Software Improvement Group

Radboud Universiteit Nijmegen

SOCIAL FACTORS OF AGILE DEVELOPMENT SUCCESS

The Influence of Transformational Leadership, Value Congruence, Communication, Degree of Agility and Project Size on Agile Project Success

E.C.A. van Kelle
ANR 522604

Master Thesis
Communication and Information Sciences
Specialization Business Communication and Digital Media

School of Humanities,
Tilburg University, Tilburg

Internal Supervisor: Dr. P. van der Wijst
External Supervisors: Prof. Dr. A. Plaat (UL)
Prof. Dr. Ir. J. Visser (SIG/RUN)

Second Reader: Prof. Dr. A. Plaat

November 2014

Management summary

This thesis asks the question which social factors may determine success of Agile projects, and we examine the influence of project size .

Agile Software Development is gaining considerable traction and many organizations are in search of ways to successfully scale up Agile methodologies. Prior research identified several candidate success factors in Agile Software Development, but few studies examined the role of social factors in project success. It goes without saying that software development, and especially Agile Software Development, is a team effort and quality must depend on communication-related factors. Therefore, project success might partially be attributable to factors such as leadership style, communication style and shared values. This thesis reports on research to answer this question.

Our methods of analysis include explorative qualitative research on candidate success factors, and quantitative research using data from 141 team members, Scrum Masters and product owners from 40 projects from 19 organizations. A conceptual model was developed and tested to examine the influence of five candidate success factors on Agile project success: (1) transformational leadership; (2) communication style; (3) value congruence; (4) degree of agility; and (5) project size.

We found no statistically significant relation between success and project size. Results from this research do suggest that Agile methodologies can be successfully applied in larger projects, as long as project members have shared values, and degree of agility among project members is high. In addition, a transformational leadership style positively influences project success. This implies that in Agile projects, there should be a strong focus on the alignment of values regarding the project (goals, vision, priorities, etc.). Regular informal communication, or spontaneous conversations, and maintaining a transformational leadership style can establish this alignment of values. Based on the qualitative data, degree of agility can be increased through openness, a shared mental context and clear communication about why Agile was chosen. Interestingly, size itself did not matter.

The result that Agile methods can indeed work for large project, is a surprising outcome, since Agile puts so much emphasis on small teams and short sprints. More research is needed to verify and analyse our findings.

Based on this study, managers should focus on (1) improving value congruence by stimulating informal communication and maintaining a transformational leadership style; and (2) increasing degree of agility through openness and clear communication, in order to increase Agile project success, regardless of project size.

Abstract

Agile Software Development methods are originally applied by, and considered successful for, small teams and projects, and scaling up these methods is challenging (Cao et al., 2004; Beck, 2000; Reifer, 2003; Boehm, 2002). However, larger organizations are facing the same challenges that are addressed by Agile methodologies (Cao et al., 2004). Since most projects do not fail due to technology, but due to social and organizational problems, a lack of effective communication (Eckstein, 2013) and unaligned teams (Bloch, Blumberg & Laartz, 2011), it is important to gain understanding about which social factors are of significant influence on Agile project success. Specifically, we are also interested in project success at larger scale.

The aim of this research is (1) to independently verify earlier identified success factors; and (2) to develop and validate a new, more comprehensive conceptual model by examining relationships between various candidate success factors and Agile project success. Hypotheses regarding these relationships are tested using data from 141 team members, Scrum Masters and product owners from 40 projects from 19 Dutch organizations. In this thesis, a conceptual model was developed based on existing literature and on explorative interviews that were held with practitioners involved in successful (large) Agile development projects. The model includes five candidate success factors: (1) transformational leadership; (2) communication style; (3) value congruence; (4) degree of agility; and (5) project size. Subsequently, this conceptual model was tested and refined based on the test results.

Results from regression and mediation analyses show that value congruence, degree of agility and transformational leadership were the most important predictors for project success in this model. In addition, value congruence was a mediating factor between candidate success factors and project success. Project size was not found to influence project success, suggesting Agile methodologies could be applied successfully on larger scale as long as there is high value congruence, high degree of agility and transformational leadership.

This study contributes to the empirical identification of (new) communication-related success factors in Agile Software Development, by providing a validated conceptual model. The model provides insights into which social factors contribute to Agile project success. We also find that project size does not play a role. This implies that the focus of managers should be on increasing value congruence, degree of agility and transformational leadership. The result that Agile methods can indeed work for large project, is a surprising outcome, since Agile puts so much emphasis on small teams and short sprints. More research is needed to verify and analyse our findings. Future research should be conducted on a larger scale, over a longer period of time in order to further validate the model (in other domains). In addition, future research could provide more clarification about the role of project size and complexity on project success.

Foreword

This thesis is written as completion to the master Business Communication and Digital Media at Tilburg University. In this study, we tried to provide more insights into the role of social factors in Agile Software Development, that may help enhance the success of (larger) Agile projects.

Writing my master thesis as a research intern in a challenging and professional organization, was something I have always aspired since I started my study. Writing it at the Software Improvement Group (SIG), kind of surprised me and everyone around me. SIG is an organization that focuses on IT related challenges and provides fact-based insights into current IT situations, along with recommendations on how to improve these situations. I always thought that IT was not 'my cup of tea', but having worked in an IT environment for over a year at two different organizations, my opinion changed completely. SIG gave me the opportunity to conduct a challenging, relevant and exiting research, about which I was enthusiastic right away.

SIG noticed that Agile methods were actually applied successfully in large organizations, which goes against the existing research findings. The question was raised to what extent this success could be attributed to social factors like communication, leadership and shared values. In my opinion, this combination of expertise is what made this research a success.

Since March I have been working on this research and I have experienced this period as challenging, stimulating and very pleasant. I would like to thank my supervisors from the university, Aske Plaat, for considering me for this research and introducing me at SIG, the inspiring conversations, and asking questions that made me think (and question everything I had done so far…). Per van de Wijst, for keeping me down to earth by always reminding me of the practical issues and realistic possibilities. Also, I would like to thank Joost Visser from SIG for giving me this opportunity, your critical view and stimulating me to get the best out of myself. Furthermore, I would like to thank Michiel Cuijpers and Niels van der Zwan, for acting as my additional supervisors from SIG, introducing me to your networks, and your interest in the study. I would like to thank Martijn Goudbeek for making statistics actually look like something I was able to control. With the help of them and the EQuA project, I was able to collect a great amount of participants and present this thesis which I am very pleased with. And last but not least, I want to thank my family and friends for putting things in perspective, their endless support and faith in me.

Evelyn van Kelle Tilburg, November 2014

Table of Contents

Management summary 2

Abstract 3

Foreword 4

List of tables and figures 7

1. Introduction 8

1.1 Problem statement and goal of the research 9

1.2 Approach 9

1.3 Scope of research 10

1.4 Relevance of research 11

1.5 Thesis structure 11

2. Theoretical Framework 12

2.1 Agile Software Development 12

2.1.1 Agile versus plan-driven 13

2.1.2 Characteristics of Agile 14

2.1.3 Agile Software Development in larger, complex projects 14

2.1.4 Challenges 16

2.1.5 Earlier identified success factors 17

2.1.6 Why focus on Agile Software Development? 18

2.2 Selection of factors 18

2.3 Agile project candidate success factors 19

2.3.1 Leadership Style 19

2.3.2 Communication Style 20

2.3.3 Value Congruence 21

2.3.4 Project Success 22

2.4 Hypotheses 23

3. Methods 24

3.1 Phase 1 24

3.1.1 Study Design of phase 1 24

3.1.2 Data Collection 25

3.1.3 Procedures 25

3.1.4 Participants 26

3.1.5 Measures 26

3.1.6 Data Analysis 27

3.1.7 Results 29

3.2 Phase 2 33

3.2.1 Study Design of phase 2 ... 33
3.2.2 Data Collection ... 34
3.2.3 Procedures ... 35
3.2.4 Participants ... 35
3.2.5 Measures ... 37
3.2.6 Data Analysis ... 39
4. Results ... 41
4.1 Candidate success factors as predictors of project success ... 41
4.1.1 Individual level ... 41
4.1.2 Project level ... 45
4.2 Different perspectives on project success ... 47
4.3 The mediating effect of value congruence ... 47
4.3.1 Individual level ... 47
4.3.2 Project level ... 50
4.4 Chapter Conclusions ... 52
4.4.1 Candidate success factors as predictors for project success ... 52
4.4.2 The mediating effect of value congruence ... 52
5. Discussion and Future Research ... 54
5.1 Discussion ... 54
5.2 Limitations and Future Research ... 57
6. Conclusion ... 60
References ... 61
Appendix A: Scaled Agile Framework (SAFe). ... 67
Appendix B: Distilled summaries of the explorative interviews. ... 68
A) General information about projects ... 68
***B)* Agile and Leadership** ... 68
***C)* Agile and Communication** ... 69
Appendix C: Questionnaire for Team Members. ... 72
Appendix D: Questionnaire for Scrum Masters. ... 79
Appendix E: Questionnaire for Product Owners. ... 85
Appendix F: Model 1, Regression analysis individual level. ... 88
Appendix G: Model 2, Regression analysis individual level. ... 88
Appendix H: Model 3, Regression analysis project level. ... 89
Appendix I: Model 3, Revised conceptual model on the individual level. ... 90
Appendix J: Model 3, Revised conceptual model on project level. ... 91

List of tables and figures

Tables

Table 1	Agile Project Candidate Success Factors	12
Table 2	Characteristics of Agile methodologies	14
Table 3	Key agents in Agile methodologies that are included in this study	15
Table 4	Different parts of the explorative interviews	25
Table 5	Most common responses per interview part	28
Table 6	Structure of the present research	32
Table 7	Sources of Agile project success measures	37
Table 8	Means, standard deviations, and reliabilities of the variables	40
Table 9	Pearson correlations between candidate success factors and project success on individual level	42
Table 10	Summary of separate regression analyses for variables influencing project success (bivariate correlations)	43
Table 11	Model 1 regression analysis, evaluation of Scrum Masters included	44
Table 12	Model 2 regression analysis, evaluation of team members included	44
Table 13	Pearson correlations between candidate success factors and project success on project level	45
Table 14	Model 3 regression analysis on project level	47

Figures

Figure 1	Conceptual Model of Agile project success and five main influencing or mediating factors	10
Figure 2	Overview of participant distribution	36
Figure 3	Overview of project distribution	36
Figure 4	Mediation model 1	48
Figure 5	Mediation model 2	49
Figure 6	Mediation model 3	50
Figure 7	Mediation model 4	51
Figure 8	Mediation model 5	51

1. Introduction

Organizations are facing constantly evolving environments and changing requirements of customers. (Nerur, Mahapatra & Mangalaraj, 2005). This change requires new software development methods that enable flexibility and adaptability in order to comply with the often-changing requirements of customers. Traditional, plan-based methodologies are no longer best suited in most of these changing environments. This need for flexibility and adaptability led to the growing popularity of Agile methodologies (Nerur et al., 2005). Agile Software Development is a group of software development methods that promote adaptive planning, self-organizing teams, rapid and frequent delivery, and client focus. Agile methodologies encourage continuous improvement and rapid, adequate response to change. These changing requirements do not only concern small organizations and projects, but larger organizations and projects as well. This seems logical, since large organizations are facing the same issues addressed in Agile methodologies (Cao, Mohan, Xu & Ramesh, 2004). However, Agile methodologies were originally designed for, and considered successful, for small teams and projects, which makes it not obvious that larger, complex projects and organizations may successfully apply Agile methods (Cao et al., 2004; Kettunen & Laanti, 2007; Beck, 2000; Reifer, 2003; Boehm, 2002). Three of the most important challenges in scaling up Agile methods are communication barriers, changing leadership requirements (Reifer et al., 2003; Kahkonen, 2004; Curtis, Krasner & Iscoe, 1988; Eckstein, 2013; Lindvall et al., 2002; Pikkarainen, Haikara, Salo, Abrahamson & Still, 2008) and ineffective, unaligned teams (Bloch et al., 2011).

Reported statistics by The Standish Group (2009) showed that 24% of information system development projects fail outright, and 32% show a low success rate. In addition, research from 2010 and 2013 suggests that Agile methods are more effective than traditional, plan-based methods in both small and large teams[1,2]. It is argued that most of these projects do not fail due to technology, but due to social and organizational deficits, and a lack of effective communication (Eckstein, 2013). Furthermore, larger projects are more likely to fail than small projects (Jehn, 1995; Jones, 1995). Since Agile methods strongly focus on people and interactions, it is likely that communication- and leadership style are important candidate success factors in Agile project success. These assumptions may especially hold in larger projects, since these factors become even more important when scaling up Agile methodologies. Therefore, it is important to gain more understanding about the relative importance of these candidate success factors.

In this study, we will assess the role of communication- and leadership-related factors in Agile project success. Furthermore, we will examine whether these candidate success factors are of greater influence in larger, complex projects and organizations. We will propose a conceptual model based on

[1] http://www.agilemodeling.com/essays/proof.html
[2] http://www.ambysoft.com/surveys/success2013.html

interviews with best practices and existing literature. Subsequently, this model will be tested quantitatively, in order to determine the relative importance of each candidate success factor in Agile project success.

1.1 Problem statement and goal of the research

The purpose of this study is to examine whether communication style, leadership style, value congruence and degree of agility are factors in successfully applying Agile methods in complex, larger projects. It is relevant and important to gain more understanding about these factors, since most projects do not fail due to technology, but due to social and organizational deficits, and a lack of effective communication (Eckstein, 2013). Gaining more insights into these 'people factors' provides more understanding about Agile project success. The focus of this study is not on development teams solely, but on Scrum Masters and product owners as well. The Scrum Master facilitates team interactions, meetings, and supports the development team so that it is fully functional and productive. The product owner is responsible for defining and prioritizing requirements. To test if the following assumptions hold, the problem statement of this research is, therefore:

Leadership style, communication style, value congruence and degree of agility are significant success factors in complex, larger Agile development projects.

Based on the goal of the study, we arrive at 2 research questions:

1. *Are leadership style, communication style, value congruence and degree of agility related to Agile project success, and if so, how?*
2. *What is the role of project size in this possible relationship?*

1.2 Approach

In order to answer these research questions, we conducted the study in two phases. Little is known about the specific roles of communication, leadership and value congruence in Agile Software Development in the existing literature. Therefore, we started with an explorative, qualitative phase. In this phase, interviews were conducted with practitioners involved in successful Agile development projects in order to explore candidate success factors regarding communication and leadership. Based on existing literature and the explorative interviews, a conceptual model was developed (figure 1). The proposed conceptual model includes the following five candidate success factors: *(1) leadership style (transformational versus transactional), (2) communication style (informal versus formal), (3) the degree of value congruence (mediator), (4) degree of agility* and (5) *project size* (total number of project members) and complexity (number of interdependencies).

