by mutual agreement are depicted in Table 29.

		Documented changes to the backlog by mutual agreement
Respondents	P1	And if the Scrum approach produced a change request that has been relevant for the contract, then there was a bundled change request that bundled these changes, as a change request into this classic contract.
	P2	So it's a kind of change request management or change management. As soon as you are in the fixed price, you need that.
	P3	And the second key point is that we have a change management process. And we use this institution to be able to incorporate these change requests, which are provoked in this Agile project, into the fixed-price project.
	P4	Are these now perhaps bugs or insufficiently fulfilled requirements of our site or are these change requests? We have sorted this and at this point, the product increment has been accepted in principle with the documented bugs that may have to be paid.
	P5	Because the customers kept coming back to me, oh, then I'd still like that and that.
	P6	So if requirements change, then that's okay, and instead of having a change management process that just takes time and nerves, it should be easy to talk about changes and take that into account.
	P7	It was actually only a coordination between the customer and me. Let's swap for equivalent requirements, or do I have to take out and swap two or three other things, which may not be so important anymore, for a requirement I can accept?
	P8	This means that we have an automatism which includes the change request. Only the product backlog had to be practically recorded and documented before planning and after planning.
	P9	Of course you have to clarify in advance what happens when I have changes.
	P10	The contractual arrangement said that you can take a user story out in exchange to a new one at any time. The only requirement is, that they had to be equivalent.
	P11	Money for nothing, change for free.
	P12	There was a lightweight process to exchange user stories, which have been documented in JIRA.

Table 29: Quotations related to documented changes to the backlog by mutual agreement; Source: The author

This finding has several meanings. Firstly, the backlog is fixed from the start and only prioritising is allowed, which is a change to the original Scrum framework. Secondly, in the case where changes to the backlog are needed, this can only be conducted with mutual

agreement. Thirdly, these changes have to be legally documented as they are part of the primary contract, which is another change to the Scrum framework. Fourthly, an empowered customer representative is needed (4.1.2.5) who is able to decide on change requests quickly, to keep the process lightweight. Finally, the finding suggests that neutral changes, i.e. where one or more features are exchanged in return for equivalent features supporting the product vision, are the most effective and efficient way to make changes to the product backlog as no new budget is required. Therefore, this approach should be preferred against additional change requests, as it has effects on the iron triangle in terms of budget and time schedule.

4.1.3.6 Explicit stakeholder management

This modification addresses the challenge *"unknown and changing stakeholders and lack of engagement"* in Section 4.1.2.3 as the relevant stakeholders have to be identified because they are the ones who decide and judge if the project has met their expectations. As described in the section *"unknown and changing stakeholders and lack of engagement"* it is not always evident who the relevant stakeholders are, as they might change over time. One interviewee (P2) has expressed this need by referring to the term *"greatest difficulty is the changing environment of stakeholders"*; others have used terms such as *"stakeholder management"*, *"stakeholders to involve"* and *"stakeholders to push aside"*.

The quotations related to explicit stakeholder management are depicted in Table 30.

		Explicit stakeholder management
Respondents	P2	The greatest difficulty is the changing environment of stakeholders.
	P6	Risk management, stakeholder management and see what interfaces the team has with other stakeholders or whoever and, in connection with this, expectation management. So these are things I would always do.
	P7	Of course, I also have to evaluate internally which of the stakeholders are the key? Which stakeholders do I have to involve in the project and how? Which stakeholder do I prefer to push a little aside? Which ones bring in trouble?
	P8	Stakeholder management is definitely important, you can take over a lot from the traditional project management.

Table 30: Quotations related to explicit stakeholder management; Source: The author

Therefore, explicit stakeholder management, similar to that which the plan-based approaches use, is recommended as a further change to the Scrum framework.

4.1.3.7 Explicit risk management

Besides stakeholder management some interviewees recommend explicit risk management, which addresses all project risks.

"And a fixed-price project needs risk management […] *I need all that, these familiar measures."* (P1)

An explicit risk management approach is needed to avoid overruns on the iron triangle. In this context, risk management has the same function as in a plan-based project.

The quotations related to explicit risk management are depicted in Table 31.

		Explicit risk management
Respondents	P1	And a fixed-price project needs risk management, change request management, I need all that, these familiar measures
	P3	Risk management is important
	P6	Risk management, stakeholder management and see what interfaces the team has with other stakeholders or whoever and, in connection with this, expectation management. So these are things I would always do.
	P7	That is important to me and I also think that more explicit risk management is important here. Risk management in Scrum comes about through prioritisation in the product backlog.

Table 31: Quotations related to explicit risk management; Source: The author

Thus, an explicit risk management approach should be established to control the project risks, which is the last recommended modification of the Scrum framework.

4.1.3.8 Summary of modifications

Because of the empirically identified challenges mentioned by the interviewees, the original Scrum framework does not work out of the box within an FFP environment. Therefore, the following modifications are needed:

1. Define client obligations, which provide the legal base to ensure some of the required changes in the next points. Eight important points have been identified which should be included in the client obligations. They deal mainly with setting up an overall project goal, initially refining the scope, empowering a project manager, i.e. Product Owner, from the customer as decision-maker to legally accept the continuous delivered product increment within a regulated time horizon, and to document all mutual agreed changes to the scope.
2. One or more initial workshops to clarify the product vision and to transfer the contract requirements to a prioritised backlog (4.1.3.2 and 4.1.3.3).
3. After each Sprint the product increment is reviewed by the stakeholders and accepted through a document or a written statement by the client's empowered representative, which is recognised as legal acceptance (4.1.3.4).
4. Changes to the backlog can be done by exchanging new user stories with equivalent user stories within the backlog, or by adding additional budget. All changes to the backlog have to be agreed mutually by both parties, be legally documented and have to promote the documented project goals or product vision (4.1.3.5).
5. Explicit stakeholder management has to be established (4.1.3.6).
6. Explicit risk management has to be established (4.1.3.7).

These modifications are depicted within the theoretical model, Figure 21.

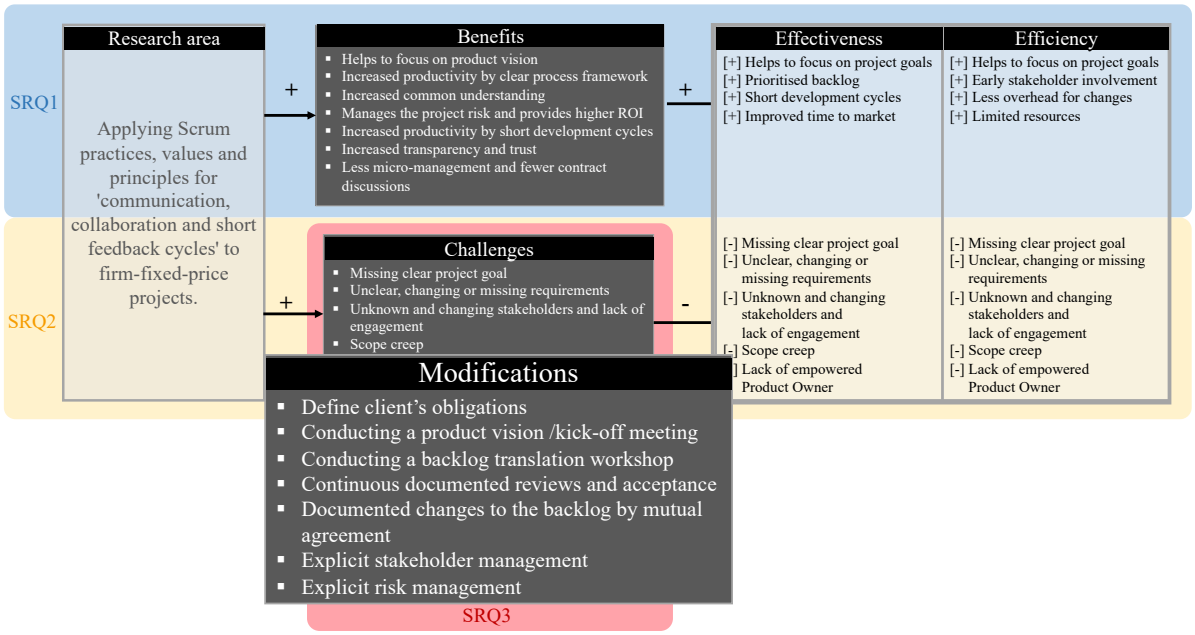


Figure 21: Recommended modifications to the Scrum framework; Source: The author

4.2 Findings from the focus groups

The findings from the interviews were presented to two different focus groups comprising eleven and four participants, respectively, as described in the data analysis Section (3.6.8). The content and the meaning of each finding within the theoretical model were discussed within each focus group. That is to say that the benefits, the challenges, the impact on effectiveness, the impact on efficiency and the recommended modifications to the Scrum framework were all discussed within each focus group. The aim was to validate and to weigh the importance of the points made by the individual interviewees. If the focus group participants can agree with the interview findings, how important are the findings perceived in their context? Furthermore, they were asked if something might be added or is missing, and if they could not agree with the presented findings. In the case of disagreement, they were asked why these findings are not perceived to be working in their context. The following structure mirrors the structure of the interview findings presenting the joint results from both focus groups.

4.2.1 Benefits of using Scrum in firm-fixed-price projects

4.2.1.1 Feedback on the benefits

The benefits from the interview findings in Section 4.1.1 were presented to both focus groups, including some of the examples that the interviewees had given. Both focus groups confirmed the perceived benefits in general as they are summarised in Section 4.1.1.8 and depicted in Figure 15. Within both focus groups there were no other reaction other than nodding and interested listening. In response to the author's question whether there are any comments or questions, FGA1[29] summarised the common view:

"[...] *these benefits are in general valid for Agile collaboration. And it is good to see that they can also be applied to FFP projects" (FGA1)*

Related to SRQ1, this means that the identified perceived benefits from the interviews were independently confirmed by both focus groups. Based on this general consent, and before the modifications were presented to the group, FGA5 asked the group how the benefits might be ensured by default in FFP projects. He noted:

"I noticed that most people were not fully surprised by the benefits. But I would like to know how you assure in your FFP projects that these benefits are implemented? Is this what is being done and if yes, how? This would be very surprising to me." (FGA5)

So, the feedback was not whether the benefits could be applied to FFP projects or not, but how to ensure their application. The discussion that followed identified the strong need for structured and documented modifications, as proposed by this thesis, to ensure that the benefits might be applied to FFP projects. Consequently, the focus group confirmed the relevance of this thesis and the need for modifications.

Finally, there was a discussion about which of the benefits are perceived to be the most important ones. The question was asked within the first group as to which of the above-mentioned benefits had had the greatest impact on their projects. The discussion promptly led to continuous communication intertwined with transparency and trust, as they are needed to

[29] FGA1 means focus group A, participant one

fulfil the contract. In the end, the discussions in both focus groups came to the same conclusion, namely how the supplier achieves the stakeholder's expectations within the given project constraints, to fulfil the contract. FGA6 emphasised that this

"[…] *is the crucial point, above all that we sharpen this close communication and build the mutual trust that what we deliver is exactly the right thing for both sides.* […] *If the trust is there, the legal contract becomes only a vehicle."* (FGA6)

In the following discussion, one side stressed that a certain level of trust has to be established between the supplier and customer by close communication and collaboration. They argued that with trust, less attention is laid on contract details and therefore it is easier to fulfil the overall contract. Others stressed that this is right, but it poses a risk to rely only on good collaboration and a relationship of trust with the customer representative. They emphasised that the customer representative might change during the project, which might have a huge impact on the final acceptance of the contract if agreements were not documented.

"This means building trust with people, not with organisations. And as soon as there are changes in the people, it falls back on the contract. And of course, this can lead to a pretty bad awakening." (FGA2)

Therefore, the discussion quickly led to the question of how mutual project agreements could be legally considered at the end of the project, in terms of the contract fulfilment. The proposal presented to document mutual agreements was considered by the group to be very useful and necessary.

Given this balanced discussion, a certain level of trust has to be established through close communication and collaboration and based on this trust mutual agreements have to be formally documented. On the one side, this finding confirms the benefit that, which trust has on the collaboration mode with customer. On the other side, this finding confirms the strong need for documented reviews and legal acceptances and documented changes to the backlog, as identified in the sections *"continuous documented reviews and acceptance"* and *"documented changes to the backlog by mutual agreement"* so that the supplier has proof that she fulfilled the contract. As Scrum does not include this by default, this must be ensured through modifications to the Scrum framework.

4.2.1.2 Feedback on impact on effectiveness

In the next step, the impact of the identified benefits on effectiveness have been presented and explained, including some the examples, the interviewees gave. Both focus groups agreed that applying Scrum to FFP projects has the presented perceived effectiveness. Apart from the approval, there was no real discussion, only nodding.

"Yes, all presented points are valid" (FGB3)

This agreement confirms that Scrum is perceived to increase the effectiveness in FFP projects.

4.2.1.3 Feedback on impact on efficiency

The impact of the identified benefits on effectiveness have been presented and explained, including some the examples, the interviewees gave. The overall feedback confirmed that there is an increase in efficiency while applying Scrum to FFP projects. There was a short discussion of the extent to which the constraints from FFP have helped them in their projects to be more efficient.
In particular, limited resources inside a clear product vision was mentioned as an efficiency booster.

"Limited resources increase efficiency" (FGB1)

This statement confirms that applying Scrum to FFP projects is perceived to be efficient in most cases.

4.2.2 Challenges of using Scrum without modifications in firm-fixed-price projects

4.2.2.1 Feedback on challenges

The challenges from the interview findings in Section 4.1.2 were presented to both focus groups, including some of the examples, the interviewees gave. Both focus groups confirmed the perceived challenges in general, as they are summarised in 4.1.2.7. Within both focus

groups, there were strong reactions about the negative experiences they create in customer projects, related to the presented challenges. Regarding the main challenges, both focus groups named scope creep and contract fulfilment.

But the big problem is that you have a fixed price at the beginning that is present, and then you switch to Agile mode and the scope creeps. And the more you come towards the end of the project, the more this contract gets important again. And suddenly you realise, oops, it is not what the contract says that we deliver here, but the customer was actually satisfied and what now? (FGA8)

This feedback indicates again that only documented mutually agreed changes to the backlog should be allowed. It is important to document each change, as it becomes part of the contract. In addition, the lack of stakeholder involvement and identifying the right stakeholders have been confirmed as the challenges above.

"Lack of stakeholder involvement, right? The fixed price is to blame, isn't it? So, you have the feeling that in two years you will get the perfect product that you described in advance. That's it." (FGA8)

"When you say communication, there's a huge gap, a huge gap to stakeholder management. […] *there are different categories of stakeholders management, CEO, purchasing department, quality assurance, legal* […]*"* (FGA5)

This feedback again reinforces the need for stakeholder management and involvement.

Related to SRQ2, this means that the identified challenges from the interview data analysis are the perceived challenges while applying Scrum without any modifications to FFP projects.

4.2.2.2 Feedback on impact on effectiveness

In the next step, the impact of the identified challenges on effectiveness have been presented and explained, including some the examples, the interviewees gave. The focus groups confirmed the interview findings about effectiveness. There was emotional discussion as to which of these challenges has had the most impact on their projects in the past. The main points for them were that it is difficult to be effective without addressing the right stakeholders,

without having a Product Owner, without a clear product vision and without having continuous feedback, and that these are issues within FFP projects.

"We need continuous feedback" (FGB2)

This finding again reinforces the need for continuous feedback from the right stakeholders within a clear product vision, which must be ensured within an FFP project, and modifications must be applied to Scrum as they are proposed in Section 4.1.3.

4.2.2.3 Feedback on impact on efficiency

In the next step, the impact of the identified challenges on efficiency have been presented and explained, including some the examples, the interviewees gave. Both focus groups confirmed the presented points about efficiency with nodding and interested listening. In response to the author's question whether there are any comments or questions, FGB2 responded:

"That is what we think" (FGB2)

This supports that the modifications are needed to diminish the challenges and to lower the risk of inefficiency.

4.2.3 Recommended modifications to the Scrum framework in firm-fixed-price projects

Finally, the challenges from the interview findings in Section 4.1.3 were presented to both focus groups, including some of the examples, about how and when they could be applied. Both focus groups were very interested in the recommendations and they confirmed that the modifications are valuable and necessary. There were short discussions and emotional nodding, concerning which which of these modifications would have had an impact on projects in the past. In response to the author's question whether there are any comments or questions, FGB1 emphasised that the modifications must be implemented as presented, and that nothing can be omitted if the revised framework is to work.

"The modifications must be as depicted. Nothing can be omitted." (FGB1)

This means that the proposed modifications are not only valuable, but they are recommended and must therefore be taken into account, as described in the section *"recommended modifications to the Scrum framework"*. There was a short discussion within the second group about how the aim of each modification can be achieved. As a result, the second focus group noted, that the workshops as proposed in the modifications *"conducting a product vision/kick-off meeting"* and "*conducting a backlog translation workshop/refinement"* are best practices to achieve the main target. This confirms that it must be ensured that a product vision and a prioritised product backlog exist at the beginning, but it means that there might also be other ways than a workshop to achieve, although conducting workshops was confirmed to be a very effective and proven way.

Related to SRQ3, this means that the identified modifications from the interview data analysis are the recommended modifications while applying Agile practices, values and principles for 'communication, collaboration and short feedback cycles' from Scrum to FFP projects.

4.3 Summary

Analysis of the data revealed that conducting FFP projects with Scrum is beneficial but also challenging, thus requiring certain modifications. Even if FFP is not the preferred contract type to use Scrum[30], Scrum is perceived as beneficial within an FFP context, as it increases the perceived effectiveness and efficiency of these projects in comparison with plan-based approaches such as the waterfall method. The perceived benefits are that Scrum in an FFP setting:

- helps to focus on a product vision, i.e. achieving a project goal, instead of implementing predefined requirements as demanded by an FFP setting, which might not support those overall goals
- increases productivity by providing a clear process framework for communication and collaboration, instead of a non-governed communication and collaboration setup in an FFP setting
- increases the common understanding of business requirements by continuous communication, which is not the case in an FFP setting as little or no communication is demanded as everything seems to be described by the contract
- manages the project risk and provides higher ROI by prioritising the backlog according to business value and technical risk, instead of focussing on efficient project execution plans such as the critical path method often used in FFP projects
- increases productivity by short planning and feedback cycles, instead of feedback at the end of the FFP projects
- increases transparency and trust by continuous delivery, instead of communicating project progress in reports in FFP projects
- leads to less micro-management and fewer contract discussions through transparency and trust, instead of a more formal process in FFP projects

[30] Scrum as it is meant to be within a T&M contract would be the preferred way of collaboration (Franklin, 2008, p.272)

These benefits lead to a perceived increase in effectiveness in FFP projects especially by:

- establishing a product vision which helps all stakeholders to focus on overall project goals rather than on single requirements
- implementing according to the highest business value, which ensures the product with the highest possible business value at any one time in the project, rather than optimising for project execution
- short planning and feedback cycles which help to focus on what is really needed, based on instant feedback, rather than on anticipation
- early delivery to end customers, i.e. increased time-to-market, to get feedback from the users of the later product, which helps to focus on what is needed by the market, rather than anticipating what is needed

In addition, the benefits increase the perceived efficiency in FFP projects by:

- establishing a product vision which helps to focus on the important things and therefore to saves resources, rather than on single requirements
- early stakeholder involvement and the feedback on product delivery which helps to identify if more effort has to be spent on a feature or if it is already sufficient for their usage. This helps to save resources rather than overfulfilling stakeholder expectations
- less overhead for change requests and their specifications as Scrum substitutes this through lightweight planning and short development cycles rather than investing a lot of time in specifications
- limiting resources which forces the development team to avoid gold-plating

While using Scrum without modifications in FFP projects the following challenges were reported, which might affect the iron triangle in all three dimensions:

- missing the big picture due to huge specifications without a focus on a specific project goal makes it difficult to meet stakeholder expectations

- unclear, changing or missing requirements due to incomplete specifications within FFP projects will generate extra effort which have not been calculated within the FFP contract which affects the scope, time and budget, as it is mostly not clear if the customer will accept them as a change request and pay for them
- unknown and changing stakeholders and lack of engagement in FFP projects make it difficult to identify the right stakeholders, which is vital to meet their expectations and to motivate them to participate in the project
- scope creep through intensive communication and collaboration by Agile methodologies if the scope is not controlled
- lack of an empowered Product Owner who has more responsibility than an ordinary project lead, but in FFP projects decision-making by the customer is not intended as everything is decided by clear statements of requirements in the contract
- contract fulfilment and legal aspects, as the stakeholders with whom the product has been developed in an Agile project are not those who might be concerned with the acceptance of the contract, which might now differ from the delivered product

All these challenges decrease the perceived effectiveness and efficiency. This is why modifications to the Scrum framework are needed to mitigate these drawbacks and the associated negative effects on effectiveness and efficiency. The identified modifications are:

1. Define client obligations, which empowers a project manager/Product Owner from the customer to accept the continuous delivered product increment within a regulated time horizon (4.1.3.1).
2. One or more initial workshops to clarify the product vision and to transfer the contract requirements to a prioritised backlog, which have to be ensured by the client's obligations (4.1.3.2 and 4.1.3.3).
3. After each Sprint the product increment is reviewed by the customer stakeholders and accepted through a document or a written statement by the client's empowered representative, which is recognised as legal acceptance (4.1.3.4).
4. Changes to backlog can be done by exchanging new user stories with equivalent user stories within the backlog, or by adding additional budget. All changes to the

backlog have to be agreed mutually by both parties, legally documented and have to promote the documented project goals or product vision (4.1.3.5).