In the second, quantitative phase, the relative importance of each candidate success factor was determined using statistical methods. In total, 40 Agile projects, divided over 19 different Dutch organizations, participated in the study by filling out an online questionnaire that assessed the candidate success factors. Of each Agile project, at least one member of the development team, a Scrum Master, and a product owner were asked to fill out the questionnaire. We then (1) statistically analysed the relationships between candidate success factors and project success (2) examined the mediating effect of value congruence, and (3) refined the conceptual model.

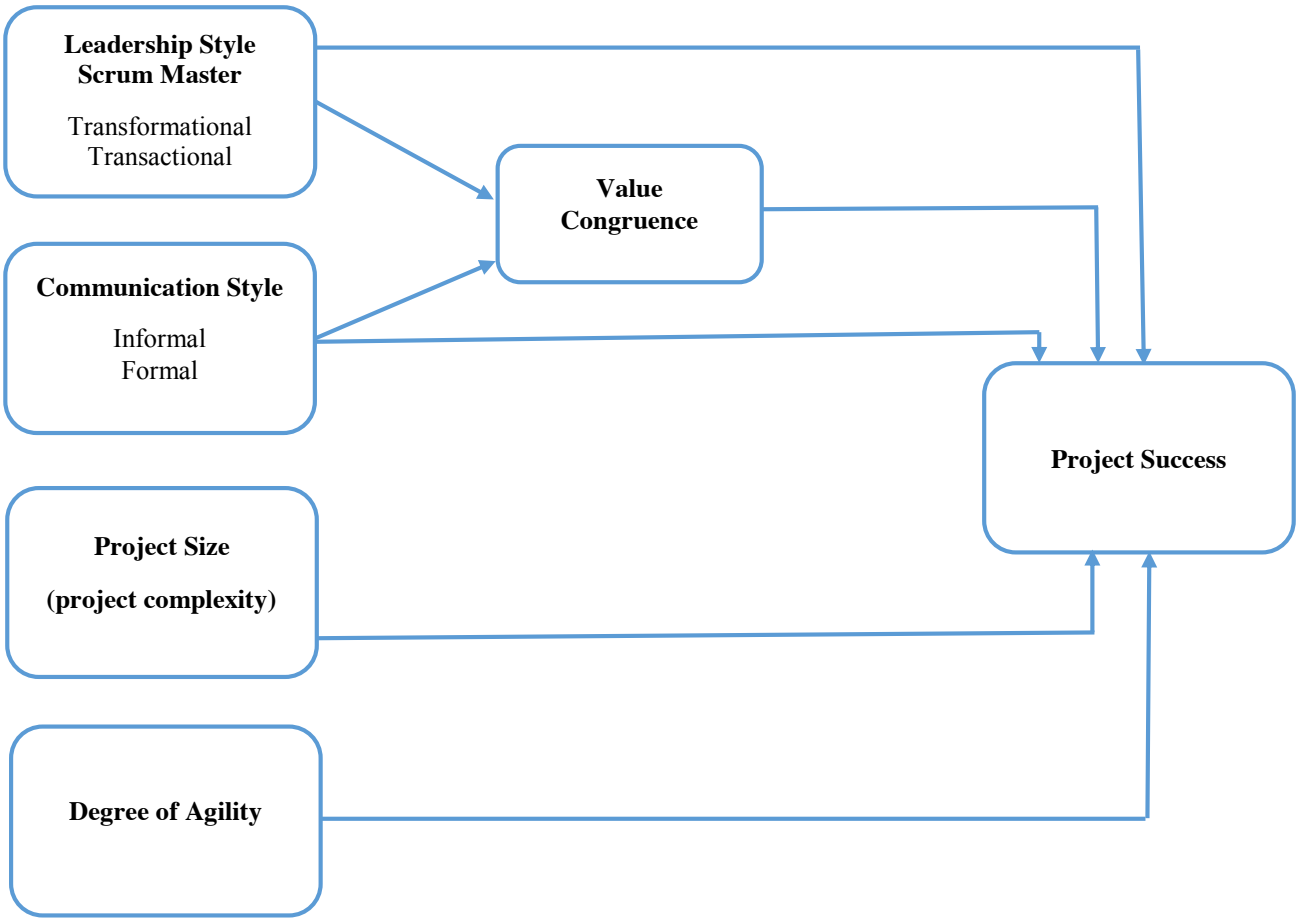


Figure 1: Conceptual Model of Agile project success and five main influencing or mediating factors.

1.3 Scope of research

This study focuses on leadership- and communication style, value congruence and degree of agility among team members and Scrum Masters of ongoing or concluded Agile projects. From the literature it is suggested that communication and leadership are of major importance in project success. We strived for an objective evaluation of project success by asking team members, Scrum Master and product owners to indicate project success. These three roles were included in the scope of the research, since they allow for the inclusion of different key perspectives on the proposed candidate success factors.

Other roles, such as project sponsors, end users and operational support staff were not included, since we believe that first it is important to examine key roles that work together closely and are more interdependent. Due to their intense collaboration, we expect that communication, leadership style and value congruence are of greater influence among team members, Scrum Masters and product owners.

1.4 Relevance of research

The expected contributions of this research are as follows: (1) we independently verify some of the identified Agile project success factors; (2) we develop a new, more comprehensive, conceptual model regarding candidate success factors in Agile Software Development; and (3) we validate this model by examining relationships between these various factors and Agile project success. In terms of theoretical relevance, this study will contribute to the existing literature on leadership, by providing insights in which leadership style is most suitable in complex, changing environments such as Agile Software Development. Furthermore, the study can reduce existing research gaps on (social) success factors in Agile Software Development.

The results of this research will have several practical implications as well. If we can identify which factors contribute to Agile project success, Agile project teams and their managers will be able to take these results into account which allows them to influence project success from the beginning of their project. Furthermore, if we can identify whether these factors are of equal, or greater importance in larger, more complex projects, the results will be beneficial for larger organizations as well. This is especially important since larger projects more often result in failure than success, due to communication barriers (Eckstein, 2013).

1.5 Thesis structure

The rest of this thesis is structured as follows. In section 2, a theoretical framework will be provided in which we will elaborate on Agile Software Development, and the included candidate success factors will be discussed and motivated. In section 3, the research methods we used to develop and test the conceptual model will be described per phase. The results of the study will be presented in section 4. In section 5, these results will be discussed, along with implications and limitations of the study. This section will be concluded with suggestions for future research. Section 6 will provide the conclusions of this study.

2. Theoretical Framework

In this chapter, a theoretical framework will be provided in which we elaborate on definitions of measured factors and their relation or contribution to Agile project success. First, Agile Software Development will be discussed. A description will be provided, and we will discuss why this research focuses specifically on Agile methods, what differences exist with traditional, plan-driven methods, how these methods are related to larger, more complex projects, and which earlier identified success factors in Agile are known along with existing research gaps. Second, the selection of factors for this study will be further discussed. Factors that can contribute to Agile project success (table 1) will be discussed and motivated, based on existing literature. Based on this theoretical framework, hypotheses will be developed which will be discussed and motivated.

Table 1

Agile Project Success Candidate Success Factors

Leadership Style	The leadership style of Scrum Masters fits the flexible character of the Agile method. A distinction is made between transformational and transactional leadership.
Communication Style	There is frequent, sufficient, spontaneous informal face-to-face contact.
Value Congruence	Project members have similar (work) values and goals.
Degree of Agility	The degree to which people believe they are working Agile.
Project Size	The total number of project members working on the project.
Project Success	The degree to which a project is concluded in a satisfying way, expected quality is achieved, and tasks were carried out as efficiently and as quickly as possible.

2.1 Agile Software Development

Before elaborating on possible success factors that can contribute to Agile project success, a description is needed of Agile Software Development. Furthermore, we will discuss the differences between Agile methods and traditional methods. Based on these differences, we will elaborate on Agile methods and plan-driven methods in relation to larger (more complex) projects. Below, a description based on existing literature and the Agile manifesto[3] (Beck et al., 2001) is provided, that allows for success factors being related to Agile project success.

[3] Agile manifesto. *Online at http://www.agilemanifesto.org*.

2.1.1 Agile versus plan-driven

For the past several years, Agile Software Development (ASD) is being used as a label for certain methods to improve software development by delivering faster, better and cheaper solutions (Dybå & Dingsøyr, 2008). This Agile movement propose an alternative to traditional project management, which is plan-based and emphasizes a "rationalized, engineering-based approach" (Dybå, 2000; Nerur et al., 2005). Traditional project management suggests, in contrast to Agile methods, that "problems can be specified and that optimal and predictable solutions exist for every problem" (Dybå, 2000; Nerur et al., 2005). Consequently, traditional project management relies heavily on extensive planning, document-driven communication and codified processes (Boehm, 2002; Hummel, Rosenkranz & Holten, 2013). Agile methods, by contrast, embrace the unpredictable character of software development, and accept that it is creative, and relies on individual human beings (Dybå & Dingsøyr, 2008; Baumeister, 2004).

Working Agile presumes a flexible and adaptive style, that enables readiness to "create change, proactively or reactively embrace change, and learn from change" (Hummel et al., 2013). Agile methods enable this flexibility and ability to react by working iteratively: an approach to building software in which the overall lifecycle of a project consists of several iterations, or sprints, that last for a determined period of time (Larman, 2004). At the end of an iteration, there is a release in which a working, tested and stable deliverable is released (Larman, 2004). In ASD, these sprints often last for two weeks, and can be considered separate mini-projects with similar stages and accompanying results. Hence, it is likely that Agile methods, due to their flexible character, can contribute to, or enhance project success.

In 2001, the 'Manifesto for Agile Software Development' (Beck et al., 2001) was written by seventeen independent practitioners of several programming methodologies. These methodologies had several things in common, and from then, these were labelled as 'Agile methodologies'. There are four principles underlying these Agile methodologies. These methods value:

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

According to the Agile principles, software development cannot be considered a defined process and (responding to) change is an essential factor (Cockburn & Williams, 2009). Working in short iterations allows for shorter feedback loops and therefore handling unpredictable and changing requirements (Cockburn & Williams, 2003; Schwaber & Beedle, 2002; Petersen, 2010). These Agile methodologies have gained considerable traction and have been studied empirically as well. However, many questions remain about successfully applying Agile methods, specifically in larger, more complex projects.

2.1.2 Characteristics of Agile

Agile methods are characterized by several key characteristics and roles. In table 2, a summary is provided of these key characteristics, based on existing literature (Lindvall et al., 2002; Miller, 2001; Nerur & Balijepally, 2007). In table 3, key agents within Agile methodologies are described. Only relevant roles that were included in this study are discussed.

Table 2

Characteristics of Agile methodologies.

Iterative	Focus on short cycles (iterations/sprints), in which working software is delivered at the end of an iteration. In one iteration, one priority (or activity) is being worked on.
Time bound	Iterations are scheduled according to time limits. Each iteration lasts for between one and six weeks. These time limits allow for a clear planning of projects.
Adaptive	Agile methods allow for responding to change. Due to the iterations, required changes can be met, allowing for quality to improve.
Incremental	An entire system is not built at once, but through increments that may be developed in parallel, at different times. Increments are integrated into the system once they are tested in isolation.
Cross-functional, self-organizing teams	Teams consist of members that perform all defined roles, and rotation from roles is common. The team has the autonomy to organize itself in order to best complete tasks.
People-oriented and collaborative	People are valued over processes and technology, and communication is crucial for effective collaboration.
Managers are facilitators	Managers are facilitators rather than controllers. They enable teams to complete tasks by facilitating, coaching and motivating.

2.1.3 Agile Software Development in larger, complex projects

Agile methodologies are originally designed for, and are considered beneficial for small teams and projects, and scaling up these methodologies is therefore considered challenging (Cao et al., 2004; Kettunen & Laanti, 2007; Beck, 2000; Reifer, 2003; Boehm, 2002). However, larger organizations and projects are facing the same issues addressed by Agile methods, and are struggling with changing environments, changing user requirements and time pressure too (Cao et al., 2004). A method that could

be of help when implementing Agile practices at enterprise scale is SAFe (Scaled Agile Framework)[4]. This framework is illustrated in a graphic that highlights different roles, teams, activities and artifacts that are necessary to scale Agile practices. In appendix A, this framework is presented. Adopting Agile methods within larger, more complex organizations or projects is especially difficult since large IT projects seem to fail more often than small ones (Bloch, Blumberg & Laartz, 2011). This higher failure rate in larger IT projects can partially be attributed to a lack of effective teams and unaligned teams (Bloch et al., 2011). Therefore, we argue that communication style, leadership style and value congruence could be candidate success factors in successfully applying Agile methods within both small and large, complex projects.

Table 3

Key agents in Agile methodologies that are included in this study

Product owner	Responsible for defining and prioritizing requirements, and making decisions about what the product does and does not include.
Scrum Master	Facilitates team interactions, meetings, and supports the development team so that it is fully functional and productive. It is a facilitating, rather than a controlling role.
Team members	Team members include individuals that are part of the development team, and are responsible for developing working software. They include mostly developers, testers, programmers and writers.

Failure is more common in larger IT projects (Bloch et al., 2011), which might be due to the more common use of traditional, plan-driven methods that are often considered more suitable in larger projects (Boehm & Turner, 2003). Based on this more frequent failure and the finding that large, complex projects and organizations face the same issues as small projects and organizations, it seems logical that applying Agile methods in larger projects is gaining traction and popularity. In these larger-scale projects, the original assumptions of the Agile methods and principles do not necessarily hold (Kettunen & Laanti, 2008), and cannot be directly adopted (Cao et al., 2004). However, there is some agreement on how Agile methodologies and elements from plan-driven approaches are compatible (Reifer et al., 2003), which can result in an increase of agility in larger projects or organizations.

Scaling up Agile methods might be more challenging due to complexity rather than size. Related challenges that arise as a result of scaling up Agile concern communication barriers (Reifer et al., 2003; Kahkonen, 2004; Curtis et al., 1988; Eckstein, 2013; Lindvall et al., 2002; Pikkarainen et al., 2008), motivation of developers (Cao et al., 2004), and ineffective, unaligned teams (Bloch et al., 2011) which stresses the importance of motivational leadership. Literature suggests that scaling up Agile becomes

[4] Scaledagileframework.com

even more challenging when teams are interdependent and connected to other parts of the organization, or even parts outside the business unit (Kettunen & Laanti, 2008; Cao et al., 2004; Kahkonen, 2004), since it becomes harder to comply with the Agile principles when scaling up Agile. Hence, the high degree of interdependence among teams in larger projects might be more challenging than the number of teams or team members. Therefore, we chose to use both the terms 'complex projects' and 'large projects' in this study, referring to both high degrees of interdependence and large team- and project size. There are some methods known for dealing with this complexity and thereby scaling up Agile methods, which mostly revolve around division of teams, which minimizes interdependence. These methods include co-location of related developers and teams (Waters & Bevan, 2005), Scrum of Scrums (McMahon, 2005), and communities of practice (Kahkonen, 2004). All methods have shown to be effective in scaling up Agile, by, for example, increasing communication effectiveness.

2.1.4 Challenges

Migrating to Agile methods often involves severe challenges. Since there is no long-term planning in iterative methods like ASD, and project members should be able to react to changing requirements, there is a risk at 'chaos'. Furthermore, most organizations are steeped in traditional methods, which gives rise to several challenges in migrating to Agile methods (Nerur et al., 2005). Replacing current methodologies and tools with new ones is not enough to accomplish changes in software development processes (Sircar, Nerur & Mahapatra, 2001). It requires changes in organizational structure, culture and management practices as well (Cockburn & Williams, 2003; Lindvall et al., 2002). Working in iterations can help prevent 'chaos', by setting clear boundaries about what request, or priority, is being dealt with during one iteration (Larman, 2004). It is also likely that working in iterations reduces uncertainty, which can enhance project success, especially on a larger scale (Zmud, 1980). Hence, prioritizing is crucial in Agile methods. These priorities are set at the beginning of a project, and documented in what some Agile methods call a 'product backlog'. Priorities can be adjusted based on previous iterations, but one iteration addresses one priority at a time. Additional changes are addressed in following iterations. Setting priorities involves all project members: product owners/sponsors usually determine *what* the priorities are, whereas Scrum Masters determine the *how* of priorities (in what order they are handled and how it will be done). Iterations and prioritizing are therefore considered important in overcoming challenges that occur when migrating to Agile.

This shift from traditional project management to Agile methods suggests several differences and challenges regarding communication related issues as well. An important aspect of ASD is the use of human- and communication-oriented rules (Cockburn, 2000), and people and interactions are considered more important than processes and tools[5] (Beck et al., 2001). Therefore, it seems legitimate and logical that this shift is being accompanied by a changing communication paradigm (Hummel et al.,

[5] Agile manifesto. *Online at http://www.agilemanifesto.org*.

2013). This changing communication paradigm is likely to focus more on, and enable more informal, spontaneous face-to-face communication and interpersonal interaction. The importance of communication within ASD is acknowledged (e.g. Mackenzie & Monk, 2004; Robinson & Sharp, 2004; Liang, Wu, Jiang & Klein, 2012), but relatively little is known about how informal communication can contribute to project success.

In addition, changes in requested leadership style are likely to be involved in this shift from traditional project management to Agile methods. The focus on people and interaction suggests that interpersonal relationships between project members, and thus project leaders, are becoming more important (e.g. Boyd & Taylor, 1998; Nerur et al., 2005; Nohria & Ghoshal, 1994; Jehn, 1994), and that a leadership-collaboration style is preferred over a command-control management style (Cockburn & Highsmith, 2001; Dyba & Dingsøyr, 2008). This shift can lead to several challenges. Leaders are required to adapt their leadership style in order to enhance effective and aligned teams, but no conclusive results are known about which specific leadership style is most suitable in ASD. This research attempts to clarify these changing requirements.

2.1.5 Earlier identified success factors

Earlier identified success factors are often divided in organizational factors and people factors (Misra, Kumar & Kumar, 2006; Misra, Kumar & Kumar, 2009; Cockburn & Highsmith, 2001; Boehm & Turner, 2003). Identified organizational success factors include customer commitment, decision time, corporate culture and planning and control. Identified people success factors include competency, personal characteristics (honesty, collaborative attitude, sense of responsibility and readiness to learn), good interpersonal and communication skills, effective communication and appropriate management (Misra et al., 2009; Lindvall et al., 2002; Cockburn & Highsmith, 2001; Turner & Boehm, 2003; Ambler, 2005; Melnik & Maurer, 2004; Pikkarainen et al., 2008).

The importance of (informal, face-to-face) communication in ASD is being acknowledged (Mackenzie & Monk, 2004; Cockburn & Highsmith, 2001; Boehm & Turner, 2003; Lindvall et al., 2002), but relatively little is known about how communication style can contribute to project success. Since complex projects are often accompanied by communication barriers and are likely to fail due to a lack of effective communication (Reifer et al., 2003; Kahkonen, 2004; Curtis et al., 1988; Eckstein, 2013; Lindvall et al., 2002; Pikkarainen et al., 2008), more insight is needed into how communication style can enhance project success. In terms of leadership, it is acknowledged that a leadership-collaboration style is more effective in ASD than command-control management (e.g. Cockburn & Highsmith, 2001), but there is no conclusive evidence on which specific leadership style is most suitable in ASD. We argue that Agile projects can be considered complex projects, and therefore a transformational leadership style is probably most effective (Dulewicz & Higgs, 2003). In order to further explore this specific relationship, additional research is required. Last, it is expected that value congruence enhances Agile project success: communication and leadership style can create and enhance

shared values among project members and therefore enhance interpersonal relationships and project success (Nohria & Ghoshal, 1994; Jehn, 1994; Jehn et al., 1999; Nerur et al., 2005; Lindvall et al., 2002; Müller, 2003; Henttonen & Blomqvist, 2005). It seems reasonable, thus, that value congruence is a mediating factor between leadership style and project success, and between communication style and project success.

2.1.6 Why focus on Agile Software Development?

ASD has gained considerable traction and is becoming more popular. Success rates suggest that Agile methods are more effective than traditional methods such as the waterfall model[6]: The waterfall model is, in contrast to Agile, a linear model of software development which employs a sequential development process, based on extensive planning and documentation. According to survey results from 2013, perceived project success is rated higher when Agile methods, rather than traditional methods, are being applied. Though the difference is small, a 2010 survey suggests that Agile methods are more effective than traditional methods in medium and large teams as well[7]. In addition, empirical research suggests that ASD can lead to an improvement of management of the development process as well as the relationships with customers (Ceschi et al., 2005), an increase of productivity in Agile teams in comparison to teams using traditional development methods (Dalcher et al., 2005; Ilieva et al., 2004; Layman et al, 2004), product quality improvement (Layman et al, 2004; Ilieva et al., 2004; Dalcher et al., 2005), and job satisfaction (Mannaro et al., 2004). Little is known, however, about how leadership style, communication style and value congruence contribute to this success of ASD. This study aims to provide more insight into these remaining questions.

Research gaps exist regarding so called 'people factors' such as communication, leadership style and value congruence (Misra et al., 2009; Lindvall et al., 2002; Cockburn & Highsmith, 2001; Turner & Boehm, 2003; Ambler, 2005; Melnik & Maurer, 2004; Pikkarainen et al., 2008). More understanding in candidate success factors can contribute to explaining or even predicting Agile project success, since these factors seem to be important during entire projects. Another remaining research gap concerns communication *around* Agile teams. Prior research focused on communication within development teams (Chow & Coa, 2008; Lindvall et al., 2004; Robinson & Sharp, 2004; Robinson & Sharp, 2005), but different layers, or roles, around these teams are rarely taken into account. Moreover, these candidate success factors may enhance project success within larger, more complex projects.

2.2 Selection of factors

We chose the earlier identified people success factors in ASD (Misra et al., 2009; Lindvall et al., 2002; Cockburn & Highsmith, 2001; Turner & Boehm, 2003; Ambler, 2005; Melnik & Maurer, 2004;

[6] http://www.ambysoft.com/surveys/success2013.html
[7] http://www.agilemodeling.com/essays/proof.htm

Pikkarainen et al., 2008) as the basis for this study, since we consider them crucial in both complex and small Agile projects. There are several questions remaining, however, about how these factors specifically operate in ASD.

First, we expect that leadership style becomes even more important in complex Agile projects (Reifer et al., 2003; Anantatmula, 2010), since ASD requires an adaptive, motivational leadership style in order to establish effective and aligned teams. No conclusive results are known, however, about which leadership style is most suitable in Agile projects. Second, communication is considered crucial in Agile projects, since it is one of the underlying principles of ASD. In ASD, adequately responding to change is essential, which makes effective communication crucial. However, relatively little is known about how communication *style*, rather than communication *frequency*, is of influence in Agile project success. Specifically, we believe that the difference between formal and informal communication within Agile projects can be of great importance. Third, we argue that value congruence is of significant importance in Agile project success, since aligned teams are considered more effective (Bloch et al., 20110. We expect that value congruence influences Agile project success directly, and that value congruence is a mediating factor between communication style and leadership style on the one hand, and project success on the other. In the next section, we will further discuss these different factors. Each factor will be discussed and related to Agile project success, and we will explain why we chose to include these factors in the study. We will only discuss leadership style, communication style, value congruence and project success, since these were included in the original set of candidate success factors. Degree of agility and project size were included after the explorative interviews, and therefore not discussed in the next section.

2.3 Agile project candidate success factors

2.3.1 Leadership Style

It is argued that a leadership-collaboration style is more suitable in ASD than command-control management style (Cockburn & Highsmith, 2001; Dyba et al., 2008). In addition, research suggests that complex projects require a different leadership style than simpler projects (Dulewicz & Higgs, 2003), and that leadership becomes more important in these complex (Agile) projects (Reifer et al., 2003; Anantatmula, 2010). Due to the emphasis on people and interactions over technology and tools in ASD, and the idea that leadership style should match a project type (Muller & Turner, 2007), it seems logical that leadership style of Scrum Masters should revolve around people and interactions as well. According to the existing literature, good Agile leadership concerns motivating people, facilitating and focussing on the process, rather than on the content (Highsmith, 2003; Medinilla, 2012; Cockburn & Highsmith, 2001). Moreover, a motivational, coaching, facilitating leader can enhance Agile project success (Highsmith, 2003; Medinilla, 2012; Cockburn & Highsmith, 2001).

An often mentioned, relevant distinction in leadership style is that between transformational and transactional leadership (Bass, 1985; Bass & Aviolo, 1998). Bass (1985) used the label 'transformational leadership' for a type of adaptive leadership style that was required in rapidly changing environments. This adaptive style allows leaders to effectively respond to change, while motivating and working with their followers in order to generate creative solutions to complex problems (Bennis, 2001). Transformational leadership revolves around expressing visions and engaging the emotional involvement of followers (Bass, 1985; Jung & Avolio, 2000). Furthermore, transformational leadership is likely to establish higher levels of motivation and contribute to followers going beyond expectations (Bass, 1985). Transactional leadership, on the other hand, revolves around a social transaction in which leaders clearly state what is being expected and what followers can expect in return (Bass, 1985).

Prior research on leadership mainly focused on the distinction between directive (task-oriented) and participative (people-oriented) leadership (Bass & Riggio, 2012). Note that transformational and transactional leadership, in contrast, is not an either-or proposition, but rather complementary (Bass, 1985). The strength of this distinction is the nuance: transformational leadership can be both directive and participative (Bass & Riggio, 2012). Bass (1985) recognized that both styles could contribute to the achievement of desired goals, and considered transformational leadership complementary to transactional leadership. Meta-analyses confirmed the positive relation between transformational leadership and performance. Research suggests, that transactional leaders are effective in stable, predictable environments, whereas transformational leaders are more effective in complex, turbulent environments, such as Agile projects (Bass 1985; Dulewicz & Higgs, 2003). Since the similarities between the principles of ASD and the assumptions of transformational leadership, we argue that in Agile projects, transformational leadership is more suitable than transactional leadership.

2.3.2 Communication Style

Communication is being acknowledged as a crucial factor in project success in general (Cartwright & Zander, 1968; Shaw, 1981; Katz & Allen, 1998), as well as in ASD (Mackenzie & Monk, 2004; Boehm & Turner, 2003; Melnik & Maurer, 2004; Martin, 2000; Pikkarainen et al., 2008; Liang, Wu, Jiang & Klein, 2012). This aligns with the emphasis on people and interaction over processes and tools, as stated in the Agile Manifesto. Agile methodologies, therefore, are accompanied by a changing communication paradigm, in which there is more focus on interpersonal, informal face-to-face communication (Hummel et al., 2013). As mentioned before, a lack of effective communication and the existence of misunderstanding are main reasons for project failure (Eckstein, 2013; Lu, Xiang, Wang & Xiapeng, 2010). Communication is described as the 'heart of group behaviour' (Shaw, 1981) and the 'essence of social systems' (Katz & Kahn, 1978), and is therefore considered crucial in Agile projects as well.

Communication can vary in frequency and in level of formality (Daft & Lengel, 1984; Hoegl & Gemuenden, 2001; Katz & Kahn, 1978). Frequency concerns the amount of communication between team members: how much time is being spent communicating with each other. Informality, or

communication style, concerns the spontaneity of communication. It describes to what extent more informal communication channels, such as spontaneous conversations, unplanned meetings and conversations over coffee are favoured over formal channels such as written documentation and planned meetings. Informal communication allows team members to share ideas and discuss problems in an effective and efficient manner. Furthermore, informal communication helps building trust (Turner & Müller, 2004; Müller, 2003), enables the creation of shared values (Nerur et al., 2005; Nohria & Ghoshal, 1994), stimulates effective knowledge sharing (Melnik & Maurer, 2004) and stimulates the formation of good interpersonal relationships (Hackman, 1990; Jehn, 1994). Moreover, trust, high value congruence, and interpersonal relationships are considered crucial success factors in (Agile) projects (e.g. Nerur et al., 2005; Nohria & Ghoshal, 1994; Jehn, 1994; Pikkarainen et al., 2008).

Note that informality becomes more challenging in larger (complex) projects. At the same time, informal communication is likely to become more important in these projects, since knowledge sharing, and discussing ideas and problems quickly and efficiently become more challenging as well. As argued by Ouchi (1980), informal clans have lower coordination costs and are therefore more efficient and flexible than formal bureaucracies. This informality allows for quick reactions to problems and changing requirements, which is particularly important in turbulent, changing environments like Agile projects. Since Agile methods emphasize the importance of informal communication, we argue that communication style is more relevant in ASD than communication frequency, and that informal communication can enhance Agile project success in both small and complex projects and organizations.

2.3.3 Value Congruence

Values have been defined as 'general beliefs about the importance of normatively desirable behaviours and end states' (Edwards & Cable, 2009; Meglino & Ravlin, 1998). Individuals often base behavioural choices on these values (Liang et al., 2012). When members of a group differ in terms of what they think tasks, goals, targets and missions should be, value diversity occurs (Liang et al., 2012; Jehn, 1999). Value diversity can increase relationship conflict, decrease satisfaction and commitment to the group, and therefore negatively affect (software) team performance (Jehn, 1999; Liu et al., 2007). Similarity in values and goals among team members, on the other hand, is needed to be efficient and effective (Jehn et al., 1999), and enhance interpersonal relationships, which is considered a crucial success factor in (Agile) project success (e.g. Hackman, 1990; Nerur et al., 2005; Nohria & Ghoshal, 1994; Jehn, 1994; Pikkarainen et al., 2008). This *value congruence* is considered essential in good interpersonal relationships between team members (Wang, Wei, Jiang & Klein, 2006), as well as between leaders and followers (Boyd & Taylor, 1998). Since Agile Software Development is a complex process in which interdependence and interactions play a key role, we argue that high value congruence among teams as a whole is crucial for Agile project success.