5. Explicit stakeholder management has to be established (4.1.3.6).
6. Explicit risk management has to be established (4.1.3.7).

The benefits, challenges and related impact on effectiveness and efficiency led to the theoretical model which is depicted in Figure 22.

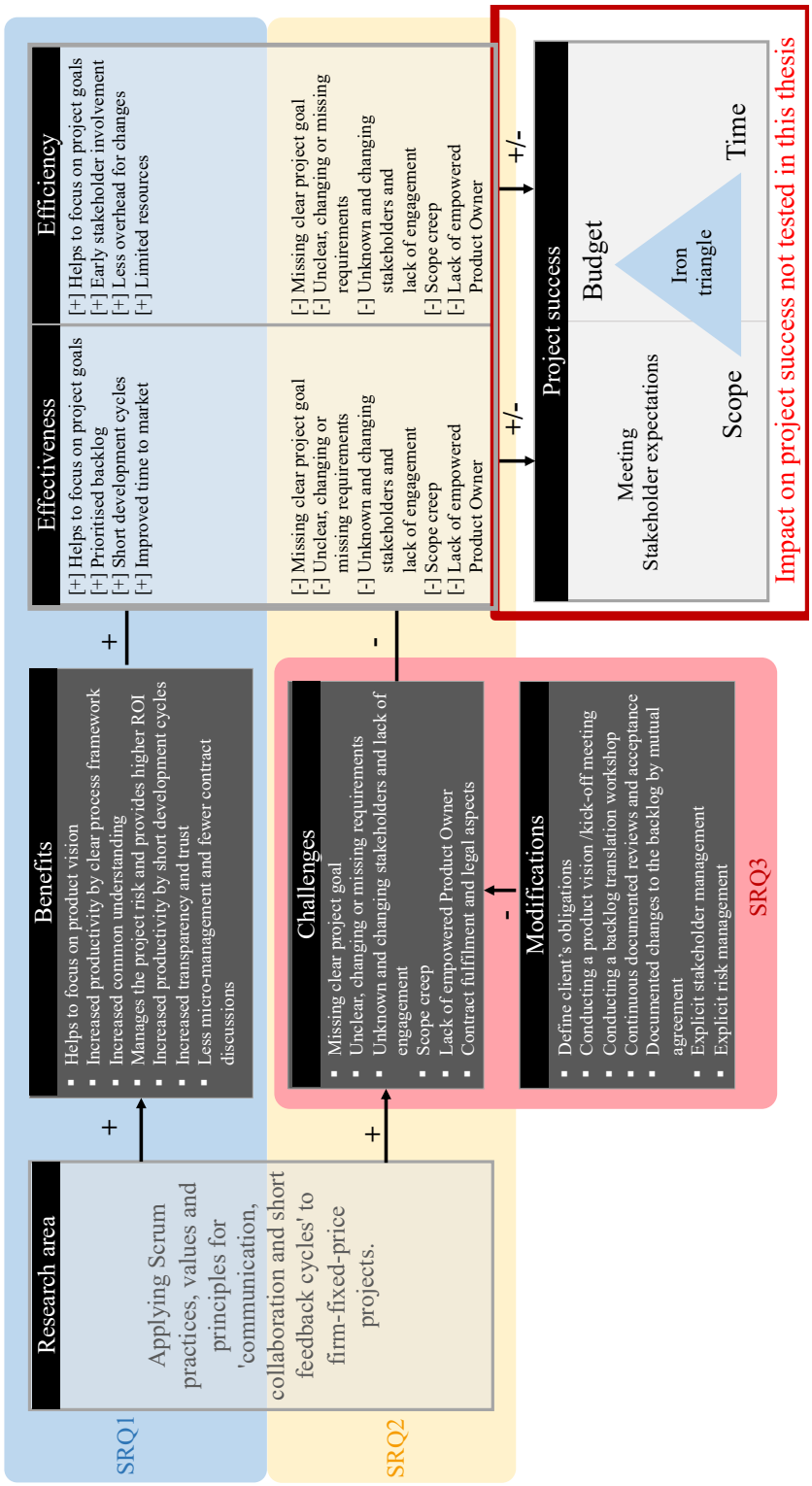


Figure 22: The theoretical model with benefits, challenges and their impact on effectiveness and efficiency; Source: The author

The next chapter will compare the reviewed literature with the findings to further the academic discussion regarding the use of Scrum in FFP projects.

5 Discussion

This chapter provides a comparison between the findings from the qualitative interviews and the literature review and their contribution to the existing body of knowledge for theory and professional practice. Its purpose is to identify how these empirical research findings further the academic discussion and alter the business view of using Scrum in FFP projects.

5.1 Contribution to theory

Despite the demand among practitioners to use Agile approaches within an FFP context, as addressed in Section 1.5, little academic research has been undertaken so far in the research field of applying Agile approaches to an FFP context. Accordingly, the literature review in Chapter 2 could not identify substantial academic literature about how to use Scrum in FFP projects. Only literature relating to plain Agile/Scrum projects and plain FFP projects – dealing with benefits, challenges and their impact on effectiveness and efficiency – could have been identified in general.

As a main contribution to theory, this thesis has addressed this gap and provides a novel theoretical model as a solution, based on empirical data, on how to apply Scrum[31] successfully to an FFP context. The analysis of the data confirmed that applying Scrum within an FFP context works and is perceived to be beneficial in software development projects. The findings showed that applying Scrum to FFP projects not only increases the perceived effectiveness, which is relevant to meeting the stakeholder expectations within the scope, but also increases the perceived efficiency, which is relevant to delivering the project on time and on budget.

Thereby, seven benefits were identified which increase the perceived effectiveness and/or efficiency for stakeholders in FFP projects (see Sections 4.3 or 5.1.2). Although not tested in this thesis, the findings suggest that applying Scrum to FFP projects increases the likelihood of project success[32] compared to plain FFP projects, through its perceived increase in effectiveness and efficiency. Therefore, it is recommended that Scrum be applied to FFP projects if a contract based on T&M is not feasible because an FFP contract is requested by the customer. The findings also showed that applying Scrum within an FFP context without modifications poses up to six challenges (see Sections 4.3 or 5.1.3), which decrease the perceived effectiveness and efficiency and might therefore have a negative impact on project

[31] i.e. using Scrum practices, values and principles for 'communication, collaboration and short feedback cycles'
[32] Meeting stakeholder expectations, on time, on budget and in scope.

success. To mitigate these challenges and to reap the benefits, the analysed data identified seven modifications (see 4.3 or 5.1.4) to the Scrum framework that are deemed necessary. Based on the findings, it is strongly recommended not to apply Scrum to FFP projects without these modifications.

In summary, the findings support that applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' to FFP projects is possible and is perceived to be beneficial if an FFP contract cannot be avoided and Scrum is modified accordingly to mitigate the associated challenges. This has been depicted in a theoretical model, which is discussed in the next section.

5.1.1 Theoretical model

The main theoretical contribution of this thesis is a theoretical model, which depicts the benefits and the challenges while applying Scrum practices, values and principles to FFP projects, and their impact on effectiveness and efficiency. It also depicts recommended modifications to mitigate the challenges and their impact on effectiveness and efficiency. This model was introduced in Figure 2 in Section 1.6. and evolved with the findings from the literature review in Figure 7 in Section 2.6. In the next step, a second model was evolved with the findings from the interviews, which then led to the final model in Figure 22 in Section 4.3.

The theoretical model development process is depicted in Figure 23.

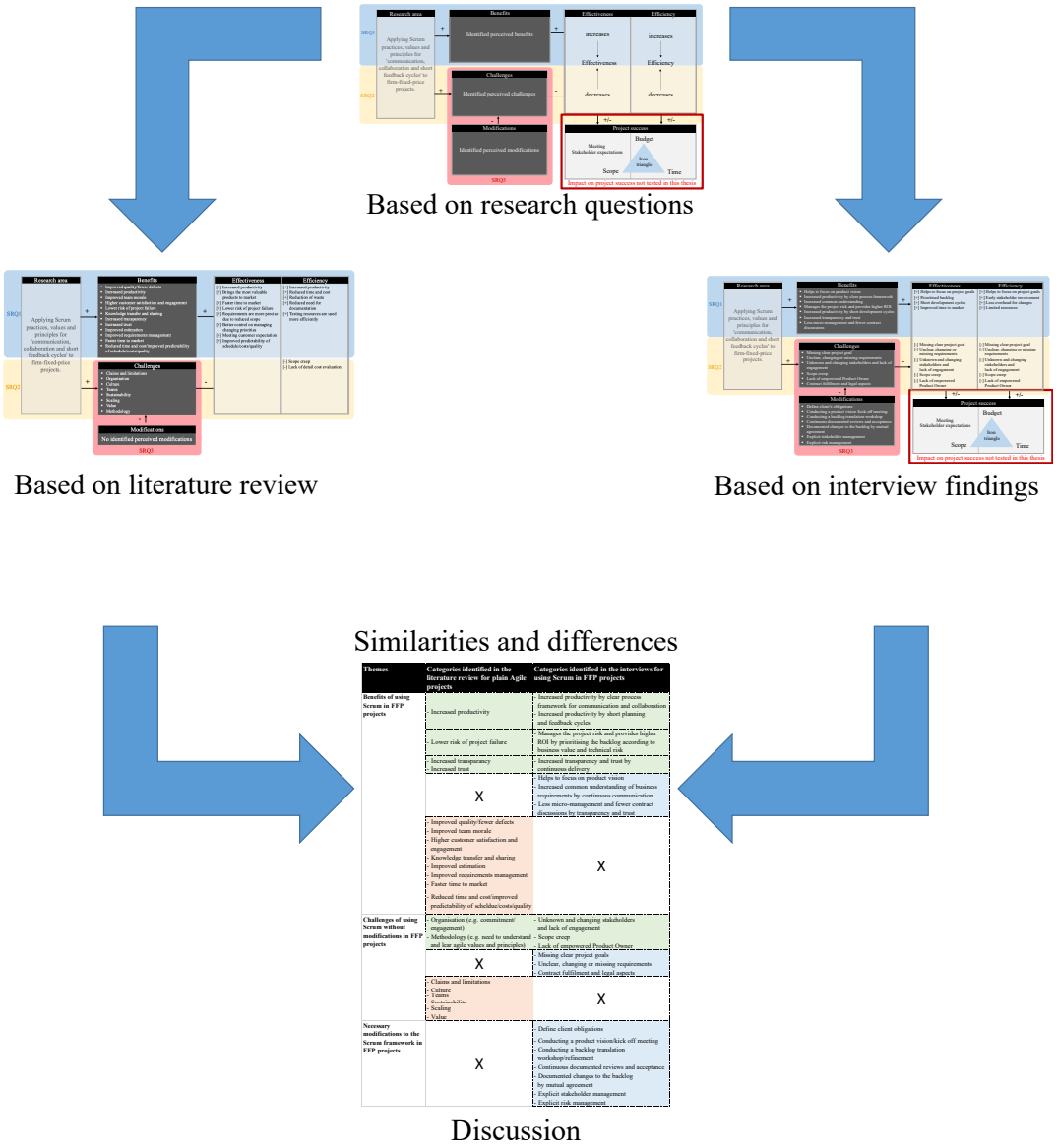


Figure 23: Theoretical model development process; Source: The author

The following sections now discuss the similarities and differences between the reviewed literature in Chapter 2 and the interview findings in Chapter 4, i.e. which benefits and challenges from plain Agile projects can be transferred or will appear as well in an FFP context, and what is their impact on effectiveness and efficiency. To identify similarities and differences between the data analysis and the literature review, the main themes from the theoretical model as depicted in Figure 22 in Section 4.3, namely benefits, challenges and modifications, were taken as basis for comparison. As there is little academic research in the precise research field,

the literature reviewed in Section 2.3 has been taken for comparison, as well as general research about Scrum, TPM and additional literature related to the type of FFP contracts. Briefly summarised, the comparison established that some of the benefits and challenges in plain Agile projects also appear when Scrum is applied to FFP projects; most of the benefits and challenges from plain Agile projects were not raised specifically in an FFP context, however. These similarities and differences, and a possible explanation as to why these have not been mentioned, are discussed in a structured way for each point in the next sections. However, the important difference and contribution to theory is, besides the new theoretical model in general, the deemed recommended modifications to apply Scrum to an FFP context, which have so far not been identified in academic literature.

The similarities and differences between both models are depicted in Table 32.

Themes	Categories identified in the literature review for Agile projects	Categories identified in the interviews for using Scrum in FFP projects
Benefits	- Increased productivity	- Increased productivity by clear process framework for communication and collaboration - Increased productivity by short planning and feedback cycles
	- Lower risk of project failure	- Manages the project risk and provides higher ROI by prioritising the backlog according to business value and technical risk
	- Increased transparancy - Increased trust	- Increased transparency and trust by continuous delivery
	not mentioned	- Helps to focus on product vision - Increased common understanding of business requirements by continuous communication - Less micro-management and fewer contract discussions by transparency and trust
	- Improved quality/fewer defects - Improved team morale - Higher customer satisfaction and engagement - Knowledge transfer and sharing - Improved estimation - Improved requirements management - Faster time-to-market - Reduced time and cost/improved predictability of scheldue/costs/quality	not mentioned
Challenges	- Organisation (e.g. commitment/ engagement) - Methodology (e.g. need to understand and lear Agile values and principles)	- Unknown and changing stakeholders and lack of engagement - Scope creep - Lack of empowered Product Owner
	not mentioned	- Missing clear project goals - Unclear, changing or missing requirements - Contract fulfilment and legal aspects
	- Claims and limitations - Culture - Teams - Sustainability - Scaling - Value	not mentioned
Recommended modifications	not mentioned	- Define client obligations - Conducting a product vision/kick-off meeting - Conducting a backlog translation workshop/refinement - Continuous documented reviews and acceptance - Documented changes to the backlog by mutual agreement - Explicit stakeholder management - Explicit risk management

Table 32: Similarities and differences between literature review and interview findings; Source: The author

5.1.2 Benefits of using Scrum in firm-fixed-price projects comparing literature and empirical findings

The first contribution to theory from this research is the seven identified benefits of using Scrum in an FFP context. The benefits emphasised by this research are needed to meet the stakeholders' expectations within the constraints of the iron triangle (see Section 1.4). Four of the seven identified benefits were also identified in plain Agile projects and could be transferred to an FFP context. Eight benefits from the literature review were not raised specifically in the context of FFP projects, as they were not explicitly mentioned by the interviewees or identified as challenge in FFP projects. Three new benefits were identified that are relevant in the context of FFP projects.

The benefits are depicted in Table 33.

Themes	Categories identified in the literature review for Agile projects	Categories identified in the interviews for using Scrum in FFP projects
Benefits	- Increased productivity	- Increased productivity by clear process framework for communication and collaboration - Increased productivity by short planning and feedback cycles
	- Lower risk of project failure	- Manages the project risk and provides higher ROI by prioritising the backlog according to business value and technical risk
	- Increased transparancy - Increased trust	- Increased transparency and trust by continuous delivery
	not mentioned	- Helps to focus on product vision - Increased common understanding of business requirements by continuous communication - Less micro-management and fewer contract discussions by transparency and trust
	- Improved quality/fewer defects - Improved team morale - Higher customer satisfaction and engagement - Knowledge transfer and sharing - Improved estimation - Improved requirements management - Faster time-to-market - Reduced time and cost/improved predictability of scheldue/costs/quality	not mentioned

Table 33: Similarities and differences of the identified benefits in reviewed literature and interview findings; Source: The author

The four benefits which were similar in literature and in the findings are: *"increased productivity", "lower risk of project failure", "increased transparency"* and *"increased trust"*. While the reviewed literature mentioned increased productivity as a benefit in general (Eloranta et al., 2016, p.202; Rigby et al., 2016, p.43; Solinski & Petersen, 2016, p.15; Vijayasarathy & Turk, 2008, p.1), the findings differentiate between *"increased productivity by clear process framework for communication and collaboration"* and *"improved productivity by short planning and feedback cycles"*. Regarding the clear process framework for communication and collaboration, the application of Scrum practices and roles were not explicitly mentioned in the reviewed literature as an accelerator for productivity. Accordingly, the explicit application of Scrum practices and roles, as provided by the Scrum framework, seem to have a greater priority in an FFP context. As a consequence, it seems that these practices that apply to the Agile process are vital and have to be maintained in an FFP context. The same applies for short planning and feedback cycles in relation to continuous delivery. The importance of early feedback and its positive effect on productivity is consistent between the empirical data and general literature (Dingsøyr & Lassenius, 2016; Itkonen et al., 2016; Petersen & Wohlin, 2009). Therefore, the short planning and feedback cycles have to be maintained in an FFP context. These continuous development cycles then lead to increased transparency and trust.

Regarding the category *"increased transparency and trust by continuous delivery"*, the empirical data showed that applying Scrum practice for frequent deliveries in an FFP context lead to increased transparency and trust between the supplier and the customer, which is needed for early escalations of problems, to focus on what is really needed within the remaining time and budget, and to avoid micro-management. Increased transparency (Eloranta et al., 2016, p.202; Petersen & Wohlin, 2009, p.1488) and trust (Rigby et al., 2016, p.43; Solinski & Petersen, 2016, p.15) were also identified in the literature review as crucial, although they were not explicitly related to frequent deliveries. This is because in general literature (Eloranta et al., 2016, p.202; McHugh, Conboy, & Lang, 2012; Stettina & Hörz, 2014), increased transparency and trust is primarily related to an internal organisational context rather than in an external relationship between a customer and a supplier. For this thesis the external view was in focus, as it considers how the customer works together with the supplier in a more formal relationship based on contracts. As a consequence, Scrum practices for continuous delivery should be maintained within an FFP context. They seem to be important within an external relationship, as they are needed to move to a more trustful relationship. Based on the reviewed literature, the impact of transparency and trust on the relationship between a customer

and a supplier does not seem to be sufficiently observed in Agile literature. However, this thesis has shown that the external relationship has a crucial influence on productivity in the FFP context (see Section 4.1.1.6) and should be further investigated in academic research.

Eight identified benefits in the reviewed literature did not come out empirically in an FFP context. These omitted benefits are *"improved quality/fewer defects", "improved team morale", "knowledge transfer and sharing", "improved estimation", "improved requirements management", "faster time-to-market", "reduced time and cost/improved predictability of schedule/costs/quality",* and *"higher customer satisfaction and engagement".*

There is evidence in general literature that *"improved quality/fewer defects"* can be achieved through shorter feedback cycles in plain Agile projects on the one side (Cline, 2015, p.7), but on the other side, literature reports that quality might be harmed if one focusses only on efficiency (DeMarco, 2002, p.122). Based on cost pressure of an FFP project the supplier tends to deliver earlier (Král & Mildeová, 2012, p.31) to be more efficient with the involved resources. In the context of this study, it is assumed that enough quality is achieved by frequent deliveries, as the customer reviews the frequent deliveries. Therefore, quality might not have been explicitly mentioned as a benefit by the interviewees. The recognition that frequent deliveries lead to better quality and that the interviewees did not mention quality issues in their projects again supports the reasoning to maintain continuous delivery in an FFP context.

"Improved team morale" (Eloranta et al., 2016, p.202; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1), *"knowledge transfer"* (Dybå & Dingsøyr, 2008, p.850; Kamei et al., 2017, p.3; Vijayasarathy & Turk, 2008, p.5) and *"improved estimation"* (Dybå & Dingsøyr, 2008, p.850; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488) were reported by introducing Agile practices for communication and collaboration to traditional organisations in literature. As the interviewees and their teams were Agile experts and working with the Agile methodology for years, these benefits seem to be taken for granted for stable Agile teams and were therefore probably not mentioned explicitly by the interviewees. However, it can be assumed that in a stable Agile team in an FFP context the team is more motivated than in traditional FFP projects because of the Scrum practices and there is an ongoing knowledge transfer, as long as the collaboration and communication structures by the Scrum framework are maintained. This collaborative working mode again leads to improved estimation. As a conclusion, the related Scrum practices should be maintained in an FFP context.

"Improved requirements management" (Eloranta et al., 2016, p.202; Kamei et al., 2017, p.3; Petersen & Wohlin, 2009, p.1488) was not explicitly mentioned as a benefit in an FFP context, perhaps because documented requirements are provided up front, but still might be related to the gain in effectiveness by a prioritised backlog as identified in the interviews (4.1.1.9). This gain in effectiveness by a prioritised backlog with the improved estimation might then lead to *"reduced time and cost/improved predictability of schedule/costs/quality"* as identified in the reviewed literature (Vijayasarathy & Turk, 2008, pp.1-5)

"Faster time-to-market", identified as a benefit in the reviewed literature (Rigby et al., 2016, p.43), was not mentioned as a benefit. The interviewees emphasised that within an FFP context the schedule for the time-to-market is pre-given and not seen as a benefit. But in relation to effectiveness some interviewees mentioned that continuous delivery to an internal test system with early key-user involvement might help the customer to soften the big bang effect the day they go in production.

The last benefit, *"higher customer satisfaction and engagement"*, which was identified in literature (Kamei et al., 2017, p.3; Rigby et al., 2016, p.43; Vijayasarathy & Turk, 2008, p.1) as a benefit, turned out to be a challenge in FFP projects, as stakeholders are unknown or changing with a lack of engagement. In addition, the findings identified that customer satisfaction is harder to achieve as the customer often wants more than contracted. Therefore, this has to be controlled, otherwise it leads to scope creep.