Value congruence can interact with leadership style and communication style (Liang et al., 2012; Edwards & Cable, 2009; Jung & Avolio, 2000). Developing a shared vision is one of the most

important components op transformational leadership (Jung & Avolio, 2000). In order to establish this shared vision, values of followers and leaders should be aligned with the collective interests of a group (Bass, 1985). This increase in value congruence could in turn lead to a decrease of relational conflict, good interpersonal relationships and project success (Hackman, 1990; Jehn, 1999). Moreover, it seems it is the transformational leader, rather than the transactional leader, who facilitates high value congruence and thereby enhances performance. Indeed, prior research postulates the mediating role of value congruence between transformational leadership and performance (Jung & Avolio, 2000). Most research, however, focuses on the predicting role and direct effects of value congruence on performance. More research is required on the mediating role of value congruence.

In terms of communication, it has been argued that value congruence promotes communication (e.g. Erdogan & Bauer, 2005; Meglino & Ravelin, 1998; Edwards & Cable, 2009). According to these studies, having shared values establishes 'a common frame' which could stimulate communication among individuals. In addition, having shared values increases trust among individuals (Dose & Klimoski, 1999), which is considered a success factor in (Agile) projects (Nerur et al., 2005; Nohria & Ghoshal, 1994; Jehn, 1994). We argue that the relationship between communication and high value congruence could be a two way street: value congruence promotes communication, but informal communication is also needed in order to create value congruence. Informal interpersonal communication will lead to trust and good interpersonal relationships, and therefore value congruence, which in turn could enhance project success. Hence, we argue, that value congruence and informal communication can reinforce each other and thereby enhance project success.

2.3.4 Project Success

In order to indicate the values of the aforementioned predicting and mediating factors, a measure of project success is required. In the present study, a subjective measure of project success is used. Due to the different parties and roles involved in ASD, perspectives on Agile project success are likely to differ, which hinders an objective measure of project success. However, assessing multiple ratings of success is argued to enhance objectivity, when coming from internal and external sources (Hoegl & Gemuenden, 2001). In addition, self-evaluation has been adopted and used often as valid predictors of performance (Jones & Harrison, 1996).

An often-used assessment of performance, or project success, concerns effectiveness and efficiency. *Effectiveness* refers to the degree 'to which a team meets the expectations of the quality of the outcome' (Hackman, 1987). For example to which degree goals and expected quality were met. *Efficiency*, on the other hand refers to the degree to which teams meet time and budget objectives (Hoegl & Gemuenden, 2001). Although time and budget are often mentioned as measures for success, these factors are not included in this study, since they do not fit the flexible, adaptive characteristics of ASD. In the present study, project success is measured using a scale based on the one suggested by Jones and Harrison (1996), which is mainly focused on effectiveness.

2.4 Hypotheses

Based on the research findings described before and the conceptual model, hypotheses were formulated regarding the proposed relationships between the candidate success factors and project success.

H1a: Transformational leadership is positively related to high value congruence on individual and project level.

H1b: Transformational leadership is positively related to project success on individual and project level.

H1c: The relationship between transformational leadership and project success is mediated by value congruence on both individual and project level.

H1d: The effect of transformational leadership on project success is stronger in larger (complex) projects.

H2a: An informal communication style is positively related to high value congruence on individual and project level.

H2b: An informal communication style is positively related to project success on both individual and project level.

H2c: The relationship between informal communication and project success is mediated by value congruence on both individual and project level.

H2d: The effect of informal communication on project success is stronger in larger (complex) projects.

H3a: High value congruence is positively related to project success on individual level.

H3b: High value congruence is positively related to project success on project level.

H4a: Project size is negatively related to project success on individual level.

H4b: Project size is negatively related to project success on project level.

H5a: High degree of agility is positively related to project success on individual level.

H5b: High degree of agility is positively related to project success on project level.

H6: Success is experienced equally by team members, Scrum Masters and product owners.

3. Methods

The main purpose of this study, as discussed in chapter 1, is to explore whether communication style, leadership style, value congruence and degree of agility are factors in successfully applying Agile methods in larger, complex projects. Since there is relatively little specific research available on the role of communication, leadership and value congruence in ASD, we decided to conduct this study in two phases: an explorative, qualitative phase and a quantitative (or survey) phase. In this chapter, the two phases will be discussed in more detail. We will explain why this approach was chosen. Furthermore, the methods for data collection and the testing of hypotheses will be motivated.

3.1 Phase 1

As suggested in Chapter 2, several open questions remain concerning communication, leadership and value congruence in ASD. These factors have been identified as possible success factors in ASD (Highsmith, 2003; Medinilla, 2012; Cockburn & Highsmith, 2001; Nohria & Ghoshal, 1994; Jehn, 1994; Jehn et al., 1999; Augustine et al., 2005) but remain, however, a 'black box': it is not specifically known how these factors work and are of influence in Agile projects. Due to these research gaps on the role of these factors in ASD, we decided to start this study with an explorative phase in which experienced practitioners were interviewed.

3.1.1 Study Design of phase 1

In order to gain more insight into the role of communication and leadership in successfully applying Agile methods, explorative interviews were conducted with practitioners involved in successful larger Agile development projects. The aim of these interviews was to identify candidate success factors regarding:

1. Communication flows and styles
2. Leadership styles
3. Key agents
4. Other relevant success factors

In this phase, qualitative data were gathered through semi-structured interviews (table 4). These interviews were held with participants that represented different roles in their organization: project leaders, Scrum Masters, team members, program managers, a CIO and a chair elect of the Agile Consortium International. By selecting this mix of roles, we strived for objectivity and completeness. Interviews were held around three topics (table 4), and follow-up questions were not determined beforehand. The aim of this first phase was to gain insight into the possible communication-related success factors. Therefore, interviews that were not fixed beforehand were expected to provide more

valuable insights and conversations (Gillham, 2005). We aimed to maintain objectivity in this qualitative phase of the research by applying the *framework approach* (Pope, Ziebland & Mays, 2000) in the data analysis. We will elaborate on this approach in paragraph 3.1.6.

Table 4

Different parts of the explorative interviews

1. General information about projects	Project size, team size, key roles, Agile frameworks.
2. Agile and Leadership	(Actual) leadership style of Scrum Masters, preferred and suitable leadership style, motivation, hierarchical structure.
3. Agile and Communication	The amount of face-to-face communication, spontaneous conversations, differences between informal and formal communication, shared values, physical proximity.

3.1.2 Data Collection

Given the limited time available, we chose to conduct six interviews, in which we strived for diversity in roles and perspectives. In order to develop a tentative conceptual model, six explorative interviews with organizations in different business areas was considered sufficient, given the explorative character of this phase (Gillham, 2005). Interviews were held with valued and trusted relations of SIG, since mutual trust and good personal relationships were considered important at this stage of the study. Participating organizations operated in different business areas and had different core businesses.

3.1.3 Procedures

Together with employees of SIG, relevant and interesting Agile projects were selected. These companies, and contacts, were all known by SIG, and good personal relationships existed. Therefore, it was expected that these organizations would be willing to participate in the study. We chose to conduct the interviews face-to-face, since this would enhance openness on the part of the respondent, and a lack of cues about sensitive elements for the interviewer to be aware of (Gillham, 2005). All interviews were held at the organization were the respondent was working. This gave the opportunity to experience organizational culture and to observe Agile workplaces and teams.

All interviews took about one hour. The interviews started with the researcher providing more information about the study, explaining the design and the purpose of the explorative interview. Next, the structure of the interview was explained to the respondent. The researcher explained that there was no fixed script, but that the interview would revolve around three topics (general information about projects, Agile and Leadership, and Agile and Communication). After these instructions, the interviews started.

3.1.4 Participants

In total, six explorative interviews were conducted with seven participants form six different organizations. One of the participants was female, the other seven were male. We interpreted results of the explorative interviews, and developed a conceptual model. Based on this conceptual model, one additional explorative interview was held in order to get feedback on the model. This last interview was held with a CIO from an organization that was considered a best practice.

As mentioned earlier, most participants in phase 1 were working at organizations in different business areas, with different core businesses. Two of the participating organizations, however, were operating in the same business area, with similar core businesses. Since they were practicing Agile in different manners and on different scales, this was not considered a problem for the study. There was a wide variety in roles, resulting in a broad and various representation of perspectives on the role of communication and leadership in ASD.

3.1.5 Measures

As mentioned above, the explorative interviews revolved around three topics: (1) general information about projects, (2) Agile and Leadership, and (3) Agile and Communication. In the literature, we could not find sufficient relevant research on these topics. This research gap, in addition to the experience from SIG, led to de selection of the following three topics.

Part 1: General information about projects. In part 1 (table 4), information was gathered about the organization in general (e.g. size, number of employees, core businesses and organizational culture). This part also included questions about the motivation to start applying Agile methods; why did the organization decide to start applying Agile methods? In this part, key roles, Agile frameworks, communication styles and leadership styles in general were discussed as well. Part 1 provided more insights into the organization as a whole, degree of agility and thoughts and opinions about how well Agile methods suited the organization.

Part 2: Agile and Leadership. The main focus of the second part was leadership style of Scrum Masters in Agile projects. Questions were asked about how the respondent experienced the leadership style of Scrum Masters, and if this style was different from other leaders within the organization. Participants were also asked if they could evaluate how other project members (other roles) experienced Scrum Masters' leadership style. Another subtopic was what participants thought about what ought to be a suitable leadership style in Agile projects. What makes someone a valued, good leader in Agile projects; what qualities should an Agile Scrum Master possess? Motivation was a topic of discussion as well: are Scrum Masters capable of (intrinsically) motivating project members?

Part 3: Agile and Communication. The aim of the third part was to determine communication flows within Agile projects. Subtopics that were discussed were communication channels and communication style. Questions were asked about which channels were used most between project members, the amount of and perceived importance of face-to-face communication, and which channels were evaluated most valuable and effective. The perceived importance of physical proximity was discussed as well. In terms of communication style, questions were asked about the difference between formal and informal communication; how often spontaneous conversations took place between project members, how informal/formal meetings were perceived and if communication style differed among different levels (or roles). Shared values within projects were mentioned as well: do project members have shared values and is that considered important? And if having shared values is considered important, how can that be achieved?

3.1.6 Data Analysis

Framework approach

Since the topics of the interviews were set in advance, and we wanted to link the analysis to the quantitative data of phase two, it was decided to apply the *framework approach* in the qualitative phase of the study (Pope et al., 2000). The framework approach allows for categories to be derived from the data deductively, starting from pre-set aims and objectives (Pope et al., 2000). This approach tends to be more structured and less time consuming than inductive approaches like 'grounded theory', and therefore considered appropriate for the explorative phase of the research. Taking into account the explorative purpose of this phase, partial transcriptions in the form of summaries of the conducted interviews, rather than full detailed transcriptions, were considered sufficient (Gillham, 2005). Data was analysed according to *the five stages of data analysis in the framework approach*, as proposed by Pope et al. (2000):

(1) Familiarisation. Key ideas and recurrent themes were identified by exploring the raw data (reading partial transcriptions and notes).

(2) Identifying a thematic framework. Identification of key concepts were incorporated in an index of data by which the data could be examined. The identified concepts were (a) general information about projects; (b) Agile and leadership; and (c) Agile and communication, consistent with the pre-set concepts of the interviews. One concept was added which was derived inductively from the data: value congruence. Since this factor was often mentioned by respondents directly and indirectly, we decided to include this factor.

(3) Indexing. The thematic framework was applied to all the data by annotating the partial transcriptions with codes (textual passages were divided according to the four different concepts of the thematic framework).

(4) Charting. Data was rearranged according to the appropriate part of the thematic framework to which they relate. Table 5 (see section 3.1.7) provides an overview of the three concepts along with the most common responses of participants.

(5) Mapping and interpretation. The rearranged data led to distilled summaries of views and experiences from participants. These summaries are presented in appendix B.

Table 5

Most common responses per interview part.

Interview Part	Most common responses
1. General information about projects	- Most participating organizations applies SAFe. - Agile needs to suit the project, organization and project members in order to be successful. - It needs to be clear why Agile is being applied. - High degree of agility leads to high perceived project success. - Interdependence is more important than project size.
2. Agile and Leadership	- Scrum Masters should facilitate, coach, motivate, inspire, show personal involvement and give constructive feedback. - Good Scrum Masters are concerned with the process, and less with the content. - Scrum Masters should facilitate a shared mental context (shared (work)values). - Power should be divided equally. - A good Scrum Masters is flexible and adaptive, as they often operate as 'the man in the middle'.
3. Agile and Communication	- Informal communication is crucial for establishing good interpersonal relationships and trust. - Informal communication can contribute to shared values. - Openness is important. - Regular informal communication (e.g. spontaneous conversations) among all involved project members is important.

3.1.7 Results

In this part, the most common responses of the interviews and the developed conceptual model will be presented. The distilled summaries, which are based on the findings presented in table 5, can be found in appendix B. Interestingly, these summaries showed that there were several points that were mentioned by all interviewees. We consider these main conclusions. These main conclusions served as the basis for the conceptual model that was developed at the end of phase 1. To test this conceptual model, an additional interview was held with a participant that was considered a best practice.

Towards a conceptual model

The results of the first, explorative phase, led to the development of a conceptual model. In this conceptual model, candidate success factors in Agile projects, regarding leadership style and communication style, were included. In order to get feedback on this model, an additional interview was conducted with the CIO of an organization that was considered a best practice. This organization applies Agile in a successful way, on a large scale, and over a longer period of time. In the interview, the model was discussed and applied to the organization in question. The conceptual model was confirmed, and therefore serves as a reliable basis for phase 2 of this study. Below, the conceptual model is visualized and explained in more detail (figure 1).

As can be seen in the conceptual model (figure 1), all relevant topics from the explorative interviews were included. Based on the explorative interviews and literature, it is expected that these mechanisms can contribute to Agile project success. The interviews indicated that leadership style, communication style and value congruence are probably most influential in the relationship between Scrum Masters and team members, since they interact most frequently. Therefore, the model will focus on leadership style of Scrum Masters, and communication style among Scrum Masters and team members.

As can be seen, communication style, leadership style, degree of agility and size are predictors in this model, and project success is the outcome variable (or dependent variable). We expect that value congruence explains the relationships between transformational leadership and informal communication on the one hand, and Agile project success on the other. Therefore, value congruence is included as a mediating factor in the model. Though prior research often argues the predicting role of value congruence, the explorative interviews related to literature, lead to the believe that value congruence is a mediating factor here.

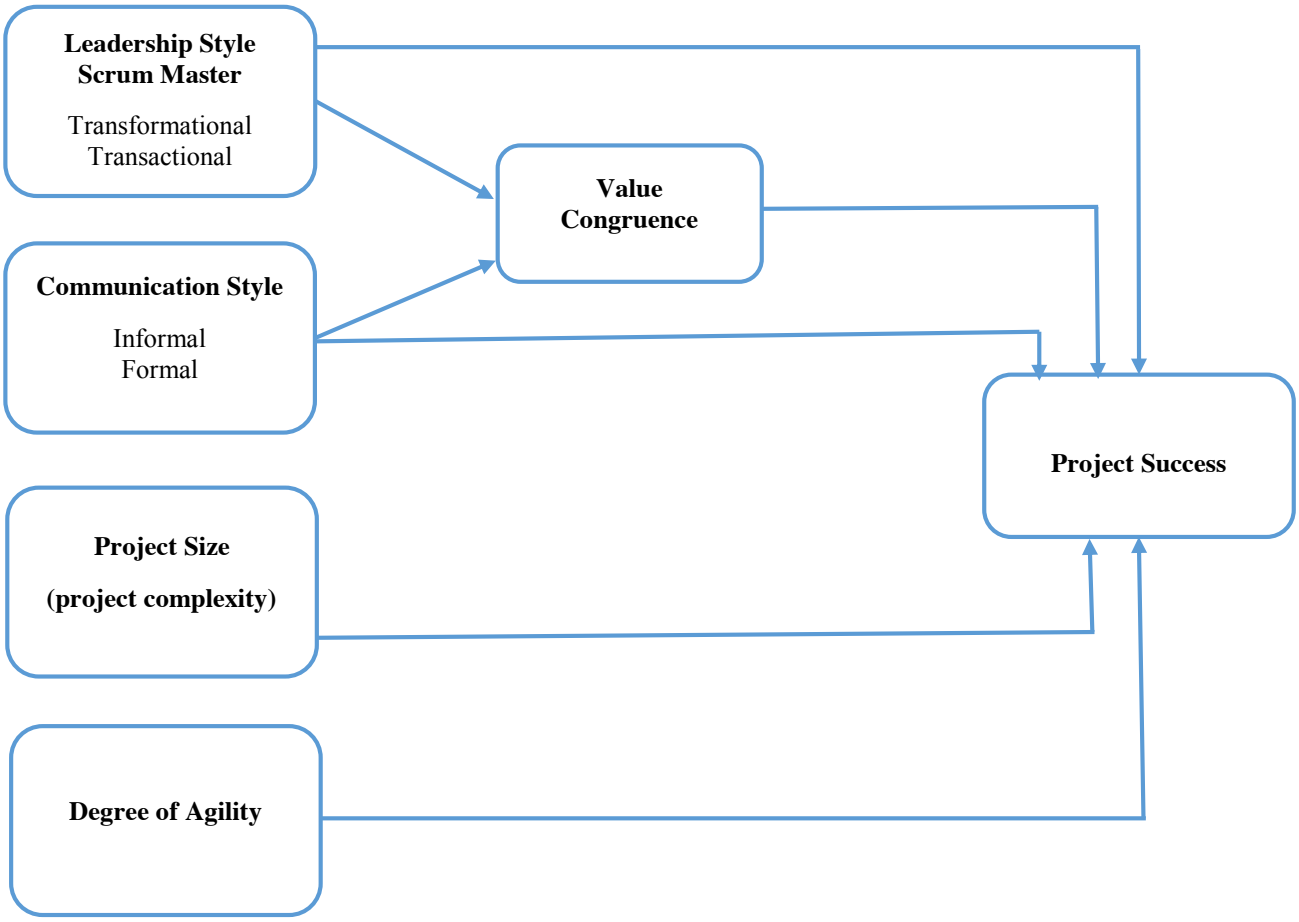


Figure 1: *Conceptual Model of Agile project success and five main influencing or mediating factors.*

In terms of leadership, the focus is on the leadership style of Scrum Masters in Agile projects. As mentioned before, Scrum Masters often operate as 'the man in the middle'. Their leadership style is expected to have a great influence on the team, shared values, and project success (Nerur et al., 2005). As for different leadership styles, transformational and transactional leadership style were distinguished, based on the reasons mentioned in Chapter 2. Transformational leadership is expected to suit the flexible nature of Agile methods better than transactional leadership, and therefore contribute to project success. Furthermore, due to the characteristics of transformational leadership (e.g. motivating, coaching, the importance of vision) it is expected to contribute to the creation of shared values, and therefore to effective collaboration and project success. Value congruence is expected to be a mediating factor, since we expect it to intervene in and explain the relation between communication style and project success, and leadership style and project success.

Communication style is expected to influence both value congruence and project success as well (e.g. Nerur et al., 2005; Jehn et al., 1999; Pikkarainen et al., 2008). According to phase 1, informal face-to-face communication is crucial in Agile projects, especially in the beginning. It is expected that the amount of spontaneous, informal conversations and discussions contribute to project success directly

(Ouchi, 1980; Pikkarainen et al., 2008). In addition, it is expected that informal communication enhances shared values of project members (Nerur et al., 2005; Nohria & Ghoshal, 1994), and that high value congruence can contribute to project success (Nohria & Ghoshal, 1994; Jehn, 1994; Jehn et al., 1999). Furthermore, high value congruence allows for the establishment of interpersonal relationships (Jehn et al., 1999; Jehn, 1994; Hackman, 1990). Moreover, interpersonal relationships can enhance active collaboration and therefore project success (Riege, 2005). The focus hereby will be on the communication style between Scrum Masters and team members.

Degree of agility is included in order to check whether project members believe they are working Agile and to what degree. This predictor was incorporated after the explorative interviews, in which it was an often mentioned factor. Last, project size is expected to have a negative influence on project success: larger projects (high amount of total project members) are expected to have lower scores on project success.

Hence, phase 1 of this study led to the development of a conceptual model. In table 6, an overview of the structure of the present research is presented, including different stages and phases.

Table 6
Structure of the present research.

Research questions	***Remaining research gaps***	***Outcomes explorative interviews***	***Conceptual model***	***Factors included in questionnaire***
1. How are leadership style, communication style and value congruence related to Agile project success? 2. Are these candidate success factors of greater influence in larger, complex Agile projects?	Ways to successfully scaling up Agile methodologies. The role of people factors, such as leadership style and communication style, in ASD and project success. Differences in the role of leadership style and communication style between simple and complex projects. Influence of leadership and communication between team members, Scrum Masters and product owners. (Not just among development teams.)	Complexity (interdependence) is more challenging than project- or team size. A good leader acts as a facilitator, coach and inspires and motivates people. Informal communication between team members, Scrum Masters and product owners is crucial in ASD, as it helps establish relationships and trust. Effective leadership and informal communication contribute to a shared mental model, which is crucial for success.	Leadership style (Predictor) *Transformational* *Transactional* Communication style (Predictor) *Informal* *Formal* Project Size (Predictor) *complexity* Degree of Agility (Predictor) Value congruence (Mediating factor) Project success (Dependent variable)	Degree of Agility *Agile checklist* *Agility as perceived by team members, Scrum Masters and product owners*. Project Size (complexity) *Total amount of project members*. Leadership style *As perceived by team members* *As preferred by Scrum Masters* Communication style *Amount of spontaneous, informal communication as perceived by team members and Scrum Masters*. Value congruence *Similarities in values and goals as perceived by team members and Scrum Masters*. Project Success *As perceived by team members, Scrum Masters and product owners*.

3.2 Phase 2

The aim of the second phase of this study is to test the conceptual model that was developed in phase 1, and thereby determine the relative importance of each candidate success factor. The outcomes of this phase will allow refinement of the conceptual model into an evaluation model regarding communication- and leadership-related candidate success factors in ASD. Online questionnaires were used to test the conceptual model, which were filled out by three different roles per project. 40 Agile projects from 19 different organizations participated in the study. Below, the study design, data collection, participants, measures and data analysis will be discussed.

3.2.1 Study Design of phase 2

In this quantitative part of the study, the relationships between leadership style, communication style, value congruence, degree of agility, project size, and project success were examined. In this second phase, quantitative data were gathered by means of a fully standardized, non-randomized online questionnaire.

Three groups of participants were distinguished: Scrum Masters, product owners and members of development teams. Per Agile project, the questionnaire was filled out by at least one participant of each role. In order to assure that the survey was filled out by each role per project, participants were first asked to identify their organization, project name, team name and their role within the project (part 1). In this part, relevant questions about demographic information were asked as well. Participants were then asked to indicate how Agile the project was in their opinion (part 2). Next, team members and Scrum Masters gave their opinion about statements regarding perceived leadership style of the Scrum Masters for team members, and preferred leadership style for Scrum Masters (part 3), communication style among team members and Scrum Masters (part 4), and value congruence within the entire project team (part 5). The last part consisted of statements about perceived project success (part 6), which was filled out by all participants. The complete questionnaire for team members can be found in Appendix C, for Scrum Masters in Appendix D, and for product owners in Appendix E. The questionnaire consisted of the following parts:

Part 1: General information about projects and demographic information.
Part 2: Perceived Agility of projects.
Part 3: Perceived/preferred leadership style of Scrum Masters.
Part 4: Perceived communication style.
Part 5: Perceived value congruence.
Part 6: Perceived project success.

In 41 out of 46 projects, the questionnaire was filled out by at least one of the aforementioned roles. In 6 out of 46 projects, the questionnaire was filled out by less than three roles. These projects were excluded from the analyses on project level. The individual responses were included, however, for analyses on the individual level. Participation of the different roles within Agile projects provided different perspectives on the degree of agility and perceived project success. Using multiple perspectives on project performance is found to be effective (Hoegl & Gemuenden, 2001), and therefore expected to be effective in this study as well.

We chose to use an online questionnaire in this phase of the study, because it is time-efficient and flexible. Furthermore, in several cases it allowed for project leaders, rather than the researcher, to distribute the survey within their organization, resulting in more participating projects. Distributing the questionnaire via project leaders is found to be effective (Evans & Mathur, 2005), which was confirmed in this study as well.

3.2.2 Data Collection

The goal was to collect as many Agile projects as possible to participate in the study, with a minimal number of 20 projects to be able to conduct statistical analyses. We tried to collect as many 'complex' projects as possible, meaning projects in which the total amount of project members and interdependence was high. In terms of diversity, it was tried to attract participating projects from different business areas with different core businesses. We managed to do so, by recruiting participants via different ways. Due to the attendance at a seminar regarding Agile Governance initiated by a participating organization, a relatively large number of participating projects came from that organization. However, these projects differed from each other since they came from different departments within the organization. Therefore, this was not considered to be obstructing.

Participant recruitment was done via different methods. First, a website within de website of SIG providing more information about the research was developed. This link was distributed through social media (LinkedIn and Twitter) and by employees of SIG. In addition, business contacts and relations of SIG and its employees were contacted and invited to participate in the study. An important method for participant recruitment was the attendance of the researcher at two seminars regarding Agile Software Development. During these seminars, attendees were asked to participate in the study. This resulted in multiple participating projects from different business areas with different core businesses. These projects and participants were not related to SIG, resulting in a good balance between relations and non-relations from SIG. In addition, the EQuA project helped recruiting participating projects. Members of the EQuA Project[8] introduced their relations and invited them to join the study. Furthermore, snowball sampling was used to recruit participants. Multiple members of participating

[8] http://www.equaproject.nl

projects introduced other interesting Agile projects from their network. The flexible character of the online questionnaire allowed for this snowball sampling to be effective.

3.2.3 Procedures

Prior to sending out the online questionnaire, personal meetings were held with at least one person from the organization who could distribute the survey within the organization. In these meetings, objectives, motivations and procedures were explained. Furthermore, it was discussed with the respondent how distribution of the survey would be most effective within a particular organization. Distribution took place in two ways: either the researcher received a list of names and email addresses of participants and sent them the link per email, or a project leader or manager sent the survey link to participants, along with an introduction text from the researcher. In several cases, the last way was more effective, since participants felt more committed to fill out the questionnaire when they received it from their manager, though participation was fully voluntary. The survey link was the same for each participant, only the survey track differed according to what role was chosen.

The questionnaire was non-randomized, so all participants received the questions in the same order. Filling out the team member questionnaire and the Scrum Master questionnaire took about 10 to 15 minutes. It took product owners approximately 5 to 10 minutes to fill out the questionnaire. The tool used to collect the data was Qualtrics[9], an online tool that enabled participants to open the questionnaire in a browser, and easily exports data for analysis.

3.2.4 Participants

The study included three groups of respondents: (1) members of development teams; (2) Scrum Masters; and (3) product owners. In total, 152 questionnaires were filled out; 52 by members of development teams, 56 by Scrum Masters and 44 by product owners. Participants who quit the questionnaire halfway or did not complete the questionnaire were excluded from analyses. Participants who (sporadically) did not answer one question, but did complete the questionnaire fully were not excluded for analysis. A total of 47 team members, 52 Scrum Masters and 42 product owners were included in the analyses. The other 11 respondents responses were removed from the samples. An overview of the participant distribution is illustrated in figure 2. In total, 141 valid respondents were included in the study for analyses. These respondents are divided over 46 Agile projects from 19 Dutch organizations . Of these 46 projects, 40 were included in the study for analyses. The other six projects were excluded because the questionnaire was not filled out (completely) by at least one of the aforementioned roles. An overview of the project distribution is illustrated in figure 3.

[9] http://www.qualtrics.com

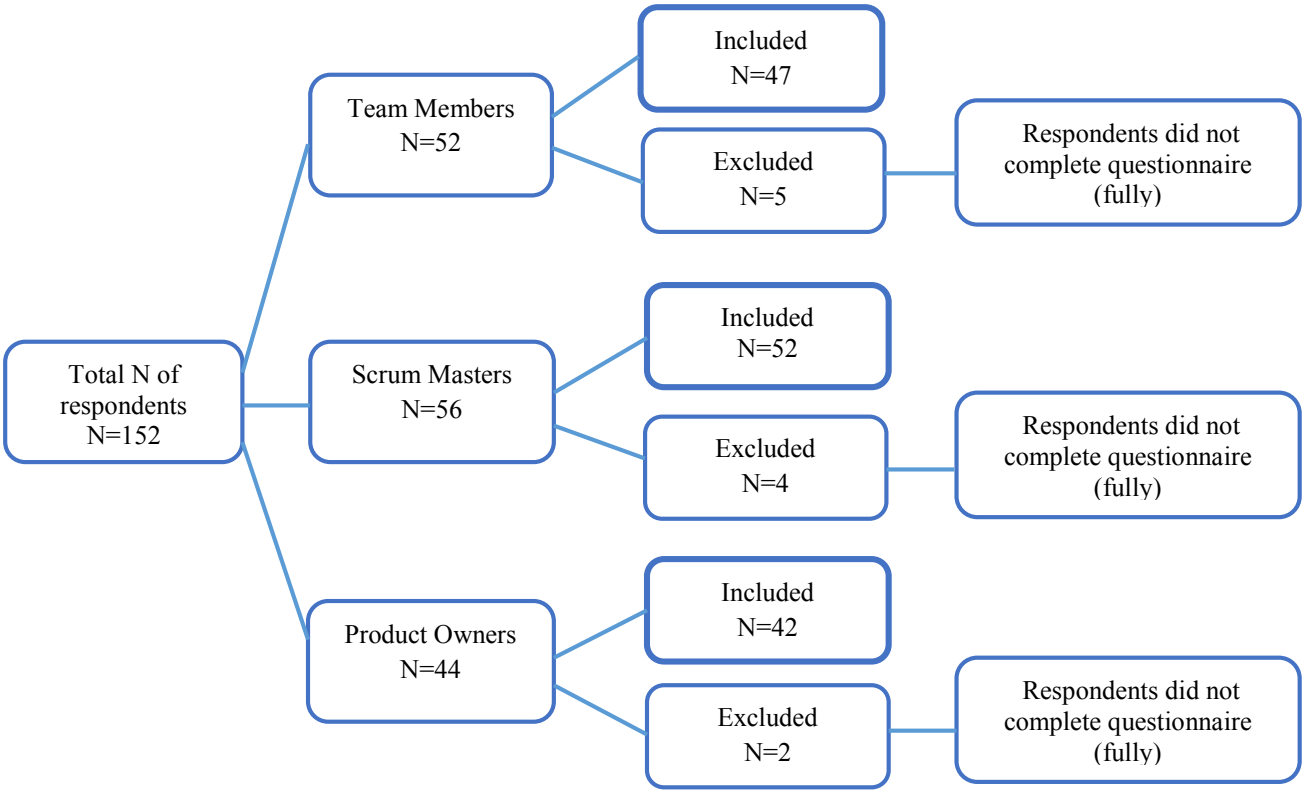


Figure 2: Overview of participant distribution.