An identified benefit which has not been identified in the reviewed literature as a benefit is that "*Scrum helps to focus on an overall product vision".* This has been identified as a very important benefit empirically. The need for an overall product vision has been confirmed by literature in general (Benassi, Amaral, & Ferreira, 2016, p.202; Highsmith, 2009; Kollmann, Sharp, & Blandford, 2009, p.17; Schwaber & Beedle, 2002). The study of Kollmann et al. (2009, p.17) thereby emphasised the importance of an overall product vision for decision-making, which is needed to steer the project in alignment to the overall goal if issues or questions arise due to internal or external influences. Therefore, a product vision must be ensured in the context of an FFP project to be able to steer the project to focus on what is really needed.

Related to meeting stakeholder expectations and fulfilling the contract, the empirical data emphasised the need for a common understanding of the requirements by extensive communication and collaboration in the category *"increased common understanding of business requirements by continuous communication"*. These findings confirm recent literature

by Hess, Diebold, and Seyff (2018), Paasivaara and Lassenius (2006) and Vijayasarathy and Turk (2008, p.1) for Agile projects in general. Moreover, Hess et al. (2018) identified the need for a guideline for communication and requirements documentation in plain Agile projects. The empirical results came to a similar perception but solved the challenge by using the Scrum approach with its clear process framework for communication and collaboration. This benefit again shows the need to maintain the Scrum process framework.

An interesting finding for using Scrum in FFP settings is expressed by the category *"manages the project risk and provides higher ROI by prioritising the backlog according to business value and technical risk"*. The empirical data showed that Scrum techniques are used in FFP projects to reduce the supplier's financial risk. This is achieved through a prioritised backlog which grants that the maximum business value is delivered at a given time, as described in Section 4.1.1.4. As a result, maximum productivity is guaranteed as the maximum business value is delivered with least usage of resources. Therefore, with this approach it is more likely to meet the stakeholders' expectations, i.e. contract fulfilment, within the iron triangle. There is evidence in the Agile literature (Vijayasarathy & Turk, 2008) related to risk management, promising *"lower risk of project failure"* (p.1) and *"improved predictability of schedule/costs/quality"* (p.1), both of which have also been identified in the literature review. There is also consistency between the empirical data and the literature for higher ROI (Eloranta et al., 2016; Rigby et al., 2016, p.43; Solinski & Petersen, 2008). Risk reduction and higher ROI are supported by the short planning and feedback cycles used by the Scrum framework. Therefore, the continuous prioritising of the product backlog must be ensured as a project steering tool within an FFP context to control the supplier's financial risk.

Finally, the identified benefit *"transparency and trust"* led to the last category that applying Scrum to FFP projects *"leads to less micro-management and fewer contract discussions"*. The positive impact of Agile is confirmed in general by Rigby et al. (2016) who emphasise that one of the main benefits in Agile is that it is *"dramatically reducing the time squandered on micromanaging functional projects"* (p.45). This is evidence for increased efficiency through less overhead and might lead to fewer contract discussions (see Section 4.1.1.7) if a trustful relationship between the supplier and the customer can be established. Therefore, it should be ensured during the project that continuous communication and collaboration is maintained by the Scrum process framework.

5.1.3 Challenges of using Scrum without modifications in firm-fixed-price projects comparing literature and empirical findings

The second contribution to theory from this research is the six identified challenges of using Scrum in an FFP context. The challenges emphasised by this research are impeding meeting the stakeholders' expectations within the constraints of the iron triangle (see Section 1.4). Three of the six challenges were identified to a large extent in plain Agile projects and appeared similarly within an FFP context. Five challenges from the literature review were not raised specifically in the context of FFP projects, as they were not explicitly mentioned by the interviewees in FFP projects. Three new challenges were identified, which are relevant in the context of FFP projects.

The challenges are depicted in Table 34.

Themes	Categories identified in the literature review for Agile projects	Categories identified in the interviews for using Scrum in FFP projects
Challenges	- Organisation (e.g. commitment/ engagement) - Methodology (e.g. need to understand and lear Agile values and principles)	- Unknown and changing stakeholders and lack of engagement - Scope creep - Lack of empowered Product Owner
	not mentioned	- Missing clear project goals - Unclear, changing or missing requirements - Contract fulfilment and legal aspects
	- Claims and limitations - Culture - Teams - Sustainability - Scaling - Value	not mentioned

Table 34: Similarities and differences of the identified challenges in reviewed literature and interview findings; Source: The author

The three challenges, which were similar to a large extent in literature and in the findings, are *"unknown and changing stakeholders and lack of engagement", "scope creep"* and *"lack of empowered Product Owner"*.

Regarding *"unknown and changing stakeholders and lack of engagement",* the literature reviews identified similar challenges under the theme *"organisation"*. In plain Agile environments these challenges were identified referring to terms such as *"management buy-in and understanding"* (Gregory et al., 2016, p.9; Vijayasarathy & Turk, 2008, p.1), *"commitment/engagement"* (Gregory et al., 2016, p.9; Kamei et al., 2017, p.3), and *"stakeholder commitment and involvement"* (Nuottila, Aaltonen, & Kujala, 2016, p.52;

Vijayasarathy & Turk, 2008, p.1). What was not explicitly mentioned in the literature review, but was identified in the interviews and in general literature, is the challenge of unknown (Anon, 2010, p.112) or changing stakeholders in Agile projects. The empirical findings suggest that explicit stakeholder management and involvement in an FFP context plays a more vital role than it does in plain Agile projects. This is because the contract fulfilment and the project success depend on meeting stakeholders' expectations, who might be unknown or changing during the project duration. In addition, the involvement of stakeholders is more difficult in FFP projects than in plain Agile projects, as the involvement is not intended by the contract design. As a consequence, explicit stakeholder management and involvement must be ensured in an FFP context.

Changing or multiple stakeholders have also been identified as a reason that leads to *"scope creep"*, which was identified empirically as one of the main challenges. Scope creep has also been identified in the literature review (Madhuri & Suma, 2014; Vijayasarathy & Turk, 2008, p.5) for Agile and FFP projects separately, but not for a mixture of both, as addressed by this thesis. Madhuri and Suma (2014, p.854) emphasise that while scope creep has little negative impact on project success in Agile projects, as Agile methodologies embrace even late changes, it does have a negative impact on project success within an FFP context, as it affects the project constraints of the iron triangle, and therefore the project success. As a consequence, the project scope has to be controlled if Scrum is used within an FFP context. As identified in this research, this will mainly concern the initial translation of the requirements to the product backlog, and later changes to the product backlog. This has not been reflected by literature for mixed approaches so far.

A further challenge, which is similar between the literature and the empirical findings, is the *"lack of empowered Product Owner"*. The empirical data showed that a customer representative who is empowered as a decision-maker in the project is needed. Without an empowered decision-maker, it would hardly be possible to react promptly to upcoming project challenges which need decisions, i.e. it would be difficult to do the right thing without wasting resources, which means it would be hardly possible to be effective and efficient. The issues with an unempowered Product Owner have also been confirmed by literature and even identified as anti-patterns[33] for plain Agile projects (Carew & Glynn, 2017; Drury, Conboy & Power, 2012; Eloranta et al., 2016; Sverrisdottir, Ingason, & Jonasson, 2014). In an FFP context

[33] An anti-pattern is seen as a bad solution for a typical challenge. For example, having no decision maker even it is clear one is needed.

the role of a decision-maker is not intended for project execution, as the decisions were already made up front, described in the specifications and the project plan. Accordingly, the empowerment of a customer representative within Scrum in an FFP context is not reflected by literature. As a consequence, it must be ensured in an FFP project that a costumer representative is similarly empowered to how she is in plain Agile projects. This includes the responsibility for the budget and the schedule, as well as the scope and the legal acceptances of the frequent deliveries.

Six identified challenge categories in the reviewed literature did not come out empirically in an FFP context. These omitted challenges are *"claims and limitations", "culture", "teams", "sustainability", "scaling"* and *"value".* The first challenge, which was not mentioned in the context of this research, was claims and limitations, which deal with areas where Agile methods are used inappropriately, i.e. Agile practices and processes are followed mechanically without understanding their value. This challenge might not have been mentioned in the context of this thesis as the interviewees were experts or even pioneers in Agile methodologies. Conversely, this means that for applying Scrum to FFP projects an experienced team in Agile methodologies should be engaged. The second challenge – culture – deals with the organisational culture of living Agile values and principles. This challenge might be, for example, changing mindsets about using Agile methodologies (Gregory et al., 2016, p.9) or the lack of developer motivation to use Agile methods (Conboy et al., 2011, p.55). Again, this applies neither to interviewees as Agile experts nor to the organisational context in which they were working. Thus, it has not been mentioned in the context of this research. The third challenge is related to teams. The named challenges in the literature were all dealing with team issues such as, for example, finding good people (Gregory et al., 2016, p.9) or difficulty with working in distributed teams (Fitriani et al., 2016, p. 159). This challenge is assumed to be less relevant for a skilled Agile team, but again underlines the need for a mature Agile team that works in an FFP context. The fourth challenge deals with sustainability. Sustainability in literature deals mainly with challenges such as, for example, documentation (Fitriani et al., 2016, p.159; Gregory et al., 2016, p.10; Kamei et al., 2017, p.3; Nuottila et al., 2016, p.52) or knowledge sharing (Conboy et al., 2011, p.55; Gregory et al., 2016, p.10). It is assumed by the author that this challenge was not raised specifically in the context of this study for two reasons. Firstly, because of the maturity of the interviewees and their teams to apply Scrum practices with ongoing knowledge transfer, as long as the collaboration and communication structures by the Scrum framework are maintained. Secondly, the upfront documentation intended by the contract type ensures that

a certain level of documentation is provided, which is not the case in plain Agile projects. As a result, the Scrum practices for knowledge sharing and a mature Agile team who knows when and how much to document is needed in the context of an FFP project. The fifth challenge – scaling – deals with challenges such as, for example, large projects (Gregory et al., 2016, p.10) or with the difficulty in monitoring distributed projects (Kamei et al., 2017, p.3). This challenge was not mentioned by the interviewees. On the contrary, one interviewee reported of a successful scaled project comprising several Scrum teams in an FFP setup. The difference again might be that the teams were skilled in applying Agile methodologies or were coached by an external Agile coach. The last challenge, which has not been mentioned in the context of this study, is the methodology, which deals with the appropriate application of the Agile methodology, for example, prioritising (Fitriani et al., 2016, p.159) or the difficulty of applying/adapting the method/practice (Kamei et al., 2017, p.3). Again, this was not relevant for the interviewed Agile experts. As a consequence, from the challenges which were not raised specifically in the context of the research, it can be stated that a skilled Agile team is a prerequisite for using Scrum in FFP projects.

The three identified challenges which have not been identified in the reviewed literature as challenges are *"missing clear project goal", "unclear, changing or missing requirements"* and *"contract fulfilment and legal aspects"*. The first identified challenge which was not mentioned in the reviewed literature is the missing clear project goals. The importance of the presence of a clear project goal, i.e. product vision, to create effective products has been confirmed by general literature (Benassi et al., 2016, p.202; Highsmith, 2009; Kollmann et al., 2009, p.17; Schwaber & Beedle, 2002), but it has not been named explicitly as a challenge in plain Agile projects. It seems that the challenge arises within an FFP context due to the attempt to describe everything in detailed upfront specifications. At this bottom-up approach, the focus lies on generating details and not on generating the big picture, as later adjustments of details are not allowed due to the FFP contract. Therefore, it seems to be more difficult to distil a clear project goal out of detailed specifications, than to define a top-down project goal based on organisational strategies and market needs without knowing the exact details up front. As a consequence, the first thing that has to be ensured by using Scrum in an FFP context is that a clear project goal is distilled, agreed and communicated among all stakeholders before the first requirements are be implemented. It can be argued that without a clear project goal it seems to be impossible to derive effective requirements, which results in the next category *"unclear, changing or missing requirements"*. Here the findings are coherent with the TPM literature

(Gaebert, 2014a, 2014c, p.98; Moløkken-Østvold & Furulund, 2007) that requirement gaps and changes will certainly appear during the FFP project. Unlike for FFP projects, this is not a challenge for plain Agile projects, as requirements engineering is one of the core concepts of Agile, where requirements are specified during the project lifetime according to the identified needs. Thus, it seems that this challenge mainly appears in projects where a lot of written specification can be found and where communication is substituted by documentation (Gaebert, 2014c, p.98), which has been confirmed by the data analysis. Therefore, in FFP projects continuous communication among the relevant stakeholders must be ensured as is intended by the Scrum framework without ignoring the project constraints. This finding has been identified empirically as critical within an FFP context, as it has a huge impact on all three dimensions, especially on the project success. This category is directly linked with *"unknown and changing stakeholders and lack of engagement"* and *"scope creep"*.

The last identified challenge is *"contract fulfilment and legal aspects",* which has a central meaning for the financial success of the supplier and has therefore been identified as critical in the empirical data. The risk of disagreement at the end of a project as to whether the initial contract has been fulfilled or not is directly influenced by all challenges above. This aspect seems to be underestimated in the literature. Only Franklin (2008, p.269) deals with issues regarding contract fulfilment in Agile FFP settings. Based on her findings and the empirical data, it can be concluded that the issues of contract fulfilment seem to be more relevant by using Scrum within an FFP context than in plain Agile or plain plan-based approaches. As a consequence, short planning and feedback cycles based on frequent deliveries to the customer with continuous legally documented acceptance by her must be ensured within an FFP context, as identified in the findings and explained in the following section.

5.1.4 Recommended modifications to the Scrum framework in firm-fixed-price projects comparing literature and empirical findings

The last and most important contribution to theory from this research is the seven identified recommended modifications to the Scrum framework to work in FFP projects. The modifications emphasised by this research are needed to meet the stakeholders' expectations within the constraints of the iron triangle (see Section 1.4). Seven modifications were empirically identified, which are relevant in the context of FFP projects.

The identified modifications are depicted in Table 35.

Themes	Categories identified in the literature review for Agile projects	Categories identified in the interviews for using Scrum in FFP projects
Recommended modifications	not mentioned	- Define client obligations - Conducting a product vision/kick-off meeting - Conducting a backlog translation workshop/refinement - Continuous documented reviews and acceptance - Documented changes to the backlog by mutual agreement - Explicit stakeholder management - Explicit risk management

Table 35: Identified recommended modifications for using Scrum in firm-fixed-price projects; Source: The author

The first identified modification *"defining client obligations"* is needed in order to fix contractually what is necessary in the context of FFP projects to enable communication and collaboration within short feedback cycles. Client obligations are the only part of the contract that are expected and normally accepted by customers within tenders. Interestingly, this possibility of influencing the contract has not been identified in the literature. Client obligations are needed to ensure that the requirements from the contract can be translated to an initial agreed product backlog, which represents the project goal/product vision. It further stipulates that an empowered customer representative/Product Owner can legally accept continuous deliveries and is able to decide which requirements/user stories will be implemented in the next feedback cycle. Therefore, the adaptations in the client obligations are crucial to steer the project to meet the stakeholder expectations and to fulfil the contract. This modification is a new contribution to theory, as little or no solutions could be identified in academic literature and practitioner reports. To be effective within the project and to fulfil the contract an initial kick-off meeting is needed, which should be also be stipulated in the client obligations. The

empirical data showed that an important quality gate is to have a common understanding about the project goal/product vision before the project can start, which is normally done within an initial workshop/kick-off meeting including all relevant stakeholders. This finding is coherent with recent Agile literature (Cervone, 2011; Hossain, Bannerman, & Jeffery, 2011; Upender, 2005), which confirms that a kick-off meeting, also called Sprint zero, should be held (Hossain et al., 2011, p.97). Right after the project goal/product vision has been stipulated, the specified requirements in the contract must be translated to the product backlog. The empirical data showed that this should be conducted in a backlog translation workshop/refinement, which is directly related to the kick-off meeting. The need for such a meeting is congruent with the general literature, although the literature suggests that this can be part of the kick-off/product vision workshop (Cervone, 2011, p.20). Once all requirements from the contract have been translated to the product backlog, only prioritising of the requirements/user stories is allowed but the scope of the product backlog can only be changed by mutual agreement. As the empirical data have identified, continuous development cycles with *"continuous documented reviews and acceptance"* is needed to get feedback and in fulfilling the contract. The findings showed that it is crucial that the customer representative/Product Owner takes part in the Sprint review meetings and accepts or rejects each Sprint artefact. This is also confirmed by literature for plain Scrum projects (Pichler, 2010, p.10; Schwaber, 2004; Schwaber & Beedle, 2002). What is new is that at the end of a Sprint review the artefact is legally accepted through a signed document or protocol, which is part of the final acceptance. In the existing literature, the acceptance through a delivery by an accountable person has been partly covered by using RACI-Scrum[34] (Elhady & Abushama, 2015; Khan & Quraishi, 2014), but without considering FFP settings. As an outcome of the Sprint review or a backlog refinement meeting, the need to make changes to the product backlog might arise, which is critical as it might influence the iron triangle and the overall project success. Therefore, only *"documented changes to the backlog by mutual agreement"* are allowed. The findings revealed that once the backlog is initially prioritised in the backlog translation workshop, changes to the backlog, except prioritising, can only be made by mutual agreement as changes may affect all three dimensions of the iron triangle. This has been an important finding – underestimated by literature – as changes to the backlog directly negatively influence the supplier's risk. Only Franklin (2008, p.273) provided a solution by substituting product backlog requirements with equal new ones, but without the proposed documented sign-off process, as has been identified by this research

[34] Responsible, Accountable, Consulted, and Informed

(see Section 4.1.3.5). Accordingly, it seems that the exchange process as proposed in Section 4.1.3.5 contributes to theory by providing a proper way to deal with changes to the backlog.

Regarding *"explicit stakeholder management",* the empirical data showed that if Scrum is used in an FFP context, explicit stakeholder management is even more important than in plain Agile environments, as the relevant stakeholders are needed for clarification and feedback. Due to the upfront statements of requirements and the chosen contract type, typically less or no stakeholder involvement is needed, in contrast to the Agile requirements process, which steadily involves different stakeholders. In this regard, the empirical data showed (see Section 4.1.2.3), that this may lead to conflicts if the relevant stakeholders are involved late in the project for the final acceptance. The data also showed that new and changing stakeholders might lead to scope creep or opposing requirements, which affects the iron triangle and the overall project success. This correlates with recent studies which emphasise the benefit of explicit stakeholder management in TPM, as they increase the likelihood of project success (Eskerod & Huemann, 2013). Furthermore, *"explicit risk management"* was identified as an essential modification. Existing studies in non-Agile project management emphasise the benefit of using explicit risk management (Carvalho & Rabechini, 2015). Kuhrmann et al. (2017) identified that in hybrid approaches, i.e. combined Agile and TPM approaches as proposed by this thesis, explicit risk management is used from TPM while requirements engineering is used from Agile. This confirms the empirical data with its identified need for explicit risk management (see Section 4.1.3.7).

5.2 Contribution to practice

All the identified modifications from the previous section are also essential for the official Scrum process framework (Figure 24). As explained in Section 4.2, all these modifications were discussed in both focus groups and validated for their practical applicability to the Scrum process framework. In addition, the modified Scrum framework and the idea behind it have been presented and discussed with other practitioners at a local Scrum table meet-up and have been confirmed as useful. Consequently, the identified modifications from the theoretical model (see Figure 22) were mapped to the Scrum process framework, which serves as a contribution to practice. Thereby, the modification *"define client obligations"* is part of the contract, whereas the modifications "*conducting a product vision/kick-off meeting"*, *"conducting a backlog translation workshop/refinement", "continuous documented reviews and acceptance"* and *"documented changes to the backlog by mutual agreement"* are integrated as ceremonies in the Scrum framework. The modifications *"explicit stakeholder management"* and *"explicit risk management"* are underlying project management tools to support the overall Scrum process.

For each project context, the proposed points within the client's obligations might be used as a checklist. As identified in Section 4.1.3, it is crucial to use these modifications to mitigate the challenges that might otherwise arise within an FFP context. Therefore, it is vital in the beginning that a clear product vision is stated in alignment with the customer and communicated to all stakeholders, i.e. worked out in a workshop as best practice. Further, the original specifications have to be transformed into a business value prioritised backlog, in alignment with the product vision, which serves as a baseline[35] and which is fixed, i.e. the scope cannot be changed without mutual agreement. This might also be done in a workshop as best practice and should then be refined continuously within the backlog refinement meetings. Refinement means prioritising and further clarification of the requirements details, but no unagreed changes to the scope. Moreover, every Sprint review has to be documented and signed off by the customer, as this acceptance serves as a basis for the overall acceptance of the contract, which is a new practice and extension of the Sprint review ceremony. If new tasks arise as an output of the Sprint review or within a backlog refinement meeting, these tasks can now only be transferred to the backlog with mutual agreement, as a new practice and extension of the previous ceremony. The analysed data showed that the best practice is to exchange one

[35] A baseline describes the agreed requirements which represents the to be created product. The baseline is fix and serves as a base for defining changes.

or more user stories or tasks with the same effort in exchange for the new requirement, as long as it supports the product vision. The exchange has to be documented and signed off by the Product Owner, i.e. the customer representative, and by the Scrum Master, i.e. the supplier representative, as this exchange is a change to the original contract and relevant for the final acceptance of contract. If additional tasks – so-called paid change requests – appear, now they have to be documented in the same way, with an extension as to how this change request will affect the three dimensions of the iron triangle. New project management tools are introduced explicitly as a practice for using Scrum within an FFP context. During the whole project life cycle, explicit stakeholder and risk management has to be conducted, as the relevant stakeholders have to be addressed, and because they might change over the project life cycle, which is important to know for the final acceptance. Explicit risk management is essential to tackle possible risks and their impact early and actively. If all those practical recommendations are conducted, the analysed data indicated that the project is then more likely to meet stakeholder expectations within the iron triangle, which means it will be finally accepted by the customer and be successful. Therefore, the modified Scrum framework serves as a guideline for Agile practitioners who wish to use Scrum in FFP projects.