Participants included members of software development teams (N = 52) of which 95.7% male (N = 45) and 4.3% female (N = 2), Scrum Masters (N = 52) of which 86.5% male (N = 45) and 13.5% female (N = 7), and product owners (N = 42) of which 78.6% male (N = 33) and 21.4% female (N=9). So, in total 82.2% of the 141 participants was male (N = 123), and 12.8% was female (N=18). The average age of the respondents was 40.75 years (*SD* = 8.89). Of the 40 projects that were included in analyses, 12.5 % was completed (N = 5), and 87.5% was ongoing at the time the questionnaire was filled out (N = 35). In 70.0% (N= 28) of the projects, the questionnaire was filled out by three respondents, in 27.5% (N=11) it was filled out by four respondents, and in 2.5%, (N=1) six respondents filled out the questionnaire.

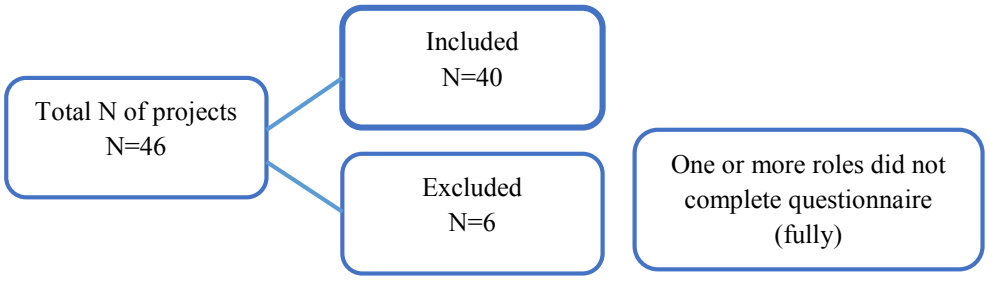


Figure 3: Overview of project distribution.

3.2.5 Measures

The questionnaire was available in Dutch and English, allowing participants to fill out the survey in their native language. Most of the questionnaires were filled out in Dutch though: from the 140 participants, 138 filled out the questionnaire in Dutch. The questionnaire was examined by two professors of the communication and information sciences department from Tilburg University, and by an employee of SIG, in order to ensure validity of the content and quality of questions.

Existing, validated questionnaires were used to measure the different scales, except for degree of agility. The scale to measure degree of agility was adopted from an online Agile checklist, since there were no existing, validated scales to measure agility available in the literature. Table 7 shows an overview of the number of items and the source of the scales of measurement. Complete questionnaires can be found in Appendix C, D and E. Below, the different scales will be discussed.

Table 7

Sources of Agile project success measures.

Agile project success factors	Items	Adapted from
Project size	1	-
Degree of Agility	8	Agile checklist[10]
Leadership style		
Rater version	36	Bass & Avolio (1997)
Self-rater version	36	Bass & Avolio (1997)
Communication style	8	Liang, Wu, Jian & Klein (2012)
Value congruence	5	Jehn (1994)
Project success	5	Jones & Harrison (1996)

Demographics. Demographic information that was gathered consisted of respondent's demographic information about age, sex and their role within the project, and general information about the project concerning project names, project size and the status of the project (concluded, ongoing or about to start).

Perceived agility. Agility was measured by eight items, adapted from an online Agile checklist[11]. The Cronbach alpha score of the scale was .68. Since there was no similar checklist available in the literature, it was decided this checklist would be sufficient to measure degree of agility from three perspectives. Items were measured using a slider, which ranged from 0 (strongly disagree) to 100 (strongly agree). Questions focused on delivery, team proximity, adaptability, planning and ways to measure progress.

[10] http://www.versionone.com/Agile101/Agile-Development-Quiz/
[11] http://www.versionone.com/Agile101/Agile-Development-Quiz/

Perceived leadership style (transformational and transactional). Bass (1985) developed an instrument to measure both transformational and transactional leadership: the Multifactor Leadership Questionnaire (MLQ). The MLQ has been improved and tested since 1985, and since then many versions of the questionnaire have been developed. The latest versions, Form 5X (Revised), is used in this study (Bass & Avolio, 2000). The MLQ is the most used instrument to measure transformational and transactional leadership (Lowe, Kroeck & Sivasubramaniam, 2003) and consists of 45 items. The first 36 items represent the eight leadership factors that were discussed in chapter 2 (idealised influence (attributes), idealised influence (behaviour), inspirational motivation, intellectual stimulation, individualised consideration, contingent reward, and management by expectation- passive/active). Therefore, only the first 36 items were included in this study. Items were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In the Dutch questionnaire, the Dutch (translated) validated version of the MLQ, the MLQ-8Y, was used (Den Hartog, Van Muijen & Koopman, 1997). Cronbach alpha scores for transformational leadership were .88 (as evaluated by team members) and .85 (as evaluated by Scrum Masters). Cronbach alpha scores for transformational leadership were .50 (as evaluated by team members), and .57 (as evaluated by Scrum Masters).

The MLQ consists of two versions: the 'rater version' and the 'self-rater version'. These versions include the same statements, but differ in the perspective they were written from. For example, Scrum Masters were given statements like: 'I spend time teaching and coaching', whereas team members were given statements like: 'My Scrum Master spends time teaching and coaching'.

Perceived communication style. Perceived communication style was measured by eight items, based on Liang, Wu, Jian and Klein (2012). One item (there is frequent formal communication (documentation etc.)) was removed from the scale in order to improve internal consistency. After removing one item, the Cronbach alpha score of the scale was .69. Questions concerned communication style among team members and Scrum Masters, and included statements about the frequency of face-to-face conversations, spontaneity of conversations and the difference in formal and informal communication. In addition to the questionnaire as used by Liang et al. (2012), two questions were added concerning the characteristics and effectiveness of discussions. These items were added because the explorative phase suggests that discussion are very important in relation to project success. Items were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Perceived value congruence. Value congruence was measured by five items, adapted from Jehn (1994). The Cronbach alpha score of the scale was .68. Participants were asked about shared values within the project team as a whole. On a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), respondents were given statements about whether the (work) values of project members were

similar, whether goals were shared, and whether project members had shared beliefs about what was important for the project. High scores reflected low value diversity, and therefore high value congruence.

Perceived project success. Project success was measured in terms of whether project goals were met, the expected amount of work (scope) was concluded, quality of results and to what degree tasks were carried out efficiently and as fast as possible, as suggested by Jones and Harrison (1996). The Cronbach alpha score of the scale was .68. It was chosen not to include to what degree the budget was adhered to, since measuring quality through time and budget was not considered in line with Agile principles. The other five items as proposed by Jones and Harrison, regarding effectiveness, were considered more relevant. These five items were measured by a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

To control for internal consistency of the scales, a Cronbach's alpha test was executed. All scales had an acceptable reliability, except for transactional leadership, which was removed from the dataset. Not all Cronbach alpha scores were highly reliable (above .07), but scores did not highly deviate from .07. For that reason, and since the scales were validated in prior research, it was decided to maintain the scales. See table 8 for all Cronbach alpha scores.

Since the questionnaire was filled out by several project members per project, a risk at common source bias existed. In order to avoid this, different variables were measured using multiple respondents. Perceived leadership style, communication style and value congruence were assessed by both team members and Scrum Masters, and therefore provided a rather objective assessment. In addition, project success and degree of agility were assessed by team members, Scrum Masters and product owners, which was expected to result in a more objective assessment of project success, and thereby minimizing the risk at common source bias.

3.2.6 Data Analysis

Pre-processing analyses

Before starting the analyses, some a priori cleaning was done by the researcher, and several pre-processing analyses were conducted. First, the data were divided into two files, following the two levels of the research: individuals and projects. On the individual level (N=141), respondents were considered one unit of analyses, allowing for different roles to be compared. On project level (N=40), an Agile project was considered one unit of analysis, allowing for projects to be compared (different roles from the same projects were clustered). Prior to conducting the analyses, the data sets were cleaned by the researcher: 11 incomplete questionnaires were deleted from the files. In some cases, several individuals from the same role filled out the questionnaire. In these cases, average scores were calculated, which we considered as in improvement of objectivity. The degree of agility scale was altered in order to

improve interpretation of results. This scale ranged from 0 to 100, whereas all other scales ranged from 1 to 5. Therefore, we computed a new variable in which we divided the degree of agility scores by 25 and added 1: ((degree of agility score/25)+1). Hence, the new degree of agility variable ranged from 1 to 5, matching the other scales.

In addition, explorative analyses were conducted to describe the characteristics of the respondents. Furthermore, Cronbach's alpha of all constructs was calculated. Explorative analyses were conducted on both the individual and the project level. Due to the low Cronbach's alpha score of transactional leadership (table 8), it was decided to exclude this variable from analyses, and rather focus on transformational leadership solely.

Regression and mediation analyses

First, regression analyses were conducted on both the individual and project level in order to examine the relative contributions of each candidate success factor to project success. All analyses were conducted in SPSS Statistics version 20.0. Scores of transformational leadership, communication style, value congruence, degree of agility and project success were aggregated in the data file. These average scores were used in the analyses. Based on these analyses, it was decided which relationships would be further examined through mediation analyses. Following Baron and Kenny's (1986) mediational procedure, mediation analyses were conducted when significant relationships existed between predictors and the outcome variable. All mediation analyses were conducted using PROCESS for SPSS (Hayes, 2008). Similar to regression analyses, aggregated scores were used in the analyses.

Table 8

Means, standard deviations, and reliabilities of the variables.

	Mean	*SD*	Alpha[a]
Transformational Leadership			
Team Members	3.56	.82	.884
Scrum Masters	3.96	.49	.853
Transactional Leadership			
Team Members	2.81	.89	.496
Scrum Masters	2.94	.81	.572
Informal Communication	4.09	.54	.690
Value Congruence	3.77	.66	.682
Degree of Agility	3.77	.37	.677
Project Success	3.65	.68	.683
Project Size	21.53	18.70	

[a] = Cronbach's alpha coefficient

4. Results

In this study, we examined how Agile methodologies could be successfully applied in larger (complex) projects. Furthermore, we assessed how several candidate success factors about social aspects relate to Agile project success. In this chapter, the results of the analyses will be presented.

4.1 Candidate success factors as predictors of project success

Prior to testing the conceptual model, regression analyses were conducted in order to examine the relationships between the proposed candidate success factors and project success. These analyses were all conducted using SPSS Statistics version 20.0. Regression analyses were conducted on both the individual and project level. Results of these analyses will be presented separately below.

In table 9, Pearson correlations between all variables on individual level are presented. Table 10 shows the bivariate correlations between all predictors and project success on both the individual and project level. Table 11 and 12 represent the results of the regression analyses on individual level. In table 13, Pearson correlations between all variables on project level are presented. And last, table 14 refers to the results of regression analysis on project level.

4.1.1 Individual level

On the individual level (N = 141), regression analyses were conducted using six predictors and one outcome variable. The six predictors were (1) transformational leadership evaluated by team members; (2) transformational leadership evaluated by Scrum Masters; (3) informal communication; (4) value congruence; (5) degree of agility; and (6) project size. The outcome variable was project success. Three different regression analyses were conducted:

(1) Regression analyses were conducted for each of the six predictors separately in order to examine their independent relationships to project success (table 10). These results represent the bivariate correlations between candidate success factors and project success.
(2) A regression analysis in which *transformational leadership evaluated by Scrum Masters, informal communication, value congruence, degree of agility* and *project size* were included in a model in order to examine their contribution to the model (table 11, model 1).
(3) A regression analysis in which *transformational leadership evaluated by team members, informal communication, value congruence, degree of agility* and *project size* were included in a model in order to examine their contribution to the model (table 12, model 2).

Prior to conducting regression analyses, correlations between candidate success factors and project success were examined. Pearson correlations are presented in table 9. Correlations were not

exceptionally high, indicating low probability of multicollinearity (Field, 2013). Not all factors were significantly related to each other. All candidate success factors were significantly positively related to project success, except for project size, which is contrary to our expectations.

Table 9

Pearson correlations between candidate success factors and project success on individual level.

	1	2	3	4	5	6	7
(1) Transformational Leadership *(Evaluated by team members)*	-						
(2) Transformational Leadership *(Evaluated by Scrum Masters)*	-	-					
(3) Informal Communication	.47**	.11	-				
(4) Value Congruence	.31*	.07	.27**	-			
(5) Degree of Agility	.44**	-.01	.40**	.41**	-		
(6) Project Size	.28	.29*	.22*	.11	.16	-	
(7) Project Success	.36*	.37**	.23*	.47**	.52**	.15	-

Note: * $p < .05$, ** $p < .01$
N = 141

Regression analyses were conducted to evaluate how well the proposed candidate success factors predicted project success. First, linear regression analyses were conducted for each predictor separately in order to examine their separate contributions to project success. Furthermore, based on these analyses we decided which mediation models would be tested. In the first column of table 10, results of the regression analyses, including unstandardized coefficients, standardized coefficients and standard deviations are presented. Beta coefficients (β) are based on one variable, and therefore equal to bivariate correlations. All bivariate correlations between the predictors and project success were positive, as expected, although only five of the six predictors were significant ($p < .05$). Contrary to our expectations, project size did not significantly predict project success.

Table 10

Summary of separate regression analyses for variables influencing project success (bivariate correlations).

	Individual Level[a]			Project Level[b]		
Variables	B	*SE B*	β	B	*SE B*	β
Transformational leadership						
Evaluated by Team Members	0.31	.12	.36*	0.08	.14	.09
Evaluated by Scrum Masters	0.60	.22	.37**	0.13	.19	.19
Informal Communication	0.28	.12	.23*	0.36	.18	.31*[c]
Value Congruence	0.46	.09	.47**	0.46	.13	.50**
Degree of Agility	0.60	.08	.52**	0.69	.14	.63**
Project Size	0.00	.00	.15	0.00	.00	.15

Note: * p < .05. ** p < .01
[a] = N = 141
[b] = N = 40
[c] = p = .056

Second, candidate success factors were included in the model using the forced entry method. This was done two times since the factors *transformational leadership as evaluated by Scrum Masters* (model 1) and *transformational leadership as evaluated by team members* (model 2) could not be entered in one model simultaneously. Below, results of the regression analyses will be discussed.

In model 1, five predictors were entered simultaneously in the model using the forced entry method. In appendix F, results of the regression analysis, including unstandardized coefficients, standardized coefficients and variances explained (*R*-square) are presented. Results suggest that value congruence, $\beta = .33$, $t\ (49) = 2.53$, $p < .05$ and transformational leadership as evaluated by Scrum Masters, $\beta = .35$, $t\ (49) = 2.72$, $p < .01$ significantly predicted project success. Degree of agility marginally significantly predicted project success, $\beta = .25$, $t\ (49) = 1.78$, $p = .08$. Value congruence and transformational leadership as evaluated by Scrum Masters also explained a significant proportion of variance in project success scores, $R^2 = .36$, $F\ (4,45) = 4.85$, $p = .001$. Hence, transformational leadership, value congruence and degree of agility are the most important predictors in this model.

In model 2, five predictors were entered simultaneously in the model using the forced entry method. In appendix G, results of the regression analysis, including unstandardized coefficients, standardized coefficients and variances explained (*R*-square) are presented. Results suggest that value congruence, $\beta = .50$, $t\ (45) = 3.19$, $p < .01$ significantly predicted project success. Value congruence also explained a significant proportion of variance in project success scores, $R^2 = .22$, $F\ (4,41) = 5.13$, $p = .001$. Hence, value congruence is the most important predictor in this model.

Finally, the non-significant predictors in both models were removed in order to build the final model. Hence, the final version of model 1 included *transformational leadership as evaluated by Scrum Masters*, *value congruence* and *degree of agility* as predictors for project success, and the final version of model 2 included *value congruence* as predictor of project success. These predictors were entered to the models using the forced entry method. Table 11 presents the results of model 1, and table 12 refers to model 2. As suggested by the results, value congruence, transformational leadership and degree of agility are the most important predictors for project success on the individual level. Based on the results in table 11, project success could be predicted on the individual level by using the following formula:

Project success = .56 * transformational_SM + .34 * value congruence + .37 * Degree of Agility + E

Table 11

Model 1 regression analysis, evaluation of Scrum Masters included.

	B	*SE B*	β
Constant	- 1.19	1.05	
Transformational leadership			
Evaluated by Scrum Masters	0.56	.19	.35**
Value Congruence	0.34	.13	33*
Degree of Agility	0.37	.19	.25*[a]
R^2	.36		
F	8.45		

Note: * p < .05, ** p < .01

[a] = p = .055

Table 12

Model 2 regression analysis, evaluation of team members included.

	B	*SE B*	β
Constant	1.96	.33	
Value Congruence	0.46	.09	.47**
R^2	.22		
F	28.02		

Note: * p < .05, ** p < .01

4.1.2 Project level

On project level (N = 40), regression analyses were conducted using six predictors and one outcome variable. The six predictors were (1) transformational leadership as evaluated by team members; (2) transformational leadership as evaluated by Scrum Masters; (3) informal communication; (4) value congruence; (5) degree of agility; and (6) project size. The outcome variable was project success. Three regression analyses were conducted:

(1) Regression analyses were conducted for each of the six predictors separately in order to examine their independent relationships to project success (table 10). These results represent the bivariate correlations between candidate success factors and project success.
(2) A regression analysis in which *transformational leadership as evaluated by Scrum Masters, transformational leadership as evaluated by team members, informal communication, value congruence, degree of agility* and *project size* were included in a model in order to examine their contribution to the model (table 14, model 3).

Prior to conducting regression analyses, correlations between candidate success factors and project success were examined. Pearson correlations are presented in table 13. Correlations were not exceptionally high, indicating low probability of multicollinearity (Field, 2013). Not all factors were significantly related to each other. As expected, informal communication, value congruence and degree of agility were significantly positively related to project success. Transformational leadership and project size were not significantly related to project success, which is contrary to our expectations.

Table 13

Pearson correlations between candidate success factors and project success on project level.

	1	2	3	4	5	6	7
(1) Transformational Leadership *(Evaluated by team members)*	-						
(2) Transformational Leadership *(Evaluated by Scrum Masters)*	.13	-					
(3) Informal Communication	.27	.11	-				
(4) Value Congruence	.16	.04	.27**	-			
(5) Degree of Agility	.27	-.07	.40**	.41**	-		
(6) Project Size	.26	.03*	.22*	.11	.16	-	
(7) Project Success	.09	.19	.31*	.50**	.63**	.15	-

Note: * $p < .05$, ** $p < .01$
N = 40

Regression analyses were conducted to evaluate how well the proposed candidate success factors predicted project success. First, linear regression analyses were conducted for each predictor separately in order to examine their separate contributions to project success. Furthermore, based on these analyses we decided which mediation models would be tested. In the second column of table 10 (project level), results of the regression analyses, including unstandardized coefficients, standardized coefficients and standard deviations are presented. All bivariate correlations between the predictors and project success were positive, as expected, although only two of the five predictors were significant ($p < .05$) and one predictor (informal communication) was marginally significant ($p = .08$). Contrary to our expectations, transformational leadership and project size did not significantly predict project success.

Second, candidate success factors were included in the model using the forced entry method. Below, results of the regression analyses will be discussed.

In model 3, five predictors were entered simultaneously in the model using the forced entry method. In appendix H, results of the regression analysis, including unstandardized coefficients, standardized coefficients and variances explained (*R*-square) are presented. Results suggest that degree of agility, $\beta = .51$, $t(39) = 3.47$, $p = .001$ significantly predicted project success. Value congruence, $\beta = .28$, $t(39) = 1.98$, $p = .06$ marginally significantly predicted project success. Degree of agility and value congruence also explained a significant proportion of variance in project success scores, $R^2 = .47$, $F(5,34) = 5.94$, $p = .00$. Hence, degree of agility and value congruence are the most important predictors in this model.

Next, the non-significant predictors in the model were removed in order to build the final model. Hence, the final version of model 3 included *degree of agility* and *value congruence* as predictors for project success. These predictors were entered to the model using the forced entry method. In table 14, the results of model 3 are presented. As suggested by the results, degree of agility and value congruence are the most important predictors for project success on project level. Based on the results of table 14, project success could be predicted on project level using the following formula:

Project success = .56 * degree of agility + .26 * value congruence + E

Table 14

Model 3 regression analysis on project level.

	B	*SE B*	β
Constant	0.56	.55	
Degree of Agility	.56	.14	.52**
Value Congruence	0.26	.12	.28*
R^2	.47		
F	16.07		

Note: * p < .05, ** p < .01

4.2 Different perspectives on project success

Team members, Scrum Masters and product owners all assessed project success. Therefore, it is interesting to examine whether these roles interpret, or experience, project success equally. Before comparing project success measures of all roles on individual level, we examined the distribution of the variable project success. The Shapiro-Wilk test showed that all performance measures were normally distributed: team members (p = .076), Scrum Masters (p = .560), product owners (p = .121).

T-tests showed that there were no significant differences in ratings for project success between roles. Team members did not give significant different ratings for project success (*M* = 3.60, *SE*= 0.43) than Scrum Masters (*M* = 3.76, *SE*= 0.58), *t*(97) = -1.57, *p* = .15. Second, ratings for project success from team members did not significantly differ (*M* = 3.60, *SE*= 0.43) from ratings from product owners (*M* = 3.57, *SE*= 0.61), *t*(87) = 0.22, *p* = .83. Last, Scrum Masters did not give significant different ratings for project success (*M* = 3.76, *SE*= 0.58) than product owners (*M* = 3.57, *SE*= 0.61), *t*(92) = 1.52, *p* = .13. Hence, team members, Scrum Masters and product owners interpreted, or experienced project success equally in this study.

4.3 The mediating effect of value congruence

In order to examine the mediating role of value congruence on project success, mediation analyses were conducted following Baron and Kenny's (1986) mediational procedure. In accordance with this procedure, the existence of significant relationships between each candidate success factor and project success were first examined using PROCESS for SPSS (Hayes, 2008). Based on these results (table 10), three mediation analyses were conducted on individual level, and two mediation analyses were conducted on project level. Below, results of the analyses will be presented per level.

4.3.1 Individual level

On the individual level (N = 141), three mediation models were tested in order to assess the expected mediating role of value congruence on project success. Regression analyses conducted with PROCESS

suggested that mediation could occur in the relationships between (1) transformational leadership evaluated by team members and project success and (2) informal communication and project success, respectively hypothesis 1c and 2c. In addition, regression analyses indicated a possible mediation effect between (3) degree of agility and project success. This mediation model was examined as well.

Hypothesis 1c cannot be rejected. The predictor variable (transformational leadership evaluated by team members) was significantly related to both the proposed mediator (value congruence; R=.10, β = .32, $F(1, 44) = 4.67$, $p = .04$) and the outcome variable (project success; R=.13, β = .31, $F(1, 44) = 6.49$, $p = .01$)**.** Additionally, value congruence was significantly related to project success; R=.36, β = .42, $F(2, 43) = 12.18$, $p < .001$**.** To test for mediation, we conducted a mediation analysis with bootstrapping and entered transformational leadership evaluated by team members and value congruence as predictor variables and project success as the outcome variable. Results suggest that there was a significant indirect effect of transformational leadership evaluated by team members on project success through value congruence, $b = .134$, 95% CI [.020, .294]. This represents a relatively small effect, $\kappa^2 = .165$, 95% CI [.032, .309]. Importantly, the relationship between transformational leadership and project success was weaker in this analysis (β = .17; $t = 1.57$, $p = .12$) compared to the direct relationship (β = .31, p = .01). These results suggest full mediation (see figure 4).

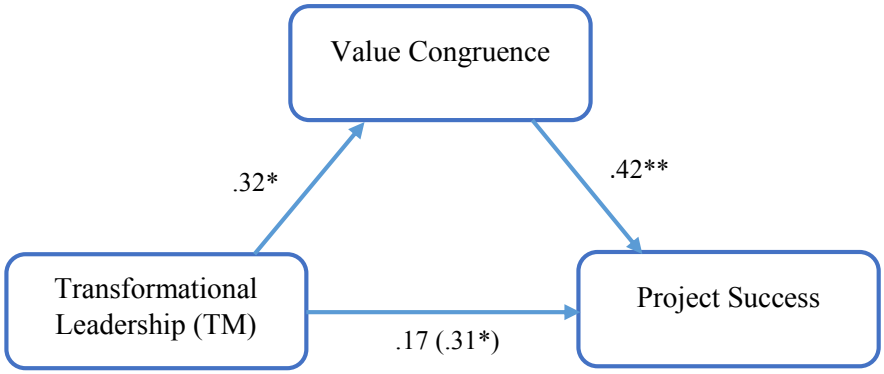


Figure 4: Mediation model 1.

Hypothesis 2c cannot be rejected on the individual level. The predictor variable (informal communication) was significantly related to both the proposed mediator (value congruence; R=.07, β = .33, $F(1, 97) = 7.42$, $p < .01$) and the outcome variable (project success; R=.05, β = .28, $F(1, 97) = 5.64$, $p < .05$)**.** Additionally, value congruence was significantly related to project success; R=.24, β = .43, $F(2, 96) = 14.89$, p **=** .00**.** To test for mediation, we conducted a mediation analysis with bootstrapping and entered informal communication and value congruence as predictor variables and project success as the outcome variable. Results suggest that there was a significant indirect effect of informal communication on project success through value congruence, $b = .140$, 95% CI [.024, 0.301]. This represents a relatively small effect, $k^2 = .121$, 95% CI [.018, .248]. Importantly, the relationship between informal communication and project success was weaker in this analysis (β =

.14; $t = 1.26$, $p = .21$) compared to the direct relationship (β = .28, p < .05). These results suggest full mediation (see figure 5).

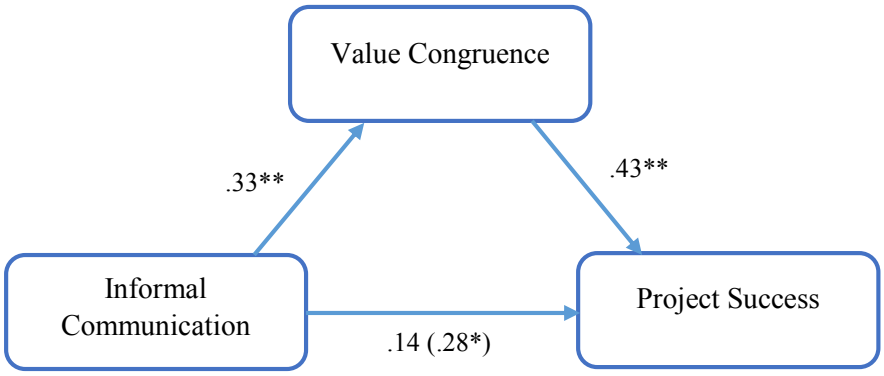


Figure 5: Mediation model 2

The third proposed mediation model was partially supported. The predictor variable (degree of agility) was significantly related to both the proposed mediator (value congruence; R=.17, β = .53, $F(1, 97) = 19.72$, $p < .01$) and the outcome variable (project success; R=.16, β = .49, $F(1, 97) = 18.18$, $p < .05$). Additionally, value congruence was significantly related to project success; R=.27, β = .36, $F(2, 96) = 18.08$, $p = .00$. To test for mediation, we conducted a mediation analysis with bootstrapping and entered degree of agility and value congruence as predictor variables and project success as the outcome variable. Results suggest that there was a significant indirect effect of degree of agility on project success through value congruence, $b = .19$, 95% CI [.064, 0.341]. This represents a relatively small effect, $\kappa^2 = .153$, 95% CI [.054, .054]. Importantly, the relationship between degree of agility and project success was weaker in this analysis (β = .30; $t = 2.56$, $p < .05$) compared to the direct relationship (β = .49, p < .001). These results suggest partial mediation (see figure 6).

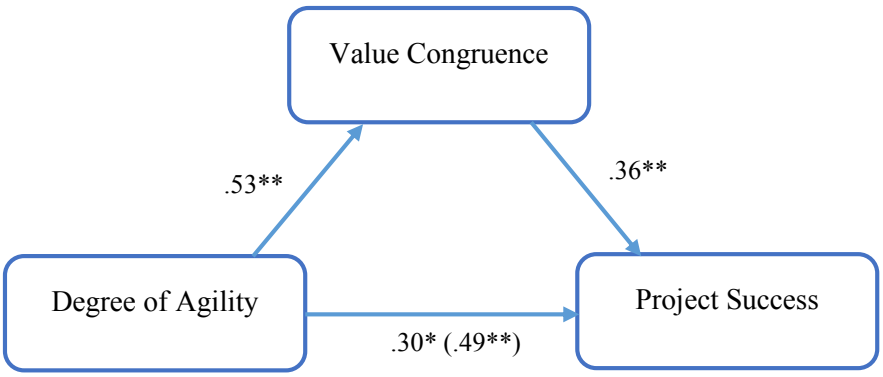


Figure 6: Mediation model 3

4.3.2 Project level

On project level (N = 40), two mediation models were tested in order to assess the expected mediating role of value congruence on project success. Regression analyses conducted with PROCESS suggested that mediation could occur in the relationship between (1) informal communication and project success. In addition, regression analyses indicated a possible mediation effect between (2) degree of agility and project success. This mediation model was examined as well.