The adapted Scrum process framework is depicted in Figure 24.

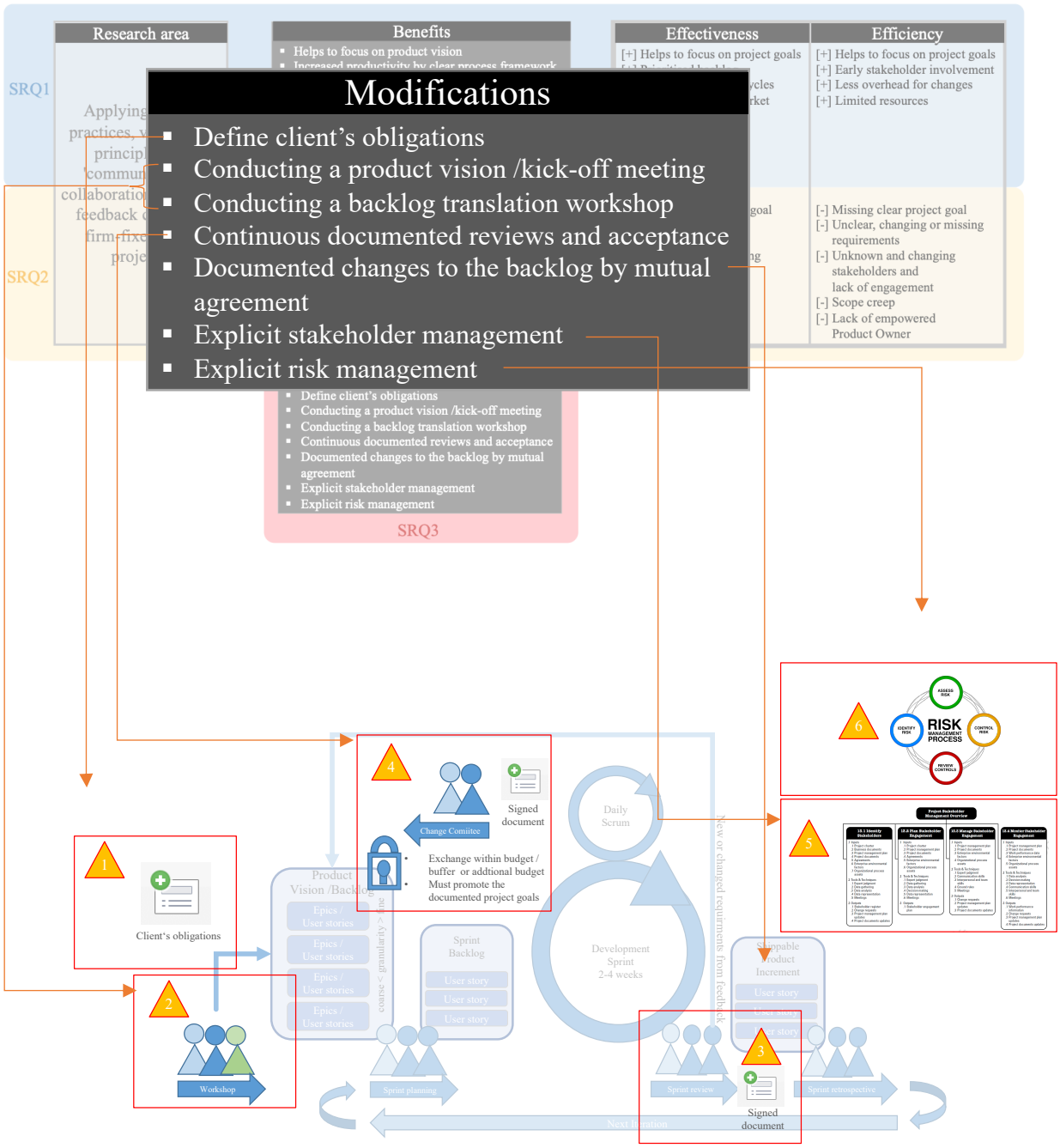


Figure 24: Modifications mapped to the original Scrum framework; Source: The author

As depicted in Figure 24 modification No.1, the adapted Scrum process begins now with the pre-defined Client's obligations, which must be part of the contract and stipulated upfront. If not all points from the checklist, as described in Section 4.1.3.1, have been considered by

the supplier and evaluated in terms of the overall project risk, the contract should not be signed off. This step is new and does not exist in the original Scrum process framework.

Once the contract has been successfully agreed, the adapted Scrum process can start. As an initial quality gate, the product vision has to be determined by the empowered customer representative, who will act as Product Owner in the project, in accordance with the development team from the supplier side (see Figure 24, modification No.2). This should happen, as a best practice, in the form of a face-to-face workshop, which is another addition to the original Scrum process framework. As a result, there must be a common understanding of the overall project goal between the supplier and customer, which defines the agreed product vision. It is highly recommended that this product vision is written down and shared among all project stakeholders. After the product vision is clear to all project stakeholders, the initial specification must be jointly translated into a prioritised product backlog. This might happen in the same workshop or in separate follow-up meetings, depending on the time needed. The prioritised backlog serves as the product baseline, which determines the scope of delivery. It is important that this initial scope of delivery is legally documented between the supplier and the customer, as its degree of completion is important for the contract fulfilment and can therefore not be changed during the project without mutual agreement. This is an important change to the original Scrum process framework.

After the product vision and the prioritised backlog have been determined, the Scrum team starts to iteratively implement the requested features in Sprints, based on the product backlog, as it is intended in the original Scrum process. After each Sprint review, the user-stories accepted by the Product Owner have to be legally confirmed in a signed document by the Product Owner (see Figure 24, modification No. 3). This is another important change to the original Scrum process framework.

If, due to new internal or external insights, there is a demand to make changes to the initial agreed product backlog, the Product Owner and the supplier representative have to mutually agree these changes (see Figure 24, modification No. 4). Changes to the product backlog should only be accepted in exchange with already agreed user-stories or with additional budget, as long these changes promote the product vision. It is important that these changes are legally documented, as they influence the contract fulfilment, which is an important change to the original Scrum process framework.

The identified stakeholders, beginning with the contract phase, but mainly within the initial meetings, should be documented and tracked during the project lifetime as described in Section 4.1.3.6 (see Figure 24, modification No. 5). This is a novelty to the original Scrum process.

Identified project risks, beginning with the contract phase, should be documented and tracked during the project lifetime as described in Section 4.1.3.7 (see Figure 24, modification No. 6). This is another novelty to the original Scrum process.

6 Conclusion

The study set out to explore whether APM, using the Scrum process framework, is perceived to be effective and efficient in the context of FFP software development projects and, if the perception is positive, to understand why and how APM is perceived to be beneficial within an FFP context. It further set out to explore if and how the Agile Scrum framework has to be modified in order to make it beneficial in firm-fixed-price contexts. Several conclusions can now be drawn on the basis of this research aim. To summarise Chapter 6, it can be concluded that applying Agile practices, values and principles for 'communication, collaboration and short feedback cycles', using the Scrum process framework, to FFP projects

a) is perceived to be beneficial (seven benefits have been identified),
b) is perceived to increase the effectiveness (four measures of effectiveness have been identified) and the efficiency (four measures of efficiency have been identified),
c) increases the likelihood of meeting stakeholders' expectations within the project constraints, i.e. to be successful (see Chapter 1),
d) needs modifications to mitigate associated challenges (seven modifications to mitigate six challenges have been identified).

These findings were drawn together in a novel theoretical model as a contribution to theory and resulted in a modified Scrum process framework as a contribution to practice; this has not previously been done in this totality. The following sections answer the research question(s) in detail and give recommendations, emphasise the limitations of this research and provide suggestions for further research.

6.1 Empirical findings and recommendations

The contribution has been enabled through a novel theoretical model, which depicts the Scrum practices, values and principles and their relationship to benefits and challenges, and their relationship to effectiveness and efficiency. With reference to this model, the analysis of the empirical data from the twelve interviews and two focus groups enabled the research question(s) to be answered. The main research question asked can now be answered through the three answered research sub-questions.

Research sub-question one asked for the perceived benefits while applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' to firm-fixed-price projects and how they increase perceived effectiveness and efficiency. The analysis of the data supported that applying Scrum to FFP contracts is perceived to be beneficial. As a result, seven benefits were identified which increase the perceived effectiveness and/or efficiency for stakeholders in FFP projects (see sections 4.1.1 and 5.1.2). Consequently, it is recommended to apply Scrum to FFP projects if a contract based on T&M is not feasible because an FFP contract is requested by the customer.

Research sub-question two asked for challenges that are perceived to arise while applying Scrum practices, values and principles for 'communication, collaboration and short feedback cycles' without any modifications within a firm-fixed-price context, and how they decrease perceived effectiveness and efficiency. Without any modifications to the Scrum framework, six challenges were identified while applying Scrum to FFP projects which decrease the perceived effectiveness and/or efficiency (see sections 4.1.2 and 5.1.3). Therefore, it is not recommended to apply Scrum to FFP projects without the recommended modifications.

Research sub-question three asked for modifications that are perceived to be necessary to be implemented within the Scrum process framework to mitigate the conflict between these two approaches and to increase the overall perceived effectiveness and efficiency. The analysis identified seven modifications to mitigate these challenges and none of these modifications should be omitted. They are deemed necessary to yield an overall beneficial perception of the approach and are one of the main contributions of this thesis. These seven modifications are:

1. defining the client’s obligations to ensure communication and collaboration by the customer
2. conducting a product vision or kick-off meeting to ensure clear project goals
3. conducting a backlog translation workshop to ensure a prioritised baseline
4. continuous documented reviews and acceptance to ensure contract fulfilment
5. documented changes to the backlog by mutual agreement to avoid scope creep
6. explicit stakeholder management to address the right decision-makers
7. explicit risk management to control project risks

As a result, it is strongly recommended to use this extended modified Scrum process framework in practice, as it mitigates the challenges that come along with this approach, i.e. a

structured approach. Thereby the modified Scrum framework serves as a guideline for Agile practitioners who wish to use Scrum in FFP projects and helps them to increase the likelihood of meeting the stakeholders' expectations within the project constraints.

6.2 Research quality and limitations

As with every research, this research design has its limitations. Research that does not address validity and reliability cannot be trusted. According to Saunders et al. (2016) *"good-quality research is judged against the criteria of reliability and validity"* (p.205). Therefore, it is important to know the challenges a research paradigm faces and how to avoid or overcome them. For the chosen research design, with interpretivism as the philosophy and the choice of qualitative surveys for data gathering, one challenge is a certain subjectivity which is related to the researcher's interpretation of the qualitative data and his potential bias. Another challenge is the generalisability of the qualitative findings. For these reasons, qualitative research is often questioned by positivists (Shenton, 2003, p.63). As a result, for qualitative researchers it is more difficult in general to demonstrate that their research is of high quality and credible (Saunders et al., 2016, p.205), as the *"concepts of validity and reliability cannot be addressed in the same way in naturalistic work"* (Shenton, 2003, p.63). For example, if validity and reliability are measured with replicability, it is hardly possible using an interpretative paradigm, as its results are based upon *"socially constructed interpretations of participants in a particular setting at the time it is conducted"* (Saunders et al., 2016, p.205). However, as there is no possibility to fully mitigate these challenges, it will be argued below that their impacts are at least limited by the chosen research design.

6.2.1 Validity

Validity is concerned with *"how valid* [...]*, how logical, how truthful, how robust, how sound, how reasonable, how meaningful and how useful"* (Quinlan, Babin, Carr, Griffin, & Zikmund, 2015, p.259) the research is. According to Quinlan et al. (2015, p.259), validity in qualitative research is mainly concerned with credibility, honesty and truthfulness. Thereby, validity can be distinguished between internal and external validity in qualitative research (Bryman & Bell, 2011, p.395). According to Bryman & Bell (2011), internal validity means whether or not there is a *"good match between the researchers' observations and the theoretical*

ideas they develop" (p.395), while external validity refers to *"the degree to which findings can be generalised across social settings"* (p.395).

Thereby, internal validity might be improved by using more than one interviewer, observer or data analyst (Francis et al., 2010, p.1234; Saunders et al., 2016, p.205). Therefore, Riege (2003) recommends a confirmability audit and triangulation by different *"sources, investigators and methods"* (p.78). Accordingly, two academic researchers have been consulted to validate samples of the findings of this research independently, also related to the third principle of data saturation by Francis et al. (2010, p.1234). In addition, multiple sources by different interview partners and a multiple-method approach as recommended by literature has been chosen to promote validity. Besides the analysing of the primary data, the secondary data gained from the literature review may not provide a complete overview of the existing knowledge in that area, as the criteria for identifying, including or excluding secondary data might be chosen in a different way. For that reason, the search criteria for the literature review are described in section 2.1.

External validity or generalisability of qualitative research might be limited due to its small purposive sample; here, the number of conducted interviews. However, according to Saunders et al. (2016, p.205), qualitative researchers have pointed to other forms of generalisability to prove the quality and value of their research, for example, by applying the findings of a qualitative research to other settings. For this, Riege (2003, p.79) and Shenton (2004, p.70) recommend providing a *"thick description"* of the phenomenon under investigation. Related to this, Shenton (2004) emphasises that it is *"important that sufficient thick description of the phenomenon under investigation is provided to allow readers to have a proper understanding of it, thereby enabling them to compare the instances of the phenomenon described in the research report with those that they have seen emerge in their situations."* (p.70). For this research, the findings have been presented with sufficiently thick description and discussed within two focus groups to identify the context in which these findings might be applied. Consequently, if the study and its findings make sense to the participants it must have a certain validity.

6.2.2 Reliability

Reliability is concerned with the degree to which *"the research can be repeated while obtaining consistent results"* (Quinlan et al., 2015, p.259); that means whether the results of a research are replicable over time and with different populations. Qualitative studies *"generally have more validity but less reliability"* (Babbie, 2004, p.309) as qualitative researchers tend to *"use a wide variety of data-gathering methods"* (Quinlan et al., 2015, p.259), but it is impossible to *"freeze a social setting and the circumstances of an initial study"* (Bryman & Bell, 2011, p.395). Reliability can be distinguished into internal and external reliability (Bryman & Bell, 2011, p.395). Internal reliability means that more than one observer or member of the research team agrees with what they see and hear; meanwhile, external reliability refers to the degree to which the study might be replicated (Bryman & Bell, 2011, p.395; Riege, 2003, p.79). For this research, internal and external reliability were assessed by peer reviews of the research process and the data analysis process by other experts. As reliability is rather of an objective nature, subjectivity is recognised in various stages of this research. For this research, subjectivity concerns the interview process through the interaction between the interviewer and the interviewee, as this may influence the responses and the directions in a semi-structured interview. To mitigate bias, open-ended questions avoid leading the interviewee to a certain answer (Easterby-Smith et al., 2015, p.143). Consequently, open-ended questions were also asked within the focus group. Further, the analysis after an interview or focus group is highly influenced by subjective choices of the researcher. This concerns the extraction of relevant data considered, the open coding approach and the conclusions to be drawn. Thus, different researchers might come to different interpretations and conclusions of the same gathered data. To mitigate bias, parts of the gathered data were analysed and discussed by two other academic researchers, as mentioned above, according to the third principle of Francis et al., (2010, p.1234), to compare their findings with those of the author. In addition, reliability was promoted by the assessments of the interview findings by the two focus groups.

6.2.3 Limitations

Some limitations of the chosen research approach were already discussed in sections 3.6, 6.2.1 and 6.2.2, which address the research techniques and the research quality, in particular which attempts have been made to avoid bias in this qualitative research. This section

summarises the limitations of the research process, based mainly on new insights which were gained during the research process.

One of the limitations which should be taken into account for this research is the sample size of twelve interviews and two focus groups, comprising eleven and four participants respectively. As discussed in Section 3.6.6. there is sufficient evidence in academic literature that the chosen qualitative approach with its sample data leads to valid and reliable results. However, more data from more interviews or focus groups covering more people from the survey population could be beneficial, as the closer the representative sample is to the survey population the smaller the possible deviations get. Furthermore, the population sample was limited to Agile experts from mature Agile organisations working mostly as external suppliers in software development projects in Germany, using German law for FFP contracts. Thus, the empirical data is valid for this research scope and no empirical statements can be made as to whether the findings can be translated one-to-one to other environments. This affects especially organisations that are introducing Agile approaches and are thus new to Agile practices, principles and values, which means they do not have the expected maturity, which underlies the research data. Further, many organisations use hybrid Agile methods, so some of the changes may need to be adapted for the particular hybrid approach being used. As each customer project has its own constraints that may mean that some of the recommendations cannot be applied in any circumstances. Also, no statement can be made about the application of the findings to other countries, with their specific contract law. In addition, all interviewees and focus group participants came from the German-speaking cultural area, and it is unclear to what extent culture played a role in the findings. For example, trust and its impact on contract fulfilling, as identified in Section 4.1.1.7, might have a different significance in other cultures than in the German-speaking cultural area. Moreover, this research was restricted to software development projects, although Agile approaches have been applied in other areas recently, e.g. hardware development projects. This research has not been able to investigate what mitigations may be possible in the above-mentioned circumstances. Notwithstanding this, it is assumed by the author that it should easily be possible to adapt the findings from this research to other countries with different cultures, different contract law and maybe to other project settings or hybrid approaches. However, as with every project, this research has been limited by its time and cost constraints, which has led to this research scope.

6.3 Further research

The limitations mentioned above might be subject to further research. An interesting question would be whether the findings can be applied one-to-one to different cultures and different contract laws, i.e. to software development projects in other countries. If this assumption is true, the theoretical model and the extended modified Scrum framework would serve a wider range of researchers and practitioners, and this approach could form a foundation for further research. Besides applying the research findings to different cultural areas, different contract laws and application fields, it might be interesting for further research if these findings could be applied to all type of software development projects in industry. In this regard, one restriction has been mentioned in the literature for Agile approaches, namely regulated safety projects where Agile approaches are not suitable because of legal requirements, e.g. the medical area. There, the v-model or plan-based approaches are determined by law. Thus, further research could try to identify application fields which are especially suitable for using the theoretical model in theory and the extended modified Scrum framework in practice.

From the methodological side, further research might be conducted using a quantitative survey, which would make it possible to address a larger sample from the survey population and to validate the impact of the theoretical model, e.g. effectiveness, efficiency or the likelihood of project success.

7 Professional review and development

This chapter describes my motivation and aims in pursuing a Doctor of Business Administration (DBA). Beside the author's personal and professional background, including strengths and weaknesses from the initial Global Competencies Inventory (GCI) test, this chapter reflects on the personal, professional and academic development the author has undertaken during his DBA journey. It seeks to demonstrate the author's ongoing commitment towards continuing professional development (CPD).

7.1 Personal motivation and professional aims

Based on my passion for IT, I studied computer science first and four years later, because I had the professional need and intrinsic motivation, I completed a part-time Master of Business Administration (MBA) programme. This part-time programme gave me very interesting insights which I could directly apply to my day-to-day business. Beyond that it was a great experience interacting and networking with people from the cohort who had different professional backgrounds. This programme pushed my personal and professional life far ahead, so that I was highly motivated to go further. Five years later, as Head of Solution Engineering, I was responsible for Agile projects in the public sector. There, the field of research was my daily business and the idea of academic research in that area and aiming for a doctorate was revived. I saw the need to raise the professional (academic) bar through academic research, which is dominated by practitioners, and to undertake deeper research in this area. After an intensive research phase for doctorate programmes I realised that the DBA is much more appropriate for me than a Doctor of Philosophy (PhD) programme for several reasons. First, from my perception the DBA is more business related than the PhD, which can add immediate value to my business, as I have experienced with my MBA. In addition, the DBA might be more accepted by customers, as it has a practitioner-based relevance. Second, the DBA journey seems to have a better support with the first taught year, the cohort and the mentoring during this time. Finally, it is possible to undertake a DBA in a part-time programme.

On a personal level, I wanted to enjoy the challenge of undertaking research in a foreign language and in a foreign country, primarily to get a more in-depth understanding of an area that I am passionate about, but also to interact and network with scholars from other countries who have different cultural backgrounds. Furthermore, I wanted to push myself again out of

my comfort zone. With this motivation I applied successfully to the University of Portsmouth for the DBA programme.

7.2 SWOT analysis

In the first year, I conducted a self-assessment called a Global Competences Inventory (GCI). Based on the results, I made a SWOT analysis which became the starting point for my personal, professional and academic development. The identified strengths were my communication skills, self-management, creativity and innovation and confidence, while I realised two weaknesses, namely my English skills and my interest flexibility. The opportunities of the DBA are clearly to improve business processes with the gained knowledge, contribute to theory and practice in APM and to accelerate my career. Based on the workload and duration of a DBA, I identified losing focus and further external influences as threats.

The following Table 36 depicts the outcome.

Strengths	Weaknesses
▪ Communication skills ▪ Self-management ▪ Creativity & Innovation ▪ Confidence	▪ English skills ▪ Interest flexibility
Opportunities	**Threats**
▪ Improve business processes through gained knowledge ▪ Contribution to theory ▪ Career path	▪ Losing focus ▪ External influences, e.g. high workload

Table 36: SWOT analysis; Source: The author

7.3 Personal, professional and academic development

Reflecting on my DBA journey, it has had a huge impact on my personal, professional and academic development. The first, and most early visible impact was the required overall commitment, which has been vastly underestimated. Time management and not losing the focus have been the biggest personal challenges throughout the whole journey. While being involved in a full-time leadership position, and as a father of three children, family life had to be coordinated in tandem with the DBA studies. Therefore, the Eisenhower principle[36] was applied to my daily work. Work assignments were prioritised after value and risk in the important, urgent, and important and urgent categories. Tasks from the categories not important and not urgent were eliminated from the list. Priority number one was always the family. As a result, I scheduled my research time around my family and work life, which resulted in optimisations such as:

- using public transport to go to work or business travel for reading academic papers or to work on the thesis
- working late at night after the family went asleep and no disturbance was expected
- using a silent hour in the morning before work, to focus on what is important and urgent
- using techniques such as the Pomodoro technique[37] or the do not break the chain technique[38] for continuous working on the thesis.

As part of my ongoing CPD, I undertook an online test which detected my learning type according to Kolb (2005). The test revealed that I am predominantly an activist, followed by a pragmatist and a reflector. According to Kolb (2005), an activist is someone who starts learning something by getting involved and trying things out, instead of making a neat plan first. The result fits well to my professional Agile attitude where upfront planning should be reduced to a minimum, as the plan will certainly change over time. The Agile process is similar

[36] The Eisenhower principle categorises tasks in four dimensions along important vs not important, and urgent vs not urgent, and determine what will be done, and when.
[37] The Pomodoro technique is used to break the work into 25-min chunks of focus time, with a following 5-min break.
[38] Don't break the chain suggests that for every day I worked on the thesis I will mark a cross in the calendar. After a few days this will result in a chain, which should not break. This is a really motivating technique based on gamification.

to Kolb's learning cycle. Therefore, I could easily adapt myself to it, which is depicted in Figure 25.

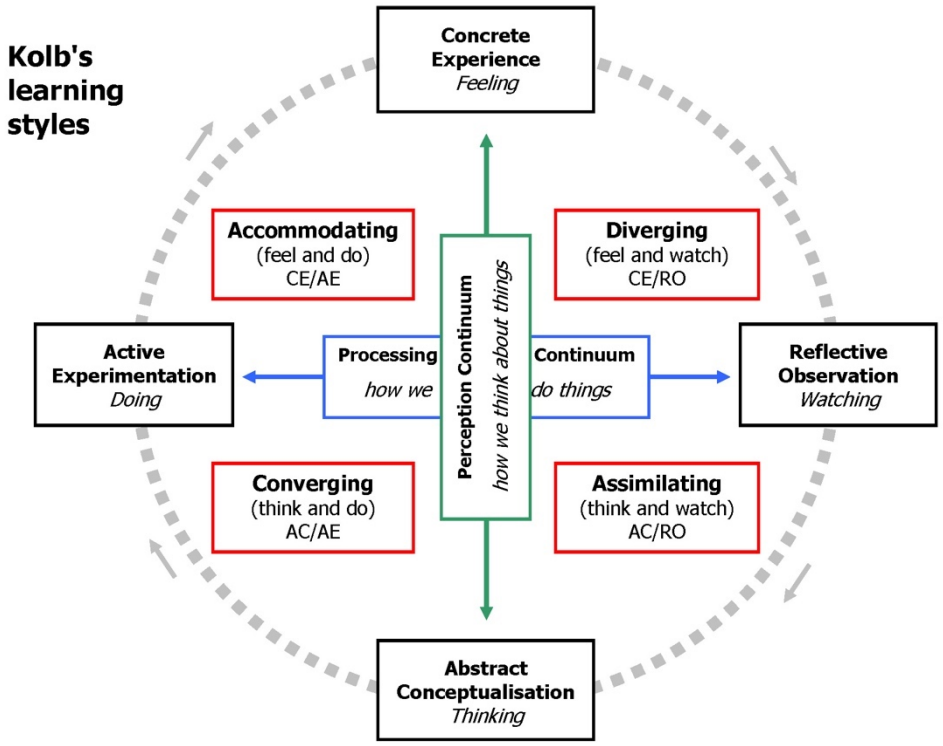


Figure 25: Kolb's learning cycle illustrated by Alan Chapman (2005).

This continuous reflection and adaption process were working well for the DBA. Regarding the DBA and academic approach, the critical thinking based on this approach has improved.

For my professional life, I realised that through reading many articles about Agile and firm-fixed-price contracting I gained a lot of knowledge as well as improving my English skills, which I was able to apply to my daily business. In addition, the doctorate taught me to be more critical, which I realised even in my professional life as I was questioning more and becoming more critical. This was a result of a different thinking promoted through my academic development, based on feedback and exchanges with academic people. Besides the critical thinking and providing evidence, I discovered my love for academia and whilst I am hopeful that successful completion will lead to further success in my professional life, I would like to contribute to academia through publications and attend research conferences to share and gain knowledge with other scholars.

Finally, the project management office (PMO) from my company was able to apply the findings from the research to several customer projects, successfully. For new FFP contracts,

the client's obligations serve now as a standard checklist for the PMO. There, the PMO stipulates the necessary prerequisites, like the product vision/kick-off meeting and the backlog translation workshop. Based on the project experiences made, both meetings helped our involved project team and the customer representatives to get a common understanding of the overall project goal in the beginning of the project, and the project teams also used both meetings in order to get to know each other better on a personal level, which makes communication and collaboration much easier. In addition, the involved project leads reported that both meetings are greatly needed to define an agreed baseline within the time and budget constraints. The continuous documented reviews and acceptances, and the light-weight process for mutually agreed changes to the product backlog, as long as they contribute to the overall project goal within the time and budget constraints, were easily accepted. But it has to be acknowledged that this process was perceived to be more time-consuming at the beginning of each project, as there was mostly some insecurity on the customer side as this process was new to them. This was mainly, because the customers had never conducted a project with teams from my company before, so trust had to be established. With each iteration and product increment, the project teams were able to build up a certain trust level, as the customers could see that we implemented what we agreed on and that we used their money carefully. As a result, the legal acceptance and documentation of each deliverable was light-weight, as to say a pure formality with little or no discussion. The explicit risk management and stakeholder management approaches were perceived to be helpful for the overall control of the project. In the end, it can be said, that based on the findings of this study, we were able to establish a new standard approach for FFP contracts at the PMO of my company, which helped us to increase our overall profitability and customer satisfaction in these projects. This could be seen from the fact that, on the one hand, the project margin was higher than in non-Agile FFP projects and, on the other hand, there was less discussion and follow-up work during the final project acceptance phase and thus during the fulfilment of the contract.

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Appendices

Appendix A – Interview guide

Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry in Germany

Written by: Daniel Georges, MBA / up753189@myport.ac.uk
Student no: 753189

Used abbreviations in the interview:
Agile project management (APM)
Fixed price (FP)

I. Experience of the interviewee

a. How many years of experience in conducting fixed price projects with traditional project management (TPM) do you have? How many projects have you conducted in this way?
b. How many years of experience in Agile project management (APM) do you have? How many projects have you conducted in this way?
c. How many Agile projects have you conducted under a fixed price contract?

II. Main interview questions

a. Please think about a particular challenging fixed price project you have successfully implemented with Scrum/APM, and which have achieved the desired results.
    i. How did Scrum/APM contribute to this success?
    ii. What were the main success factors in this context?
b. Apart from this specific example, what would you say are the main benefits for using Scrum/APM in a fixed price project in general?
c. Which Agile practices (values and/or principles) might be applied to a fixed price project and which not?
d. What might be improved through applying these practices (values and principles), and what might be a possible outcome?
    i. [if not mentioned] What about effectiveness?
    ii. [if not mentioned] What about efficiency?
e. In which terms does applying APM/Scrum to a fixed price project improve the effectiveness and the efficiency?
f. Are there vice versa advantages fixed price might have on Agile development projects?
    i. [if not mentioned] What about effectiveness?
    ii. [if not mentioned] What about efficiency?
g. What would you say are possible projects for using APM/ Scrum in fixed price projects, and which are less appropriate?
    i. In terms of project type
    ii. In terms of clear project objectives
    iii. In terms of project size
    iv. In terms of team size
    v. In terms of budget/project duration
h. What would you say are the main challenges with combining APM with Scrum in a fixed price project?
i. How would you overcome them, and which actions should be implemented to mitigate the conflict between these two approaches?
    i. [if not mentioned] What about stakeholder management?
    ii. [if not mentioned] What about change request management?
j. How should Scrum be adapted to work in fixed price projects?
k. My assumption for this study is that *applying the agile practices (values and principles) for 'communication, collaboration and short feedback cycles' with Scrum within the constraints of fixed price software development projects lead to higher effectiveness and efficiency in these projects.* Based on your experience would you agree or disagree? What are your thoughts about this position?

III. Final

a. Would you like to add or amend something which is important to conduct fixed price projects in an Agile way?

Appendix B – Participant information sheet and invitation letter

Portsmouth Business School
Head of Department: Professor Gary Rees; gary.rees@port.ac.uk

PARTICIPANT INFORMATION SHEET AND INVITATION LETTER FOR INTERVIEW PARTICIPANTS

Title of Project: Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry

Name and Contact Details of Researcher: Daniel Georges | +49 (0) 173 9917239 | daniel.georges@myport.ac.uk
Name and Contact Details of Supervisor (if relevant): Dr Andrew Lee | andrew.lee@port.ac.uk

Ethics Committee Reference Number: E453

Dear Mrs./Mr. XY

I am a doctorate student at the University of Portsmouth / Portsmouth Business School and I would like to invite you to participate in my research study:
Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry
Joining the study is entirely up to you, before you decide I would like you to understand why the research is being done and what it would involve for you. I will go through this information sheet with you, to help you decide whether or not you would like to take part and answer any questions you may have. I would suggest this should take about 15 minutes. Please feel free to talk to others about the study if you wish. Do ask if anything is unclear.

Study Summary

This study is concerned with agile project management with Scrum in fixed-price projects. We are seeking agile coaches, Scrum Masters, Product Owners or project managers who should have undertaken at least three projects with agile project management under a fixed-price contract or two years of professional experience in that field of research. Participation in the research requires you to attend an interview that takes approximately 60-90 minutes of your time.

What is the purpose of the study?

This research will investigate how the agile practices (values and principles) for 'communication, collaboration and short feedback cycles' can be applied with Scrum to software development projects conducted under a fixed-price contract, to help the project stakeholders to increase the effectiveness and efficiency, and which actions can be implemented to mitigate the conflict between these two approaches.

Why have I been invited?
You have been invited because of your professional experience in agile project management. Your experience could help to improve the success of agile projects conducted under fixed-price contracts, and to raise the bar of professionalism in this field of research.

Do I have to take part?
No, taking part in this research is entirely voluntary. It is up to you to decide if you want to volunteer for the study. We will describe the study in this information sheet. If you agree to take part, we will then ask you to sign the attached consent form, dated 09.07.2017, version number, V1.02.

What will happen to me if I take part?
If you agree to take part in this study, you will be interviewed for approximately 60 to 90 minutes. The interview will be conducted in German or English language. It will be digitally recorded, transcribed, and anonymised afterwards. The interview will take place in your local office or any other location that you prefer, at a time that is convenient to you.
The questions will mainly be about your experience in agile project management with Scrum in fixed-priced projects. Of special interest are those factors that you consider as relevant for success or for failure.

Expenses and payments
The participation on this research study does not involve any recompense or cost compensation. I will undertake any travel necessary to be able to interview you. I will also use as little time as possible. After acceptance of the thesis at the University of Portsmouth, I will get you a copy of the final version on request.

Anything else I will have to do?
Except of the interview, there will be no further actions.

What data will be collected?
The whole interview will be recorded, transcribed, and anonymised. If you will reveal sensitive information during the interview, this information will be anonymised or withdrawn from the transcript, if you wish so.

What are the possible disadvantages, burdens and risks of taking part?
The only commitment from your side will be your time and there are no risks involved, because all information will be confidential. Moreover, it is entirely up to you, which information you want to share.

What are the possible benefits of taking part?
Your participation will help to contribute to new insights in this field of research, which might help other agile practitioners in similar environments. A summary of the research results will be made available to you on request.

Will my taking part in the study be kept confidential?
The interview is absolute anonymous and all information will be treated strictly confidential. The data from interviewed persons will therefore be encrypted and stored on a secured private device, which fulfils the requirements of the Federal Office for Information Security in Germany. Any paper-based material will be scanned, encrypted and stored at the same place, and the original paper will be securely destroyed. The names of the interviewees as well as their organisation will not be noted in the data, instead numbers and codes will be assigned.
The research data will be kept for 10 years after completing the research in line with UoP Retention Schedule for Research Data. Original consent forms will be scanned, digitally signed, and kept securely by the researcher for 30 years after completing the research. If no longer required, it will be securely destroyed. The data will only be used for this study, or related publications, and will not be handed out to third parties under any circumstances.

What will happen if I don't want to carry on with the study?
As a volunteer you can stop any participation in the interview at any time, or withdraw from the study at any time before or two weeks after the interview has taken place, without giving a reason if you do not wish to.. If you do withdraw from a study after some data have been collected you will be asked if you are content for the data collected thus far to be retained and included in the study. If you prefer, the data collected can be destroyed and not included in the study. Once the research has been completed, and the data analysed, it will not be possible for you to withdraw your data from the study.

What if there is a problem?
If you have a query, concern or complaint about any aspect of this study, in the first instance you should contact the researcher, if appropriate.
The contact details of the researcher are:
Daniel Georges | +49 (0) 173 9917239 | daniel.georges@myport.ac.uk
The contact details of the supervisor are:
Dr Andrew Lee | andrew.lee@port.ac.uk
If your concern or complaint is not resolved by the researcher or his supervisor, you should contact the Head of Department:
Head of Department: Gary Rees
Telephone: +44 (0) 23 9284 4221
Email: gary.rees@port.ac.uk
Address: Richmond Building Portland Street Portsmouth PO1 3DE
If the complaint remains unresolved, please contact: The University Complaints Officer +44 (0) 23 9284 3642 complaintsadvice@port.ac.uk

Who is funding the research?
The research is fully self-funded and nobody will receive any financial contribution by conducting this research.

Who has reviewed the study?
Research in the University of Portsmouth is looked at by independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and given a favourable opinion by University of Portsmouth Research Ethics Committee.

Thank you for taking time to read this information sheet and for considering volunteering for this research. If you do agree to participate your consent will be sought; please see the accompanying consent form. You will then be given a copy of this information sheet and your signed consent form, to keep.

Appendix C – Ethical approval

11 July 2017

Daniel Georges
DBA Student
Portsmouth Business School

Dear Daniel

Study Title:	**Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry**
Ethics Committee reference:	**E453**

Thank you for submitting your documents for ethical review. The Ethics Committee was content to grant a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, revised in the light of any conditions set, subject to the general conditions set out in the attached document, and with the following stipulation:
The favourable opinion of the EC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including University of Portsmouth, prior to the start of the study.

Summary of any ethical considerations:
-

Documents reviewed
The documents reviewed by Peter Scott [LCM] + PBS Ethics Committee

Document	*Version*	*Date*
Ethics application form	V1	26 April 2017
Invitation letter	V1	26 April 2017
Participant information sheet	V1	26 April 2017
Consent form	V1	26 April 2017
Interview questions	V1	26 April 2017
Focus Group questions	V1	26 April 2017
Ethics application form	V2	24 May 2017
Interview questions	V2	24 May 2017
Focus Group questions	V2	24 May 2017
Ethics application form	V2	09 Jul 2017
Invitation letter for Interviews for Focus Group	V3	09 Jul 2017
Participant information sheet for Interviews for Focus Group	V3	09 Jul 2017
Consent form for Interviews for Focus Group	V3	09 Jul 2017

Statement of compliance
The Committee is constituted in accordance with the Governance Arrangements set out by the University of Portsmouth.

After ethical review

Reporting and other requirements
The attached document acts as a reminder that research should be conducted with integrity and gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Notification of serious breaches of the protocol
- Progress reports
- Notifying the end of the study

Feedback

You are invited to give your view of the service that you have received from the Faculty Ethics Committee. If you wish to make your views known please contact the administrator, Christopher Martin.

Please quote this number on all correspondence: E453

Yours sincerely and wishing you every success in your research

Chair
Email:

Enclosures: *"After ethical review – guidance for researchers"*

Copy to:
Dr Andrew Lee

Appendix D – Consent form for interviews

University of Portsmouth
Portsmouth Business School

CONSENT FORM FOR INTERVIEWS

Title of Project: Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry

Name and Contact Details of Researcher: Daniel Georges | +49 (0) 173 9917239 | daniel.georges@myport.ac.uk

Name and Contact Details of Supervisor (if relevant): Dr Andrew Lee | andrew.lee@port.ac.uk

Ethics Committee Reference Number: E453

Please initial box
☐

I confirm that I have read and understood the information sheet dated July 2017 Version 1.1

for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time until the data analysis has started, or two weeks have passed, after the interview has been conducted, without giving any reason. ☐

I understand that data collected during this study, *could* be requested and looked at by regulatory authorities. I give my permission for any authority, with a legal right of access, to view data which might identify me. Any promises of confidentiality provided by the researcher will be respected. ☐

I understand that the results of this study may be published and / or presented at meetings or academic conferences and may be provided to research commissioner. I give my permission for my anonymous data, which does not identify me, to be disseminated in this way. ☐

I agree to the data I contribute being retained for any future research that has been approved by a Research Ethics Committee. ☐

I agree to take part in the above study. ☐

I consent for my interview to be audio recorded. The recording will be transcribed, anonymised and analysed for the purposes of the research. The interview is absolute anonymous, and all information will be treated strictly confidential. The data from interviewed persons will therefore be encrypted and stored on a secured private device, which fulfils the requirements of the Federal Office for Information Security. Any paper-based material will be scanned, encrypted and stored at the same place, and the original paper will be securely destroyed. The names of the interviewees as well as their organisation will not be noted in the data, instead numbers and codes will be assigned.
The data, when made anonymous, may be presented to others at academic conferences, or published as a project report, academic dissertation or in academic journals or book. Anonymous data, which does not identify you, may be used in future research studies approved by an appropriate research ethics committee.
The research data will be kept for 10 years after completing the research in line with UoP Retention Schedule for Research Data. Original consent forms will be scanned, digitally signed, and kept securely by the researcher for 30 years after completing the research. If no longer required, it will be securely destroyed. The data will only be used for this study, or related publications, and will not be handed out to third parties under any circumstances. ☐

I do not give consent for audio recording but to note taking. All other aspects from point 7 do apply equally for notes taken. ☐

I consent to verbatim quotes being used in publications; I will not be named but I understand ☐

that there is a risk that I could be identified.
I agree to be named as a participant and referred to accordingly. ☐

Name of Participant: **Date:** **Signature:**

Name of Person taking Consent: Date: Signature:

***Note**: When completed, one copy to be given to the participant, one copy to be retained in the study file*

Appendix E – Consent form for focus group participants

University of Portsmouth
Portsmouth Business School

CONSENT FORM FOR FOCUS GROUP PARTICIPANTS

Title of Project: Transferring the benefits of agile project management with Scrum to fixed price projects in the software industry

Name and Contact Details of Researcher: Daniel Georges | +49 (0) 173 9917239 | daniel.georges@myport.ac.uk

Name and Contact Details of Supervisor (if relevant): Dr Andrew Lee | andrew.lee@port.ac.uk

Please initial box

Ethics Committee Reference Number: E453

I confirm that I have read and understood the information sheet dated July 2017 Version 1.0 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary, and that I am free to withdraw at any time, until the focus group discussion has been conducted, without giving any reason. ☐

I understand that data collected during this study, *could* be requested and looked at by regulatory authorities. I give my permission for any authority, with a legal right of access, to view data which might identify me. Any promises of confidentiality provided by the researcher will be respected. ☐

I understand that the results of this study may be published and / or presented at meetings or academic conferences and may be provided to research commissioner. I give my permission for my anonymous data, which does not identify me, to be disseminated in this way. ☐

I agree to the data I contribute being retained for any future research that has been approved by a Research Ethics Committee. ☐

I agree to take part in the above study. ☐

I consent to be audio recorded during the focus group discussion. The recording will be transcribed, anonymised and analysed for the purposes of the research. The focus group discussion is absolute anonymous and all information will be treated strictly confidential. The data from the participants will therefore be encrypted and stored on a secured private device, which fulfils the requirements of the Federal Office for Information Security. Any paper-based material will be scanned, encrypted and stored at the same place, and the original paper will be securely destroyed. The names of the participants as well as their organisation will not be noted in the data, instead numbers and codes will be assigned.
The data, when made anonymous, may be presented to others at academic conferences, or published as a project report, academic dissertation or in academic journals or book. Anonymous data, which does not identify you, may be used in future research studies approved by an appropriate research ethics committee.
The research data will be kept for 10 years after completing the research in line with UoP Retention Schedule for Research Data. Original consent forms will be scanned, digitally signed, and kept securely by the researcher for 30 years after completing the research. If no longer required, it will be securely destroyed. The data will only be used for this study, or related publications, and will not be handed out to third parties under any circumstances. ☐

I do not give consent for audio recording but to note taking. All other aspects from point 7 do apply equally for notes taken. ☐

I consent to verbatim quotes being used in publications; I will not be named but I understand that there is a risk that I could be identified. ☐
I agree to be named as a participant and referred to accordingly. ☐

Name of Participant: **Date:** **Signature:**

Name of Person taking Consent: Date: Signature:

***Note**: When completed, one copy to be given to the participant, one copy to be retained in the study file*

Appendix F – Focus group interview guide

Transferring the benefits of agile project management using Scrum to fixed-price software projects

Written by: Daniel Georges, MBA / daniel.georges@myport.ac.uk
Student no: 753189

Used abbreviations in the Focus group:
Agile project management (APM)
Fixed price (FP)

Research Question [RQ]: *How can applying agile practices, values and principles for 'communication, collaboration and short feedback cycles' from Scrum help the project stakeholders, to increase the effectiveness and efficiency in the context of FP software development projects?*

***Participants**:* Interviewees and participants of the focus group need to be familiar with Scrum in fixed price projects. Therefore, the participants must fulfil the following criteria[39]:

- Should work as an Agile Coach, a Scrum Master or a Product Owner in software development projects, or as a project manager in fixed price projects, adopting agile principles and values
- Should have conducted at minimum three agile projects under fixed price conditions, or should have a minimum experience of two years in that field

Participant Consent: Participants will sign a consent form to participate in the focus group discussion. One copy of the informed consent form is given to participants and a second copy is kept by the focus group facilitator. Participants are informed that audio-recording will be used for data collection.

Timing: The focus group will take up to 2 hours. There is an introduction about the topic and an overview about the findings for about 30 mins. 60 mins are planned for the adapted Scrum framework. 30 mins in the end for a general discussion.

Participant management: Participants have to raise their hands, if they want to say something. Monologues will be gently stopped, if they took too long and people will be asked directly about their opinion if they do not participate to get a common view to the topic.

Lack of consensus: If there is a lack of consensus, the aim is to understand and write down the reasoning behind it and ask what needs to be changed so that they can agree on it.

Focus Group Script

Welcome and thank you for being here today. The purpose of this focus group is to get your feedback about findings from 4 years of research and 13 expert interviews within the field of research. The aim of the next 2 hours is to get your assessments on these findings, which resulted in an adapted Scrum framework. To understand what would work for you and what would not work for you in your specific project situation. That is why we are talking today.

Let me introduce myself. My name is Daniel Georges and I am working since 2003 in agile environments in different roles, such as Agile Coach, Product Owner, Scrum Master or Developer, and since 2013 I am working agile within FP contexts. I will be the moderator in today's discussion. The format we are using is a focus group. A focus group is a conversation that focuses on specific questions in a safe and confidential environment. I will guide the conversation by asking questions that each of you can respond to. There are no right or wrong answers to these questions. I am just seeking your opinion as agile experts on this topic. If you wish, you can also respond to each other's comments, like you would in an ordinary conversation. It is my job to make sure that everyone here gets to participate and that we stay on track.

I will also record and summarise your comments. Before we get started, I want to inform you that findings from today will be compiled in my thesis. That thesis will include a summary of your anonymised comments and some recommendations and is going to be published in academia. Secondly, you do not have to answer any questions that you do not feel comfortable with.

[39] The same criteria were applied as for the interviews

This focus group today is anonymous towards third parties and confidential. "Anonymous" means that you will not be identified within the thesis as an individual, as all data will be anonymised. In addition, companies or projects notes will be anonymised as well, so that the reader will not be able to identify these. "Confidential" means that what we say in this room should not be repeated outside of this room. Obviously, I cannot control what you do when you leave, but I ask each of you to respect each other's privacy and not tell anyone what was said by others here today. Although we hope everyone here honours this confidentiality, please remember that what you say here today could be repeated by another focus group member. So please, do not say anything that you absolutely need to keep private. As you can see, I will be audio recording this focus group. The recording will only be used to make sure my notes are correct and will not be heard by anyone outside of my supervisory and examination teams. All participants' data will be destroyed / deleted according to the ethical regulations of the University of Portsmouth. Let's begin with introductions.

Ground rules

- The most important rule is that only one person speaks at a time. There may be a temptation to jump in when someone is talking but please raise your hand so I can record the order and wait until they have finished.
- There are no right or wrong answers
- You do not have to speak in any particular order
- When you do have something to say, please do so. There are many of you in the group and it is important that I obtain the views of each of you
- You do not have to agree with the views of other people in the group
- Does anyone have any questions? (answers).
- OK, let's begin

Warm up

- First, I would like anyone to introduce himself. Can you just introduce yourself with your name and role?
- Now, let me introduce you to the topic of my thesis. This research explores if Agile Project Management (APM), using the process framework Scrum, is perceived to be effective and efficient in the context of fixed-price (FP) software development projects and, if the perception is positive, to understand why and how APM is perceived to be beneficial within a FP context. Fixed-price in this context means, that the scope, price, and schedule within the contract is fixed and not negotiable.

  Why is this important? On the one hand, the Standish Group (2015) report states clearly the main reasons why projects have failed or have been challenged. Namely *"Incomplete requirements"*, *"The lack of User Involvement"* and *"Changing requirements"*. On the other hand, communication and collaboration is needed to close these requirement gaps, to eliminate uncertainty, and to react to external project influences. The importance of communication is supported by several studies which emphasise that communication is a critical success factor in project management (Cockburn, 2006; Holzmann & Panizel, 2013; Mishra, Mishra & Ostrovska ,2012).

  Scrum provides a communication and collaboration framework which is able to close these requirement gaps.

Introductory question

Research question:

- Based on personal experiences and reports from practitioners the assumption for this thesis is that: *applying agile practices, values and principles for 'communication, collaboration and short feedback cycles' from Scrum help the project stakeholders, increases the effectiveness and efficiency in the context of FP software development projects* and is more likely to meet the stakeholder expectations. Please take a couple of minutes to think about using Agile values and principles within a FP project on your own. What is your perception about this? What would be the benefits? What would be the challenges by using Agile within an FP setting?

My research findings suggest that if you make the following adaptions to the Scrum framework, you will be able to apply them to FP settings and thus increase the effectiveness and downstream the efficiency of FP projects. I want you to comment on two things:
How suitable would these changes be to promote agility in a FP setting, and under which conditions would they be feasible to implement in your projects.

Scrum adaptions (findings):

Client's obligations:

- Beside the risk mitigation or ROI decision making, fixed-price contracts are related to command & control structures of an organisation. Fixed-price contracts are a vehicle and needed for the purchasing and legal department, which are later not involved in the project implementation. That means that people from the company organisation tend to be highly open for an agile working mode, meanwhile the organisation itself is not. A product owner/ project manager from the customer has to be empowered, i.e. he must be able to accept deliveries or if necessary, change request, etc.. A safe place outside of the organisation can help to empower the customer's team. These **preconditions** have to be stated in the **client's obligations** and is part of the contract. What do you think about this? How effective, efficient and feasible would that be in your project context?

Initial project start conditions:

- As projects are dynamic, we must accept that requirements will be incomplete, might change during the project, might be misunderstood, or are not mentioned. Therefore, a **product vision** has to be extracted in a **workshop** first, as it is essential to be effective. Based on this product vision the known requirements have to be transferred to a backlog in another **workshop**. This latter workshop might happen or is best before the contract signing. These initial project start conditions must be achieved to start the project. In addition, **Definitions of Ready** and **Definitions of Done** must be clarified upfront. These things are also stated in the client's obligations. What do you think about this? How effective, efficient and feasible would that be in your project context?

Risk management:

- As the risk is borne by the supplier, explicit risk management has to be established from the beginning and maintained properly during the project, meanwhile this is not part of the Scrum framework. Through the continuous delivery and feedback, risks might be identified earlier. What is your perception about this? How important is this in your project context? What would you see as the biggest risk, if explicit risk management would be avoided?

Sprint review:

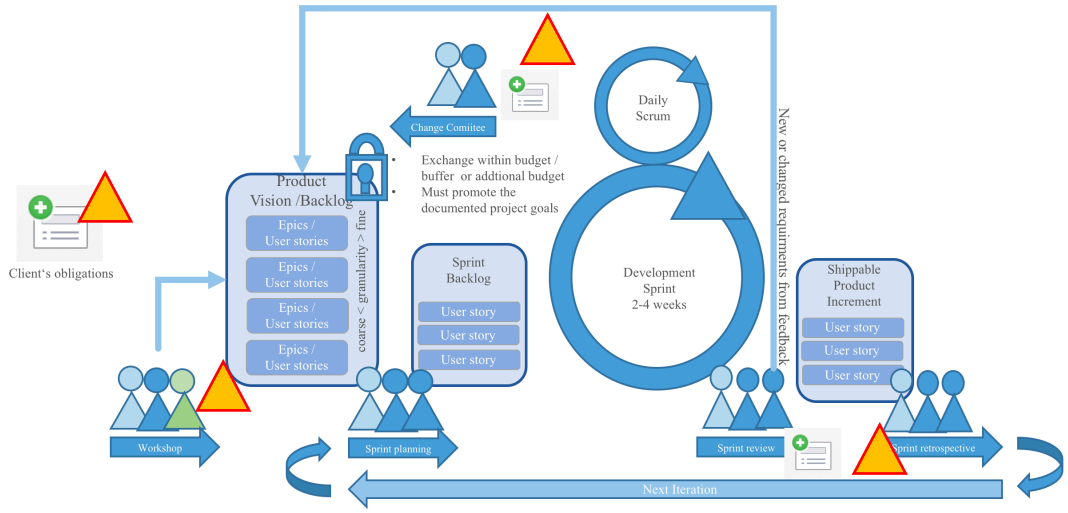
- The legal acceptance is done, based on the acceptance criteria, at the end of a sprint, or within a determined period of time, through a signed document / email / etc. which documents the acceptance of the implemented features. This is independent from a final acceptance at the end of a plan-based project. Changes after this acceptance must be paid by the customer. The warranty starts, at the latest, with the use in production. What is your perception about this? How effective, efficient and feasible would that be in your project context?

Stakeholder management:

- To get the acceptance from the right stakeholders, beside the customer representative, which is determined within the client's obligations, it is vital to identify the right stakeholders through a dedicated stakeholder management process and to involve them within the Scrum process. The collaboration is enforced by **informing** the relevant stakeholders that their requirements are clarified within the dedicated Scrum meetings, and once accepted cannot be changed without further payment. This **motivates** the **relevant stakeholders** to participate in the Scrum meetings. What is your perception about this? How could this work in your project context?

Changes to the backlog:

- If changes to the agreed backlog or implementation details appear, the backlog can only be changed in accordance with the customer and supplier, based on a **documented** act within a change committee. **Exchanges** to the backlog might happen through exchanging one story with an equivalent story, within a budget buffer or with additional budget, as long it fits in the product vision. An empowered **customer representative** is required by the **client's obligation**. The customer has to name a person who is able to legally accept deliveries, and if he is not available to name a replacement within a sprint. All **changes** to the product backlog must **promote** the **product vision** and the **project goals**, otherwise these changes are not possible. External experts from the client and the supplier might help to estimate the effort for the (ex-)change. What is your perception about this? How important is it to have a particular change committee meeting in your project context?



- What is your perception of the explicit Scrum adaptions? How important are these adaptions in your project context? Is something missing?

Benefits:

Transparency:

- Transparency through continuous delivery and collaboration leads to a better understanding and trust. This helps the collaboration to focus on the product and not on the contract. In the case of issues, these are solved in a more pragmatic way. What is your opinion about this? How important is transparency in your project context?

Effectiveness:

- Effectiveness is promoted through MVP and continuous delivery with its feedback. Effectiveness goes before efficiency. According to Scrum business value prioritising, and Time to Market are the dominant objectives. What is your perception about this? How much more effective would this be in your FP context?

Efficiency:

- Based on the findings of the interviews, this approach tends to be more efficient through the limited resources, which promotes efficiency. Efficiency drivers are limited resources, clear product vision, close collaboration, less documentation effort. Efficiency stoppers are (late) changes to the product (functionality or architecture) which might happen. What is your perception about this? How much more efficient would this be in your FP context?

Challenges

Scope creep:

- Different stakeholders and close collaboration might lead to further requirements. Therefore, stakeholder management and the change committee process are essential not to lose the focus.

Collaboration:

- Motivating the relevant stakeholders to participate in the project and to allocate enough project time is essential. First, this is done through empowering them within the client's obligations. Second, this is done operatively through informing all relevant stakeholders about the scrum methodology and that the scrum meetings are their (only) opportunity to get what they want. Once, a feature is accepted it cannot be changed for free.

What is your perception about this? Which further challenges do you see?

Concluding question

- Of all the things we have discussed today, which three things were the most important for you? What is the reason for your prioritisation?
- Did we forget something? Would you like to add something?

Conclusion

- Thank you for participating. This has been a very insightful discussion
- Your opinions will be a valuable asset to the study
- I hope you have found the discussion interesting

- If there is anything you are unhappy with or wish to complain about, please contact my supervisor or speak to me later
- I would like to remind you that any comments featuring in this report will be anonymous
- Please remember to maintain confidentiality of the participating individuals by not disclosing their names.

Appendix G – German citations

Table 10

		Documents should comprise the product vision, instead of specifications that are overly detailed
Respondents	P2	[…] wenn sich der Kunde über seine Bedürfnisse im Klaren ist, dann kann er auch seine Anforderungen entsprechend ableiten.
	P3	[…] Es wäre besser, wenn wir die Bedürfnisse des Kunden erfüllen könnten, [instead of implementing a lot of predefined requirements]
	P6	Im Vertrag war also nur ein grober Rahmen vorgegeben, in dem auf einer abstrakten Ebene gezeigt wurde, was das Ziel des gesamten Projektes ist und welche Funktionalität enthalten sein sollte. Das wurde aber nicht im Detail spezifiziert, um einen gewissen Spielraum zu erhalten.
	P8	Das Wichtigste ist, den Fokus zu behalten. Dass du immer weißt, woran wir wirklich arbeiten? Was ist unser Ziel, das wir erreichen wollen? Und das wird nur durch die Produktvision definiert.
	P8	[...] muss man die Arbeit am Anfang machen und vorher klar machen, was die Produktvision ist. Und das ist schwer. Das ist wirklich ein hartes, ständiges Zuhören, Vorschläge machen, was es sein könnte. Zuhören, Vorschläge machen, zuhören, Vorschläge machen. Aber immer aus der Perspektive des Endkunden.
	P8	Eine Produktvision ist für mich am Anfang eine Art Quality Gate. Das allererste, wir nennen es immer Sprint Zero, das allererste, was vorhanden sein muss, ist die Produktvision, wir müssen einen Fokus haben.
	P9	[…] der Hauptvertrag hat keine Funktionalitäten beschrieben, außer einer groben Vision des Projekts.
	P10	[…] This exploration concept included a vision. The exploration concept included the major features that they envision and even a technical architecture.
	P12	Die Kunden wissen am Anfang nicht genau was sie wollen. Deshalb ist es besser, sich auf eine Produktvision zu konzentrieren.

Table 11

		Clear process framework for communication and collaboration
Respondents	P2	Es gab 14 Teams, die parallel und immer im gleichen Tempo arbeiteten. Auch hier bietet die Methode so viel, bezogen auf Kommunikation und Koordination, etc.
	P9	[...] dass man sich diese Zeiten bewusst nimmt, sich zusammensetzt, die Ergebnisse bespricht und vor allem bespricht, was man als nächstes tun soll. Das ist in der Regel nicht das, was für den nächsten Monat vorher geplant war. Und das, denke ich, ist die zentrale Stärke, die ich sehe.
	P10	Scrum hat sehr klare Zeremonien und wenn Sie sich daran halten, haben Sie bereits eine Basis, die andere agile Ansätze nicht haben. Wenn Sie sich strikt an diese drei Meetings, drei Rollen halten, haben Sie viel Erfolg. Und ich denke, wenn Sie einen anderen agilen Ansatz wählen würden, wäre das nicht so streng. Und deshalb ist es so wichtig, diese Zeremonien so zu halten. […] Es ist sehr klar definiert, was der Inhalt dieser Zeremonien ist. Es ist sehr klar, wer der Verantwortliche ist und es ist sehr klar definiert, was das Ergebnis sein sollte. Und das macht das Ganze meiner Meinung nach erfolgreich.
	P11	Regelmäßige gemeinsame Treffen, d.h. alle 14 Tage einen Sprint und nicht nur einmal während einer Inbetriebnahme und dann wird es eine Auslieferung geben.
	P12	Scrum bietet ein klares Kommunikations- und Kollaborationsmodell.

Table 12

		Continuous communication
Respondents	P1	Durch die enge Kommunikation, durch das enge Feedback ist es uns gelungen, Planungssicherheit zu erhalten.
	P2	[...] also Zusammenarbeit, Feedback und Kommunikation sind zwingende Voraussetzung und auch letztendlich immer natürlich das Endergebnis in agilen Projekten, sobald ich die Methode anwende.
	P3	Durch eben diese kontinuierliche Feedback-Schleife. Kommunikation, Verstehen der Anforderungen, das ist eigentlich ein Kernelement
	P4	Ich habe also diesen kurzen Feedback-Zyklus, sowohl auf Projektmanagement- als auch auf Entwicklungsebene, das ist der Hauptpunkt. Und dazu gehören Kommunikation, miteinander reden und Transparenz.
	P5	Kommunikation ist ein Muss!
	P6	Eine davon sind regelmäßige Feedbackschleifen mit dem Kunden, wobei regelmäßig bedeutet, alle zwei Wochen.
	P7	Die Kommunikation sorgt dann dafür [Transparency]
	P8	Die Kommunikation ist also das entscheidende Kriterium, das über Erfolg oder Misserfolg eines Projektes entscheidet. Und Agilität hat viel damit zu tun, die permanente Kommunikation zu fördern. Die kontinuierliche Kommunikation zu fördern. Und auch, um die Stimmen einzuholen, die vorher vielleicht aufgrund von übermäßiger Arbeitsteilung oder zu starrem Phasendenken ignoriert wurden. Kommunikation ist das Alpha und Omega. Es geht um Kommunikation, es geht um Kooperation und es geht um Qualität.
	P10	Und dieses Gespräch mit dem Entwickler, dass der Kunde dem Entwickler wirklich klar gemacht hat, was er eigentlich will.
	P11	Erstens Kommunikation, Kommunikation und nochmals Kommunikation.
	P12	Kontinuierliche Kommunikation ist zweifellos ein wichtiger Erfolgsfaktor.

Table 13

		Prioritising the backlog according to business value and technical risk
Respondents	P3	Und dann arbeitet man wirklich lieber an dem Value noch, an dem Business Value, mit absolut guter Qualität aus Anwendersicht.
	P4	Ich meine, die Maximierung des Geschäftswerts ist definitiv ein Punkt, denn ich stelle zum Zeitpunkt X immer sicher, dass die Software beim nächsten erfolgreichen Sprint den größtmöglichen Nutzen bringt.
	P6	Aber durch den agilen Festpreis bin ich schon eher dazu gezwungen Dinge zu priorisieren, eben weil Dinge sich ändern können an Randbedingungen, Anforderungen und und und, ja, man aber im bestimmten Zeit- und Budgetfenster bleiben möchte, also muss ich priorisieren.
	P7	Wir haben uns darauf konzentriert und waren uns einig, dass das Budget als fix betrachtet werden sollte und dass wir innerhalb dieses Budgets die beste Lösung für den Kunden mit dem höchsten Geschäftswert erreichen würden.
	P7	Es wurde nach den typischen Scrum-Themen priorisiert, die man dort hat, Business Value, das Wichtigste für das Unternehmen, Abhängigkeit, Risiko, auch technisches Risiko, deshalb waren wir von Anfang an mit an Bord. […] Aus betriebswirtschaftlicher Sicht ziehe ich dann in erster Linie den ROI nach vorne. Ich habe den Business Value im Auge und beschäftige mich nur mit der Flut von Anforderungen, die natürlich in einer so großen Spezifikation enthalten sind.
	P8	[…] wenn ich 50 Prozent der Funktionen habe und ich sortiere sie nach Geschäftswert, dann habe ich nicht 50 Prozent des Geschäftswertes, sondern 70 oder 80 Prozent des Geschäftswertes.

Table 14

Increased productivity by short planning and feedback cycles		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Early key user involvement	P1, P3, P4, P6, P7, P9	Aber der erste Erfolg, den wir hatten, war eigentlich, dass ich irgendwann bemerkte, dass ein Key-User sagte: "Ja, das hat immer noch hier und da Fehler. Aber ich benutze es jetzt seit drei Wochen, um meine Projekte zu kalkulieren." Also hat er es im Prinzip schon benutzt, obwohl es eigentlich noch relativ wackelig war, denn er sagte, es funktioniert viel besser als die alte Lösung, ich finde es wirklich cool.
Increased effectiveness	P1, P3, P4, P6, P8, P9, P10, P11, P12	Es gibt eine Untersuchung der Standard Group International. Sie haben herausgefunden, welche Features in einem fertigen Produkt verwendet werden. Sie haben festgestellt, dass 45 Prozent der implementierten Features überhaupt nicht verwendet wurden, obwohl sie vorher spezifiziert wurden. Wenn Sie Agile entwickeln und das Kundenfeedback frühzeitig erhalten, können Sie diese 45 Prozent schnell wieder finden. Und das wiederum macht Agile schnell, denn ich finde diese Features, die man nicht braucht, sofort wieder.
Increased efficiency	P4, P6, P8, P9, P10, P12	Die Effizienz ergibt sich wiederum daraus, dass wir das entwickeln, was benötigt wird und nichts, was am Ende nie in der Funktionalität eingesetzt wird. Das ist natürlich auch nicht hundertprozentig.
Increased transparency and trust	P2, P4, P7, P9, P11, P12	Schafft Vertrauen, zeigt dem Kunden, wir sind on Track. Man kann ihnen was zeigen, Kunde kann selber intern was zeigen, macht es einfach entspannter.
A project steering tool - planning, controlling, early escalation	P1, P2, P4, P6	Durch die enge Kommunikation, durch das enge Feedback ist es uns gelungen, Planungssicherheit zu erhalten. So konnten wir mögliche Engpässe schneller kommunizieren. Auch konnten wir sie begründen. So konnte ich auch sagen: Warum kann ich das nicht liefern? Weil ich dieses Steuerungsinstrument hatte. Auch das technische Feedback kam durch diese wöchentlichen Meetings schneller zum Kunden zurück: "Es steht in den Spezifikationen, aber Vorsicht! Wir haben Folgendes herausgefunden."
Improved time-to-market	P1, P7, P9, P10, P11, P12	Was man schafft ist, man fängt relativ schnell an mit kleinen Features an den Markt zu kommen, ja, aber nicht mit einem kompletten Produkt, sondern nur mit kleinen Features. Und kriegt ein sehr schnelles Kundenfeedback.

Table 15

	Transparency and trust
Respondents P2	Die Transparenz ist wichtig, es ist auch wichtig die Störungen, die da sind, egal in welchem Umfeld oder woher sie kommen, woraus sie bedingt sind, transparent zu machen, um was dagegen machen zu können. Allerdings läuft eine Gefahr, dass, das was gut läuft, als sehr selbstverständlich genommen wird, weil das ist ja immer das Ziel, wenn das eigentlich noch mal gewürdigt wird und letztlich arbeiten Menschen miteinander.
P4	Und dazu gehören Kommunikation, das Gespräch miteinander und Transparenz. Dass man dies transparent macht, darüber spricht und sich sozusagen auf empirische Daten stützt.
P7	Schafft Vertrauen, zeigt dem Kunden, wir sind on Track. Man kann ihnen was zeigen, Kunde kann selber intern was zeigen, macht es einfach entspannter.
P9	Aber nichts davon ist messbar. Und bei unserem Agile-Ansatz ist es tatsächlich so, dass wir in der Regel schon nach wenigen Wochen, manchmal sogar Tagen, ein System haben, auf das der Kunde zugreifen kann. Noch sehr rudimentär, aber wo er zumindest etwas in der Hand hat. Und das erhöht die Akzeptanz beim Kunden deutlich, hält aber zweitens auch den Wunsch nach Zusammenarbeit aufrecht.
P11	Die zweite ist Vertrauen. Kommunikationstransparenz führt zu Vertrauen.
P12	Diese Transparenz zeigt dem Kunden, dass wir sorgsam mit seinem Geld umgegangen sind.

Table 16

		Close collaboration and trust lead to fewer contract discussions
Respondents	P6	Ich möchte die Zusammenarbeit noch einmal betonen, denn dadurch kann ich ein viel besseres gemeinsames Verständnis aufbauen, das Verständnis für das Projektthema, den Umfang, aber auch für Dinge, die möglicherweise problematisch sind. Nur um noch einmal das Beispiel zu nehmen: Wenn ich in einer frühen Phase gemeinsam mit meinem Kunden meine User Story Map erstelle und eng zusammenarbeite, dann ist das, sagen wir mal, eine sehr, sehr gute Basis für den Rest des Projekts.
	P7	Es war natürlich einerseits auf der persönlichen Ebene ein ganz wichtiger Punkt, dass man da auch auf persönlichen Ebene gut miteinander kann. Das ist eine Win-Win-, eine laufende Win-Win- oder eine Win-Win-Situation, die während des Projekts bestehen bleibt.
	P9	Je mehr Menschen miteinander reden, desto besser ist das persönliche Vertrauen untereinander. Und es ist mir wichtig, dass wir nicht als anonyme Dienstleister wahrgenommen werden und dass man immer diese persönliche Kommunikation hat - dass man weiß, auf der anderen Seite sitzt ein Mensch. Ich weiß das. Das mildert auch viele Krisen in Projekten.
	P10	Vertrauen kann also in agilen Projekten nicht hoch genug eingeschätzt werden, denn es schafft folgende Situation. Der Kunde gibt Geld und hofft, dass derjenige, der das Geld nimmt, ein tolles Feature daraus baut. Und wenn man ihnen nicht vertraut, dann gibt es viel Kontrolle und Mikromanagement - es funktioniert einfach nicht. Das führt zu Unmut und Unzufriedenheit. Dies ist dann sichtbar und die Produktivität geht deutlich zurück.

Table 17

Benefits which promote effectiveness		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Focus on project goals / product vision	P2, P3, P6, P8, P9, P10, P12	Zuerst muss die Effektivität gewährleistet sein. Dies kann ich nur erreichen, wenn ich eine klare Produktvision habe, ein klares Ziel setze.
Prioritised backlog according to business value	P3, P4, P6, P7, P11	Und das hat den sehr, sehr großen Vorteil - die alte 80-20-Regel - dass der Kunde den Geschäftswert, den er damit hat, einschätzen kann - er kann sagen: "Wenn ich 50 Prozent der Features habe und ich sortiere sie nach dem Wert, dann habe ich nicht 50 Prozent des Wertes, sondern 70 oder 80 Prozent des Wertes."
Short planning and feedback cycles by continuous delivery of MVPs	P1, P3, P4, P6, P8, P9, P10, P11, P12	Ich denke, dass im Allgemeinen das Beste an Agile diese kurzen Feedback-Zyklen sind. Das ist eigentlich die Einführung eines Feedback-Zyklus, der mir genau das gibt, was ich brauche. Ich erwarte nicht zu viel, ich tue es, liefere das, was notwendig ist, um eine Diskussionsgrundlage zu schaffen, und sammle dann im Vorfeld kurz Feedback, wie es weitergehen soll.
Improved time-to-market	P4, P7, P10, P11	Der typische Treiber für Agile Festpreisprojekte oder Agile im Allgemeinen ist "time-to-market". Aber "time-to-market" bedeutet, dass ich so schnell wie möglich Geld verdienen möchte. "Time-to-Market" bedeutet nicht, dass ich meine Kosten so niedrig wie möglich halten möchte.

Table 18

Benefits which promote efficiency		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Help to focus on product vision / project goals	P8, P9	Und das war für mich absolut frappierend es zu sehen, welch kanalisierende Wirkung ein gemeinsames Ziel haben kann. Und diese Kanalisierung, die ist ein absoluter Effizienzbringer. Und deswegen ist für mich die Reihenfolge Effektivität herstellen im Sinne von klarer Vision. Effizienz wird folgen automatisch durch dieses klare Ziel.
Early stakeholder involvement	P2, P4, P9, P10	Aber an sich habe ich einen Geschwindigkeitsvorteil, ich habe Effizienzvorteile, die ich durch die Art und Weise, wie ich mit einem Go-Live-System arbeite, gewonnen habe. Ich habe sehr gut ausgebildete Leute auf diesem System.
Less overhead for change requests and specification	P2, P4, P7	Ja, Effizienz jedenfalls, das hatten wir schon. Gerade weil der gesamte Overhead für Änderungen wegfällt und auch teilweise, hat Scrum auch den Ansatz, dass die Dokumentation wegfällt, das ist natürlich auch ein Ansatz von Scrum, das ist dann natürlich in gewissem Maße auch vorteilhaft für die Effizienz.
Limited resources promote efficiency	P6, P7, P8, P10	Nun, es ist definitiv richtig, wenn ich sage, dass ich irgendwie ein Modul X brauche und ich gebe Ihnen 100 Personentage dafür, dann bekommen Sie das Ding in 100 Personentagen. Und wenn Sie sagen, dass Sie nur zehn Personentage dafür haben, dann bekommen Sie das Modul X in seiner einfachsten Form in 10 Personentagen.

Table 19

	Unclear, changing or missing requirements
Respondents P1	Das ist natürlich immer so, dass die Anforderungen, so gut wie es geht eben, vorab vertraglich festgelegt sind, aber sich durch die Arbeit dann tatsächlich eben herausstellt, dass Nachfragen folgen müssen, um das Feature zu verstehen und da draus dann wieder Changes entstehen. Das ist ganz normal.
P2	Es wird in der Angebotsphase sehr holzschnittartig gehalten. Der Dienstleister schreibt seinen Lösungsweg kurz und knapp auf, und dann kommt er relativ schnell wieder und: "Das ist ein Change Request, das ist eine Erweiterung der Anforderung, es wird ein zusätzliches Attribut hinzugefügt, oder wir haben es nicht so gemeint". Die Interpretationsvielfalt ist also hoch und es muss eine Ausschreibung mit wirklich hoher Präzision geben, damit ein Dienstleister hier wirklich vernünftige Schätzungen machen kann.
P4	Wir hatten mehr oder weniger einen riesigen Anforderungskatalog, aber der Kunde war eigentlich nicht klar, wohin die Reise gehen sollte. Was muss noch getan werden, was ist wirklich wichtig? Und dann haben wir uns entschieden, Agil vorzugehen.
P5	Nein. Der Kunde weiß nie, was er wirklich will. Er hat immer eine solche Grundidee und nicht selten findet man in den Ausschreibungsunterlagen immer wieder Halbsätze darin. Und da steht: "Das muss weiter spezifiziert werden". Aber es ist ein Festpreis; das ist typisch für die öffentliche Hand.
P10	Es kommt aus dem Wissensmanagement und besagt, dass wenn man sich eine Spezifikation anschaut, welches Wissen wir dort haben. […] Aus meiner Sicht kann man es in vier Gruppen einteilen. Die erste Gruppe des expliziten Wissens ist uninteressantes Wissen. Also etwas, das dort aufgeschrieben ist, wo Sie sagen, dass Sie keine Erfüllung brauchen. Einer von ihnen hat einen schönen Text geschrieben. Die zweite ist: Sie haben Wissen, es gibt ein gemeinsames Verständnis darüber. Also, wenn ich das genommen habe und es den Entwicklern gebe, werden sie immer genau das programmieren, was ich brauche. Der dritte große Block ist, dass es Wissen gibt, über das es kein gemeinsames Verständnis gibt. Ein Spezialist hat als Stakeholder etwas aufgeschrieben und der Entwickler versteht nicht, was er dort implementieren soll. Nun, und dieser Punkt ist manchmal recht groß. Und dann haben wir immer noch implizites Wissen, wo Dinge nicht niedergeschrieben wurden, weil sie sagen, dass der Entwickler das selbst wissen muss. Also, und diese Kategorie ist im Bereich der Softwareentwicklung so groß, dass man, wenn man ein Anforderungsdokument nur eins zu eins übersetzt, nicht das bekommt, was man wirklich will. Und das, glaube ich, war das erste Grundwissen, bei dem einem gesagt wurde, dass man nicht alles auf Papier schreiben kann, damit es jemand anderes gut versteht. Wir nennen das geteiltes Wissen, das ist das goldene Prinzip. Und das ist das, was Agile auszeichnet, deshalb macht Agile sehr viel Sinn.
P11	Es gibt ja nicht nur Pflichtenhefte, sondern auch noch Lastenhefte, die dann gerne mal geschrieben werden. [...] Und das ist das Standardproblem, dass beim Übergang vom Pflichten- zum Lastenheft man sich nicht versteht oder aneinander vorbeiredet. Im Pflichtenheft ist immer die-. Zwischen den Zeilen steht ein maximaler Wunsch und im Lastenheft steht zwischen den Zeilen ein minimaler Wunsch. Das geht teilweise so weit auseinander, dass zwar ähnliche Dokumente existieren, aber trotzdem die Vorstellungen von dem, was da gemacht werden soll, sehr extrem weit auseinandergehen. Da gibt es diesen uralten Spruch: „Hundehütte oder Hochhaus – was willst du denn jetzt?“ Ja? Also im Pflichten- und Lastenheft stehen Dinge drin, die kann man sowohl als Hundehütte interpretieren als auch als Hochhaus und das geht halt signifikant auseinander.

Table 20

	Stakeholder involvement
Respondents P2	Die größte Schwierigkeit ist das Umfeld der sich ändernden Stakeholder.
P3	Sie waren nur an der Initialisierung des Projekts beteiligt. Also wollten sie Dinge wie Festpreis und Garantie und so weiter. Und der Rest ist nicht mehr interessant. Für den Rest ist die Abteilung zuständig. Das ist also auch ein sehr typisches Szenario, dass man nicht nur einen Kunden hat. Sondern dass Sie verschiedene Bereiche mit verschiedenen Kunden haben, mit denen Sie zu verschiedenen Zeiten des Projekts zu tun haben. Und dass die Einkaufsabteilung oft die Struktur der Bezahlung bestimmt, die die Modalitäten bestimmt. Aber dann stellt die Abteilung ganz andere Anforderungen an das Projekt. In diesem Fall war ihnen das jetzt nicht so wichtig.
P7	Natürlich muss ich auch intern evaluieren, welche der Stakeholder "key" sind? Welche Stakeholder muss ich in das Projekt einbeziehen und wie? Welchen Stakeholder schiebe ich am liebsten ein wenig beiseite? Welche bringen Probleme mit sich?
P9	Dass wir zunächst über Funktionalitäten diskutiert haben, die am Ende nicht mehr zeitgemäß waren. Denn entweder hat sich das Geschäft geändert oder, noch häufiger, die Menschen haben gewechselt, und wir hatten dann andere Ansprechpartner, die ganz andere Vorstellungen hatten.
P10	Eines Tages waren die Stakeholder nicht Im Reviewmeting anwesend, aber die Anforderung wurde trotzdem vom Product Owner akzeptiert und schließlich kam es zu einem Streit zwischen Stakeholdern und Product Owner. Das Erfolgskriterium ist also eigentlich, dass sie in der Planung und im Review anwesend sind.
P10	Als wir das Projekt durchgeführt haben, wurde also einer als Product Owner bestimmt, der einen geschäftlichen Überblick hatte und sehen konnte, was tatsächlich zu tun ist. Und die anderen kamen aus den Fachabteilungen des Unternehmens, die sozusagen Anforderungen an das Produkt hatten. Nun, es gab mehrere Stakeholder, aus mehreren Abteilungen, und da war eigentlich die Schwierigkeit.
P11	Es gibt durchaus Festpreisprojekte, wo die Projektleiter ein hohes Interesse daran haben zu kommunizieren. Also das gibt es auch, wenn es blöd läuft. Also der Klassiker ist ja bei einem Festpreisprojekt folgender: Solang, wie ich noch in der Vertragsfindung bin, kommt der Stakeholder, also der, der es bezahlt, und macht den Vertrag mit mir. Das ist dann ein Vertrag, sage ich mal - ich mache es jetzt mal einfach –, zehn Seiten hat der, da stehen zehn Anforderungen drin – das heißt ja schon, dass jede Anforderung maximal eine Seite lang sein kann – und ist da beschrieben. So, dann kommt ein Angebot raus und dann sagt der Auftragnehmer „Ja, kostet 100.000 Euro.“, ja? So. Die Kommunikation läuft jetzt weiter und wenn ich jetzt beauftrage „Los geht es!“ und ab jetzt schickt der Auftraggeber seine Mitarbeiter hin, die diese Software, die da entsteht, nutzen müssen, ja, sollen. Und die interpretieren jetzt diese zehn Seiten, diese zehn Feature-Beschreibungen maximal für ihren Nutzen.

Table 21

		Scope creep
Respondants	P5	Besser mehr als zu wenig, denn dann sehen sie, ob du in die richtige Richtung denkst. Ob du das auch verstanden hast. Wie ich schon sagte, sie nehmen alles, was sie kriegen können. Und wenn du nicht kooperierst, dann gibt es meistens, "oh ja, warum funktioniert das nicht? Ja, es ist nicht im Scope. Und das nicht? Aber wir brauchen das".[...] Die größte Herausforderung ist das Scope-Screeping, eine andere große Herausforderung gibt es nicht. Ich fürchte, ich muss das so sagen.
	P10	Die Stakeholder aus den Fachabteilungen haben dann ihre Wunschlisten erstellt, so dass es teilweise schon eine "Wünsch Dir was Liste" war. Und diese Wünsche haben sie nun formuliert.
	P11	Von nun an schickt der Kunde seine Mitarbeiter, die die dort erstellte Software nutzen müssen, ja sollten. Und sie interpretieren nun die Vorgaben zu ihrem maximalen Nutzen. [...] Das führt nun in diesem Fall also dazu, dass der Auftragnehmer gerne pleite geht, weil die Anwender dies natürlich zu ihrem maximalen Nutzen interpretieren und niemand mehr auf die Kosten schaut, ja? Es ist ein Festpreisprojekt.

Table 22

		Need for an empowered Product Owner / team
Respondents	P4	Das heißt, das Weggehen von dieser Command & Control-Struktur zur, ja, zum Enabling und Empowering des Teams und auch ein Stück weit gewisse Verantwortung abzugeben, um damit letztendlich auf die Expertise des Teams und der Einzelnen drauf zurückzugreifen. Das ist, glaube ich, ein wichtiger Punkt. Das ist-, geht oftmals-, geht oft verloren.
	P8	Aber nochmal, es ist sehr wichtig, dass der Product Owner diese große Freiheit hat. […]
	P9	Es ist nur: Ich bin [der Product Owner] in den Review-Meetings, und ich gebe eine klare Akzeptanz des aktuellen Status und eine klare Priorisierung der nächsten Aktivitäten.

Table 23

		Contract fulfilment and legal aspects
Respondents	P5	Es war eine komplette Endabnahme, bei der dann oft auch der IT-Betrieb mit einbezogen wurde. Und dann kamen neue Themen auf.
	P8	Und die Frage ist, das ist zumindest unserer Sicht hier, was man stattdessen dem Einkauf anbieten kann, damit er sagen kann, okay, ich habe hier etwas, das ich als Vertragserfüllung akzeptieren kann. Denn das ist es, was sie brauchen. Wenn sie überhaupt ein Festpreis-Kriterium haben.
	P10	Wenn Sie zu einem großen Unternehmen gehen und ein solches Festpreisprojekt machen, ist es immer so, dass die Einkaufsabteilung die Vorverhandlung, den Vertrag gemacht hat. Und manchmal habe ich immer das Gefühl, dass diejenigen, die es dann umsetzen, den Vertrag gar nicht kennen.
	P11	Im Pflichtenheft steht wischen den Zeilen ein maximaler Wunsch und im Lastenheft steht zwischen den Zeilen ein minimaler Wunsch. Das geht teilweise so weit auseinander, dass zwar ähnliche Dokumente existieren, aber trotzdem die Vorstellungen von dem, was da gemacht werden soll, sehr extrem weit auseinandergehen. Da gibt es diesen uralten Spruch: „Hundehütte oder Hochhaus – was willst du denn jetzt?“ Ja? Also im Pflichten- und Lastenheft stehen Dinge drin, die kann man sowohl als Hundehütte interpretieren als auch als Hochhaus und das geht halt signifikant auseinander.

Table 24

		Client's obligations to cooperate as part of the contract
Respondants	P1	[client's obligations to cooperate] Nun, das ist natürlich eine Veränderung, das ist interessant, genau richtig.
	P2	[client's obligations to cooperate] Rechtzeitiges Grooming. Ausreichend Tester, d.h. Personal, Räumlichkeiten, Infrastruktur...
	P3	Ohne die Verpflichtung zur Zusammenarbeit gäbe es die Mitwirkung des Auftraggebers, also die Möglichkeit des Feedbacks, nicht. […]
	P4	Bei unserem Projekt war es natürlich so im Vertrag [...]
	P5	[client's obligations to cooperate] Das ist, was wir tun.
	P6	[client's obligations to cooperate] Genau, das war Teil des Vertrages.
	P7	[…] es war auch vertraglich vereinbart worden und das war auch eine Vorbedingung von mir.
	P8	Aber nochmal, es sehr wichtig, dass der Product Owner diese große Freiheit hat.[…]
	P9	In den Verträgen, die wir für Agile Praktiken haben, auch in den Vorlagen, die wir verwenden, gibt es ausdrückliche Verpflichtungen zur Zusammenarbeit.
	P10	Das heißt - wir hatten noch nie Probleme damit, muss ich ehrlich sagen.
	P11	Einverstanden. Sicher, absolut, sie müssen reingenommen werden. In einer klassischen Umgebung muss man immer irgendwie die Auftragsgebermitwirkungspflichten beschreiben.
	P12	Natürlich sind Auftragsgebermitwirkungspflichten Teil des Vertrages.

Table 25

Content of client's obligation to cooperate		
Paraphrased statement	**Evidence found in interviews**	**Sample quote**
Empower a customer representative as Product Owner	P4, P8	Das heißt, das Weggehen von dieser Command & Control-Struktur zur, ja, zum Enabling und Empowering des Teams und auch ein Stück weit gewisse Verantwortung abzugeben, um damit letztendlich auf die Expertise des Teams und der Einzelnen drauf zurückzugreifen. Das ist, glaube ich, ein wichtiger Punkt.
Conducting an initial product vision workshop / kick off	P2, P3, P6, P8, P9, P10 , P12	Eine Produktvision ist für mich am Anfang eine Art Quality Gate. Das allererste, wir nennen es immer Sprint Zero, das allererste, was vorhanden sein muss, ist die Produktvision, wir müssen einen Fokus haben.
Conducting an initial backlog translation workshop	P2, P4, P6, P7, P8, P9, P10	Agile Projekte bedeutet immer, das Thema "Spezifikationen" gegen einen Backlog mit User-Stories aufzulösen.
Definition of ready / definition of done	P11	[it's important] wie gut die Anforderungen spezifiziert werden müssen, damit das Team sie abschätzen und umsetzen kann.
Provide protected work places	P8, P10	Wir haben nun von diesem Kunden eigene Büroräume gemietet, in denen die Mitarbeiter dieses Kunden und unsere Mitarbeiter dann solche MVPs erstellen können, aber sie befinden sich im geschützten Bereich.
Continuous delivery and acceptance	P3, P4, P5, P6, P7, P8, P9, P10, P11, P12	Wir stellen das Produktinkrement immer einen Sprint im Voraus zur Verfügung, welches dann im nächsten Review wieder gezeigt wurde, so dass der Kunde eine gewisse Zeit hat, sich das Produktinkrement genauer anzusehen, es testen zu lassen.
Presence of the customer representatives at regular meetings	P3, P7	Ohne die Teilnahme des Kunden würde es die Möglichkeit zum Feedback nicht geben.
Access to all necessary infrastructure, etc.	P2	Ausreichend Tester, d.h. Personal, Räumlichkeiten, Infrastruktur

Table 26

		Specifications must be translated into a prioritised backlog with user stories
Respondents	P2	[...] es ist sinnvoll, Zeit in Workshops zu investieren, um User-Stories zu klären
	P4	[...] Ich würde einen Workshop empfehlen.
	P6	Wir führten einen Workshop mit dem Kunden durch, um ein User Story Mapping zu erhalten, in dem wir für jeden Punkt, der im Vertrag aufgeführt wurde, gemeinsam spezifizierten, wie das Ganze aussieht, wie der Anwednungsfall aussieht, wie es gestaltet ist, welche User Stories wir haben.
	P7	Der Kunde war wirklich gut vorbereitet und hat im Vorfeld mit uns ein Pflichtenheft erarbeitet, das 300 Seiten kurz war. Es wurde jedoch in Abstimmung mit uns so geschrieben, dass es priorisiert und entsprechend den typischen Scrum User-Stories, geschrieben wurde.
	P8	Agile Projekte bedeuten immer, die Anforderungsspezifikationen und technischen Spezifikationen in ein Backlog mit User Stories zu überführen. Das heißt, wenn ich so etwas finde [schriftliches Spezifikationsdokument], dann gibt es einen ein- bis dreitägigen Workshop, bei dem die Leute, die die Anforderungsspezifikationen und die technischen Spezifikationen schreiben, den Raum nicht verlassen, bis wir all diese schrecklichen Dokumente in User-Stories umgewandelt haben.
	P9	Ein initialer Workshop ist die Voraussetzung für die Durchführung dieses Projektes. Ohne diesen machen wir es nicht.
	P10	Es gab einen solchen Workshop. Drei, sogar vier Stunden, wirklich lang. Dort wurde jede einzelne User-Story, die auch manchmal den Charakter eines Epics, also einer viel höheren Abstraktion hatte, diskutiert.

Table 27

		Continuous documented reviews and acceptance
Respondents	P3	[…] haben wir die Software kontinuierlich auch an die Key-User pro Sprint ausgerollt. Und sie testeten dann auf ihren Systeme und gaben uns das Feedback.
	P4	[…] nach dem Sprint-Review hatte der Kunde genau diesen Sprint-Offset, um Feedback zu geben. Wir haben das Feedback sortiert und dann wird an dieser Stelle das Inkrement im Prinzip akzeptiert, mit den dokumentierten Fehlern, die ggf. zu beheben sind.
	P5	Es gibt auch eine Endabnahme, die einfach die Abnahme für die Releases zusammengefasst hat.
	P6	Die Abnahme musste spätestens bei der Sprint-Review erfolgen, konnte aber auch früher erfolgen.
	P7	Wir haben gemeinsam mit dem Auftraggeber beschlossen, die Sprint-Reviews formal als Abnahme zu definieren.
	P8	[continuous acceptance at the sprint review] also haben wir bereits einen Teil dessen geliefert, was wir im Vertrag vereinbart haben.
	P9	[…] dass das Ganze dann akzeptiert wird, dass wir es vor Ort präsentieren.
	P9	Das ist auch eine der Bedingungen der Zusammenarbeit, dass in diesen Abnahmegesprächen das Ganze akzeptiert wird, dass wir vor Ort das, was wir haben, so präsentieren, wie es ist. Gern geben wir dem Kunden anschließend Gelegenheit zum Testen. […] Man baut praktisch eine Menge kleiner Module, und am Ende des Projekts baut man sie alle zusammen. Und das ist natürlich eine zusätzliche Akzeptanz.
	P10	Das Schöne am Abnahmetest ist, dass er natürlich Agil läuft, und das funktioniert super cool, denn die Aufgabe ist, dass der Product Owner nach jedem Sprint abnimmt.
	P11	[…] die Abnahme ist eine Abnahme im Sinne des Festpreises. […] wie es das Bürgerliche Gesetzbuch vorschreibt, ist dieses Abnahmeprotokoll unterzeichnet worden.
	P11	Der Product Owner akzeptiert das Produktinkrement nach jedem Sprint. Das ist eine Akzeptanz. Ehrlich gesagt: Ich bekomme keine Akzeptanz am Ende [des Projekts], aber ich bekomme im Laufe der Zeit [nach jedem Sprint] eine Menge Akzeptanzen, was es viel, viel besser macht, ja? Denn, nehmen wir an, der Kunde akzeptiert etwas nicht, dann kann das Entwicklungsteam es früher verbessern, was viel besser ist als spät im Projekt, wenn die Zeit abläuft.
	P12	[…] es gab eine kontinuierliche Abnahme am Ende jedes Sprints. Und eine Endabnahme am Ende des Projektes.

Table 28

		Documented changes to the backlog by mutual agreement
Respondents	P1	Und wenn der Scrum-Ansatz einen vertragsrelevanten Change Request erzeugt hat, dann gab es einen gebündelten Change Request, der diese Änderungen gebündelt hat, als Change Request in diesen klassischen Vertrag.
	P2	Es handelt sich also um eine Art Change Request Management oder Änderungsmanagement. Sobald Sie im Festpreis sind, brauchen Sie das.
	P3	Und der zweite wichtige Punkt ist, dass wir einen Change-Management-Prozess haben. Und wir nutzen diese Institution, um diese Änderungswünsche, die in diesem Agile Projekt ausgelöst werden, in das Festpreisprojekt einfließen lassen zu können.
	P4	Sind dies nun vielleicht Fehler oder unzureichend erfüllte Anforderungen unserer Seite oder sind dies Änderungswünsche? Wir haben das sortiert und an dieser Stelle ist das Produktinkrement mit den dokumentierten Bugs, die eventuell bezahlt werden müssen, im Prinzip akzeptiert worden.
	P5	Weil die Kunden immer wieder zu mir zurückkamen, oh, dann würde mir das und das noch gefallen.
	P6	Wenn sich also die Anforderungen ändern, dann ist das in Ordnung, und anstatt einen Change-Management-Prozess zu haben, der nur Zeit und Nerven kostet, sollte es einfach sein, über Veränderungen zu sprechen und diese zu berücksichtigen.
	P7	Es war eigentlich nur eine Abstimmung zwischen dem Kunden und mir. Tauschen wir gegen gleichwertige Anforderungen, oder muss ich zwei oder drei andere Dinge, die vielleicht nicht mehr so wichtig sind, gegen eine Anforderung, die ich akzeptieren kann, austauschen?
	P8	Das bedeutet, dass wir einen Automatismus haben, der den Änderungswunsch mit einbezieht. Lediglich das Produktbacklog musste vor und nach der Planung praktisch erfasst und dokumentiert werden.
	P9	Natürlich muss man im Vorfeld klären, was passiert, wenn ich Änderungen habe.
	P10	Die vertragliche Vereinbarung besagt, dass Sie eine User-Story jederzeit gegen eine neue austauschen können. Die einzige Voraussetzung ist, dass sie gleichwertig sein müssen.
	P11	"Money for nothing, change for free."
	P12	Es gab einen leichtgewichtigen Prozess zum Austausch von Benutzergeschichten, die in JIRA dokumentiert wurden.

Table 29

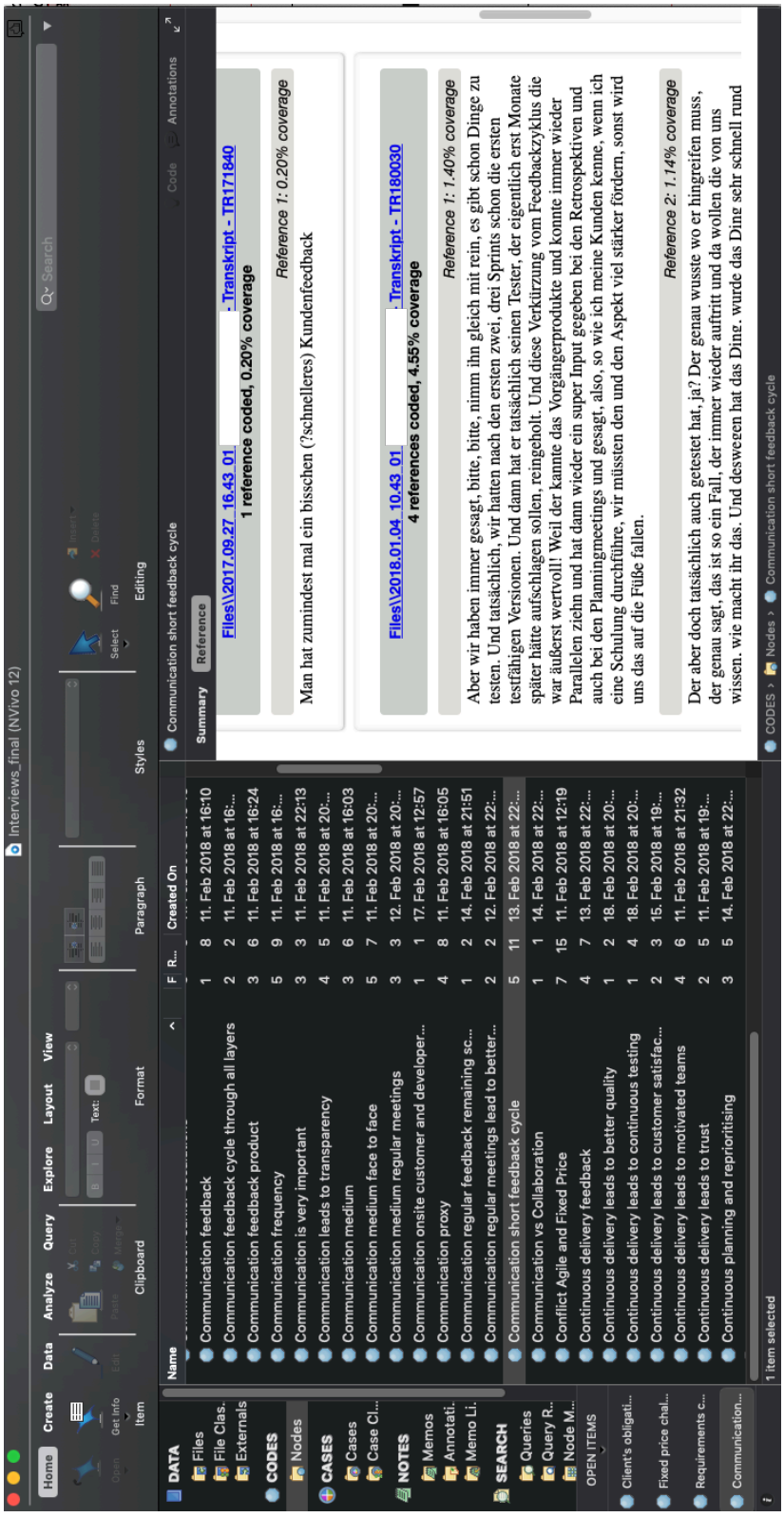
		Explicit stakeholder management
Respondents	P2	Die größte Schwierigkeit ist das Umfeld der sich ändernden Stakeholder.
	P6	Risikomanagement, Stakeholdermanagement um zu sehen, welche Schnittstellen das Team zu anderen Stakeholdern oder wem auch immer hat und, in Verbindung damit, Erwartungsmanagement. Das sind also Dinge, die ich immer machen würde.
	P7	Natürlich muss ich auch intern evaluieren, welche der Stakeholder key sind? Welche Stakeholder muss ich in das Projekt einbeziehen und wie? Welchen Stakeholder schiebe ich am liebsten ein wenig beiseite? Welche bringen Probleme mit sich?
	P8	Stakeholder Management ist definitiv wichtig, man kann viel vom traditionellen Projektmanagement übernehmen.

Table 30

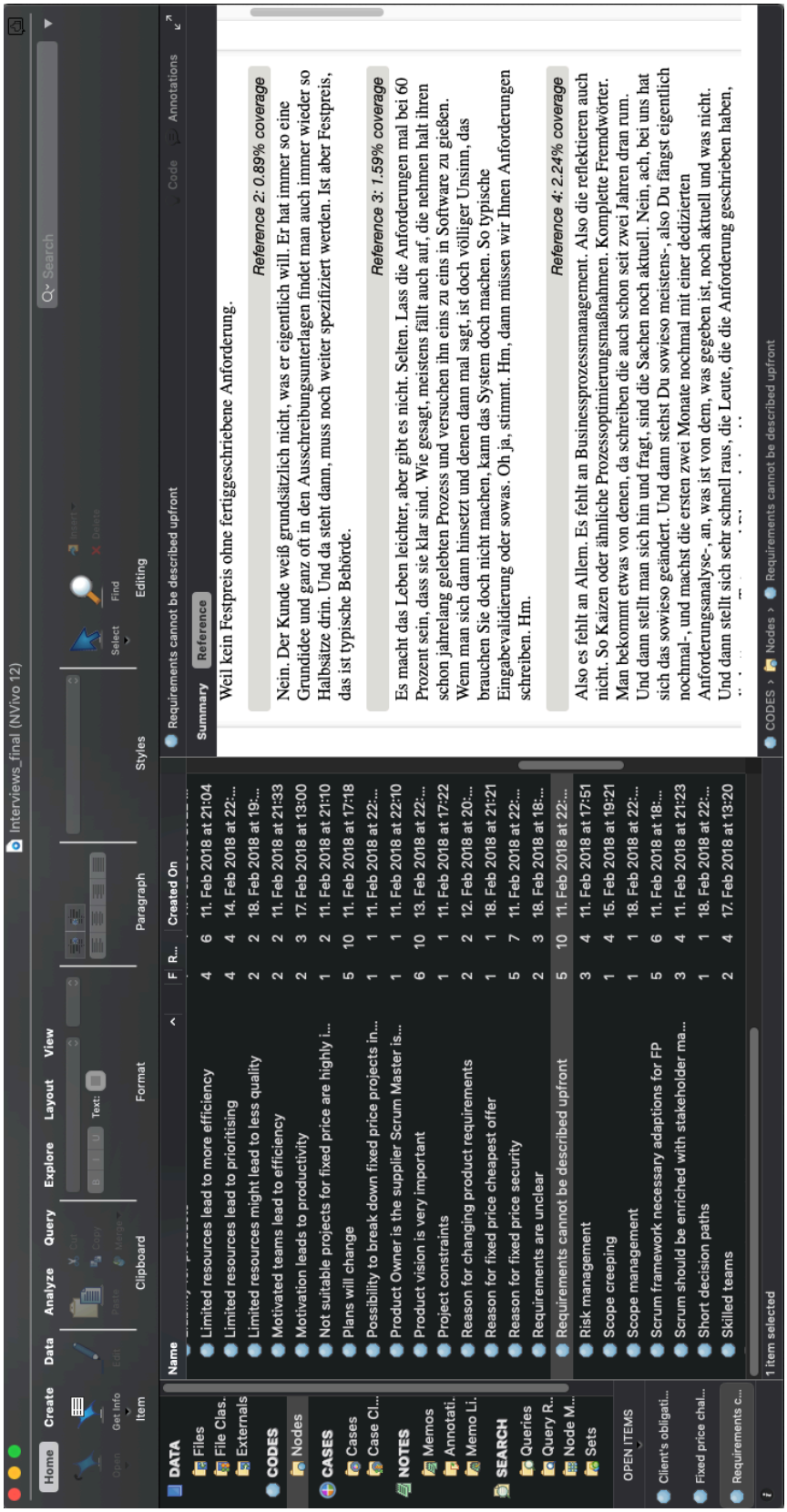
		Explicit risk management
Respondents	P1	Und ein Festpreisprojekt braucht Risikomanagement, Change Request Management, das alles brauche ich, diese bekannten Maßnahmen.
	P3	Risikomanagement ist wichtig.
	P6	Risikomanagement, Stakeholdermanagement um zu sehen, welche Schnittstellen das Team zu anderen Stakeholdern oder wem auch immer hat und, in Verbindung damit, Erwartungsmanagement. Das sind also Dinge, die ich immer machen würde.
	P7	Das ist mir wichtig, und ich denke auch, dass ein expliziteres Risikomanagement hier wichtig ist. Risikomanagement in Scrum entsteht durch die Priorisierung im Product Backlog.

Appendix H – NVivo sample codes

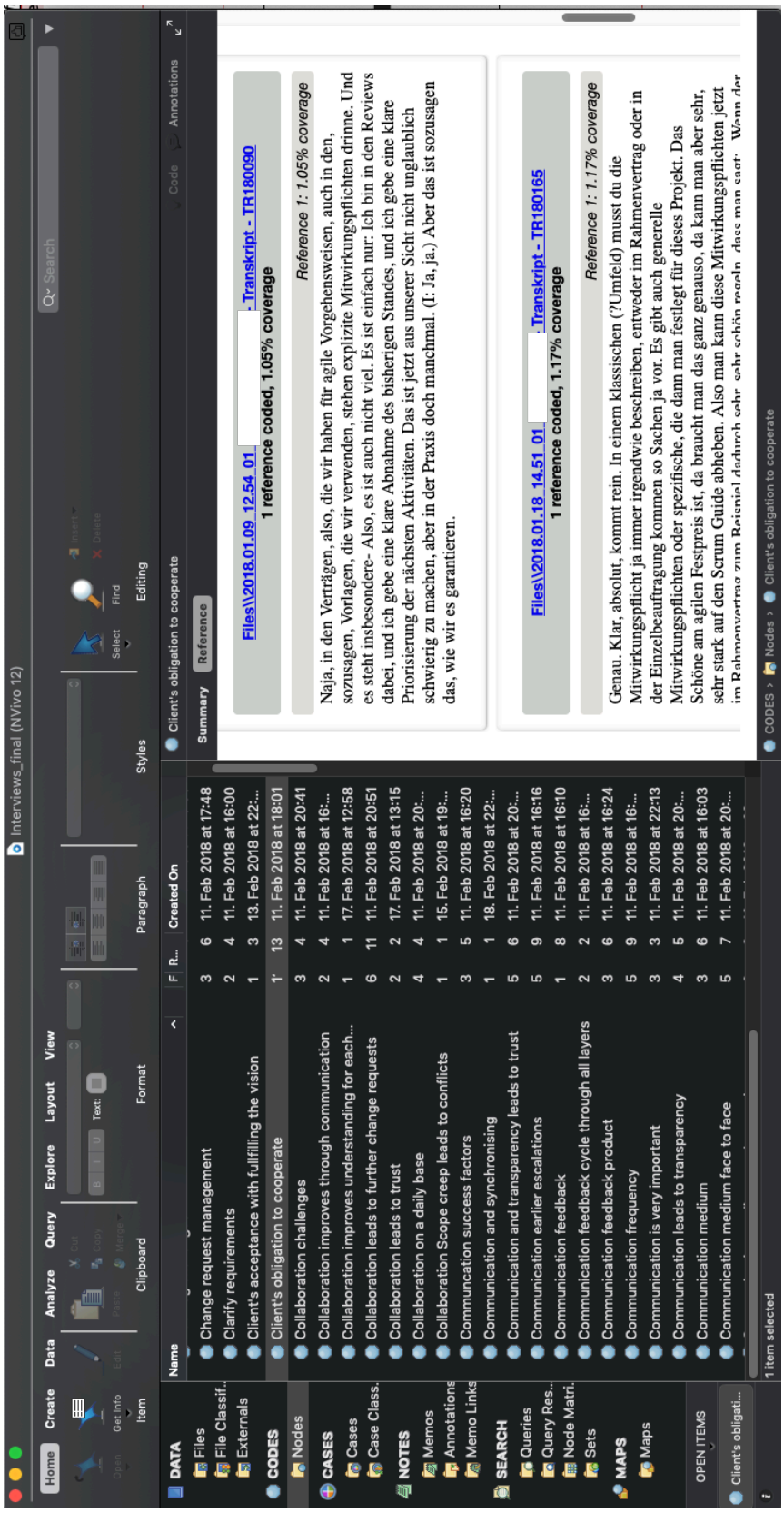
Sample code for category *"Increased common understanding of business requirements by continuous communication"* in theme *"Benefits of using Scrum in firm-fixed-price projects"* with corresponding paraphrases.



Sample code for category *"Unclear, changing or missing requirements"* in theme *"Challenges of using Scrum without modifications in firm-fixed-price projects"* with corresponding paraphrases.



Sample code for category *"Defining client's obligations"* in theme *"Recommended modifications to the Scrum framework in firm-fixed-price projects"* with corresponding paraphrases.



Appendix I – UPR 16

FORM UPR16

Research Ethics Review Checklist

Please include this completed form as an appendix to your thesis (see the Research Degrees Operational Handbook for more information

UNIVERSITY OF PORTSMOUTH

Postgraduate Research Student (PGRS) Information			**Student ID:**	753189
PGRS Name:	Daniel Georges			
Department:	BAL/OSM	**First Supervisor:**	Dr Debbie Reed	
Start Date: (or progression date for Prof Doc students)		**October 2014**		
Study Mode and Route:	Part-time ☒ Full-time ☐	MPhil ☐ PhD ☐	MD ☐ Professional Doctorate ☒	

Title of Thesis:	Transferring the benefits of Agile project management using Scrum to firm-fixed-price software projects
Thesis Word Count: (excluding ancillary data)	49,680

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:
(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: http://www.ukrio.org/what-we-do/code-of-practice-for-research/)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES ☒ NO ☐
b) Have all contributions to knowledge been acknowledged?	YES ☒ NO ☐
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES ☒ NO ☐
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES ☒ NO ☐
e) Does your research comply with all legal, ethical, and contractual requirements?	YES ☒ NO ☐

Candidate Statement:	
I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)	
Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):	E453
If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:	
Signed *(PGRS)*:	**Date:** 5th January 2020