Hypothesis 2c cannot be rejected on project level. The predictor variable (informal communication) was significantly related to both the proposed mediator (value congruence; R=.10, β = .40, $F(1, 38) = 4.16$, $p < .05$) and the outcome variable (project success; R=.09, β = .36, $F(1, 38) = 3.89$, $p = .056$)**.** Additionally, value congruence was significantly related to project success; R=.27, β = .41, $F(2, 37) = 6.85$, p **<** .01**.** To test for mediation, we conducted a mediation analysis with bootstrapping and entered informal communication and value congruence as predictor variables and project success as the outcome variable. Results suggest that there was a significant indirect effect of informal communication on project success through value congruence, b = .165, 95% CI [.016, 0.423]. This represents a relatively small effect, κ^2 = .142, 95% CI [.014, .319]. Importantly, the relationship between informal communication and project success was weaker in this analysis (β = .20; t = 1.12, p = .27) compared to the direct relationship (β = .36, p = .056). These results suggest full mediation (see figure 7).

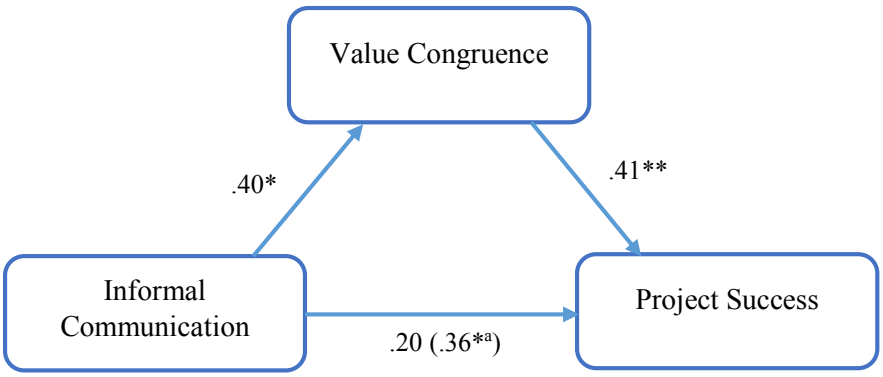


Figure 7: Mediation model 4
Note: [a] = p = .056

The second proposed mediation model cannot be rejected. The predictor variable (degree of agility) was significantly related to both the proposed mediator (value congruence; R=.18, β = .50, $F(1, 38)$ = 8.31, p < .01) and the outcome variable (project success; R=.69, β = .03, $F(1, 38)$ = 25.54**,** p = .00). Additionally, value congruence was significantly related to project success; R=.46, β = .26, $F(2, 37)$ = 16.07, p **=** .00**.** To test for mediation, we conducted a mediation analysis with bootstrapping and entered degree of agility and value congruence as predictor variables and project success as the outcome variable. Results suggest that there was a significant indirect effect of degree of agility on project success through value congruence, b = .127, 95% CI [.032, .330]. This represents a relatively small effect, κ^2 = .139, 95% CI [.034, .300]. Importantly, the relationship between degree of agility and project success was weaker in this analysis (β = .56; t = 3.89, p **<** .01) compared to the direct relationship (β **=** .69, p < .01). These results suggest partial mediation (see figure 8).

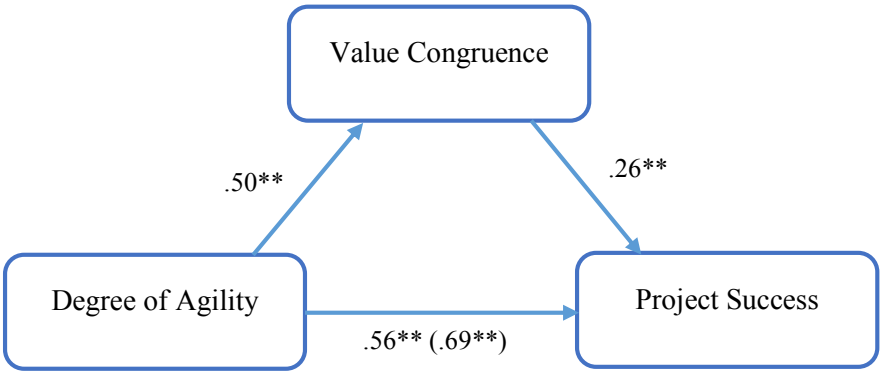


Figure 8: Mediation model 5

4.4 Chapter Conclusions

4.4.1 Candidate success factors as predictors for project success

Results of the regression analyses show that *value congruence* and *degree of agility* best predicted project success on both the individual and project level. On the individual level, respondents were treated as units of analyses, allowing for different roles to be compared. On project level, projects were units of analyses (different roles from the same projects were clustered), allowing for projects to be compared. Hence, scores on both levels strengthen each other. On the individual level, value congruence, degree of agility and transformational leadership as evaluated by Scrum Masters, explained 36% of the variance in project success scores. On project level, value congruence and degree of agility explained 47% of the variance in project success scores. Whereas transformational leadership is a significant predictor for project success on the individual level, this effect was not found on project level. This difference might be attributed to the lower number of observations on project level. On the individual level, scores on transformational leadership were separately included in the analyses, whereas scores were averaged on project level. Value congruence and degree of agility remained highly significant in the analyses on both levels, suggesting these are the most important predictors for project success in this model.

Although a significant correlation between informal communication and project success existed, informal communication was not a significant predictor for project success on neither level. Project size did not significantly predict project success on individual or project level. These results suggest that project size is less important than value congruence, degree of agility and transformational leadership as evaluated by Scrum Masters, in predicting project success. Moreover, project size is not an explaining factor here; project success is not explained by project size, but by value congruence. With an average project size of 21.53 team members (*SD* = 18.70, range from 3.75 to 80.0), it can be argued that Agile Software Development can be successfully applied in larger (complex) projects, as long as there is high value congruence and high degree of agility among project members.

4.4.2 The mediating effect of value congruence

Results of the mediation analyses show that value congruence is a mediating factor in the conceptual model on both the individual and project level. Mediation analyses were conducted when predictors were significantly related to both the proposed mediator (value congruence) and project success. On individual level, value congruence fully mediated the relationship between transformational leadership as evaluated by team members and project success, and the relationship between informal communication and project success. The relationship between degree of agility and project success was partially mediated by value congruence. On project level, value congruence fully mediated the relationship between informal communication and project success. The relationship between degree of agility and project success was partially mediated by value congruence. These results suggest that value congruence is an important factor in predicting project success. Based on these results, it can be argued

that when applying Agile methodologies, it is most important to facilitate high value congruence among project members. High value congruence can be established by maintaining a transformational leadership style and facilitating and stimulating informal communication.

5. Discussion and Future Research

5.1 Discussion

The purpose of this study was to examine whether leadership style, value congruence, degree of agility and informal communication are of significant influence in applying Agile methods in larger, complex projects. Most projects do not fail due to technology, but due to social and organizational deficits, and a lack of effective communication (Eckstein, 2013). In addition, larger projects fail more often than small projects, due to ineffective and unaligned teams (Bloch et al., 2011). Therefore, it is important to gain more understanding about these factors and their relation to project success. Agile methodologies are originally designed for, and considered beneficial, for small teams, and scaling up these methods is reported to be challenging (Cao et al., 2004; Kettunen & Laanti, 2007; Beck, 2000; Reifer, 2003; Boehm, 2002). However, larger projects and organizations are facing the same issues addressed by Agile methods. In addition, there are examples of large projects that are applying Agile methods successfully. This might be attributed to the effect of other factors such as leadership style and value congruence on project success, which might be of greater influence than project size. Based on the literature and explorative interviews with best practices, a conceptual model was developed regarding these candidate success factors in Agile Software Development. The goal of the study was, therefore, to validate and refine this model by examining relationships between these various factors and Agile project success.

This study aimed to answer the following two research questions: (1) are leadership style, communication style, value congruence and degree of agility related to Agile project success, and if so, how?; and (2) what is the role of project size in this possible relationship? Several hypotheses regarding these questions were tested. Three main findings were revealed that answer these questions:

1. Transformational leadership, value congruence, informal communication and degree of agility significantly correlated with project success. However, only value congruence, degree of agility, and transformational leadership as evaluated by Scrum Masters significantly predicted project success. Value congruence and degree of agility were most influential since they significantly predicted project success on both the individual and project level.
2. Project size did not significantly predict project success, suggesting Agile methods could be successfully applied in larger (complex) projects. Significant positive bivariate correlations existed between all candidate success factors and project success, except between project size and project success.
3. Value congruence is a mediating factor between candidate success factors and project success. Value congruence mediated the relationships between (1) transformational leadership as evaluated by team members and project success, (2) informal communication and project success and (3) degree of agility and project success.

Results support that the proposed candidate success factors are of influence on Agile project success, as all bivariate correlations were positively significant except for project size. In addition, value congruence, degree of agility and transformational leadership as evaluated by Scrum Masters significantly predict Agile project success. Research findings allow refinement of the proposed conceptual model into revised conceptual models regarding communication-related success factors in Agile Software Development. In appendix I and J, the revised conceptual models are presented on both the individual and project level. Practical implications of this model can be found in the management summary. Regression- and mediation analyses reveal that value congruence and degree of agility are the strongest predictors for project success, regardless of project size. This suggests that Agile methodologies could be successfully applied in larger projects, as long as value congruence and degree of agility are high. Below, we will further discuss the answers to the two research questions.

1. *Are leadership style, communication style, value congruence and degree of agility related to Agile project success, and if so, how?*

Our results show that value congruence, degree of agility, and transformational leadership as evaluated by Scrum Masters significantly predict project success. Although positive bivariate correlations existed between transformational leadership, value congruence, informal communication, degree of agility and project success, only three remained significant in the regression analyses. Value congruence explained various relationships between candidate success factors and project success, and was therefore identified as a mediating factor.

In prior research, value congruence was already identified as a success factor in (Agile) projects, which was confirmed in this study. Based on prior research, it was expected that transformational leadership would be more suitable in Agile Software Development than transactional leadership. Indeed, this study suggests that transformational leadership positively influences project success. In prior research, informal communication was found to be a success factor in Agile projects as well, which was not confirmed in this research. In this study, informal communication did not significantly predict project success, suggesting that other communication mechanisms might be of greater influence on project success. The specific amount of spontaneous, informal communication was not measured in this study, but there might be an optimum for the amount of informal communication (and formal documentation). In addition, participants were asked to self-assess the degree of informality. It is possible that results would be different (and more objective) when Agile teams would be observed by a researcher. Degree of agility was not included in prior research or explicitly identified as a success factor. This study shows, however, that degree of agility was a significant predictor for project success.

Degree of agility was included in the conceptual model and analyses as a control variable; to check whether participants believed they were working Agile, and to what degree. This factor was included since it was mentioned several times in the explorative interviews. Results suggest that degree

of agility is an important factor in predicting project success: when degree of agility was high, project success scores were higher as well. High degrees of agility indicated effective, aligned, self-organizing teams that were able to adequately respond to change, and therefore enhance project success. In projects that scored high on degree of agility, project members were aware of the underlying principles of the Agile method, and complied to these principles. In other words, project members knew what they were doing and why, leading to high (perceived) degrees of agility. Thus, it seems reasonable that high degrees of agility are crucial for project success. Based on these results, it can be argued that degree of agility should be further empirically explored. The relative importance of degree of agility in relation to project success is not identified in prior research yet. Therefore, this study contributes to the empirical identification of (new) success factors in Agile Software Development. In this study, we used an Agile checklist to indicate degree of agility. This scale was, in contrast to all other scales that were used, not validated in prior scientific research. However, Cronbach's alpha scores indicated that the scale was reliable and that measures were normally distributed. In addition, analyses showed highly significant effects of degree of agility on project success and value congruence. Hence, we argue that degree of agility is an important factor in predicting Agile project success.

On project level, the proposed formula implies that in Agile projects, the emphasis should be increasing degree of agility and value congruence. According to the formula, degree of agility is the most important factor to focus on when enhancing project success, since this factor has a weight of .56. whereas value congruence has a weight of .26. Value congruence, however, is both a predictor and mediating factor in relation to project success, and is the explaining factor for project success or failure. Therefore, we argue that value congruence and degree of agility are both important in increasing project success, and that there should be a focus on both of these factors.

2. *What is the role of project size in this possible relationship?*

Contrary to our expectations, project size did not significantly predict project success. No significant correlation was found between project size and project success, whereas all other candidate success factors were significantly positively related to project success. Based on the explorative interviews, we used the term complex projects rather than large projects. Interviewees mentioned that interdependence among teams and project members was more important than project size, in relation to project success. In this study, however, we only quantitatively measured project size. Interdependence was not measured in this study. The quantitative data do not prove the importance of interdependence over project size, but the qualitative data do confirm this argument. In addition, results show that project size does not significantly predict project success, suggesting the importance of other candidate success factors over project size in Agile Software Development. The average size of projects in this study was relatively high (21.53), but no significant (negative) correlation was found between project size and project success. In this study, project size was measured using one question regarding the total amount of project members. In several projects, team members, Scrum Masters and product owners answered this question

differently, resulting in deviation in scores. In these cases, we averaged the scores of respondents per project. It is possible that this led to measures that were not as accurate as possible. However, these scores did not highly deviate, and were therefore considered reliable. Based on these results, we argue in favour of the relative importance of value congruence, degree of agility and transformational leadership over project size in predicting Agile project success.

Based on the results, we argue that project size certainly can influence project success, but it is not an explaining factor. Indeed, larger IT projects do fail more often than smaller ones, but this failure cannot be necessarily explained by project size. We argue that the failure or success of projects can be explained by the degree of agility, value congruence and transformational leadership. Projects with high scores on these three factors, are more likely to score higher on project success, regardless of project size. Moreover, projects with high scores on all three success factors, are likely to score even higher on project success than projects that score high on only one or two success factors.

To summarize, the refined conceptual model provides new insights into the relationships between communication-related candidate success factors and project success in Agile Software Development. Results suggest that Agile methodologies could be successfully applied in larger, or complex projects, as long as there is high value congruence, high degree of agility and transformational leadership. Project success (or failure) can be influenced by project size, but it is explained by degree of agility, value congruence and transformational leadership. Further research is essential to make strong(er) statements about these arguments. Nevertheless, the significant relations between the various candidate success factors and project success indicate the importance of focussing on communication-related factors in Agile Software Development. These results contribute to the empirical identification of (new) success factors in Agile Software Development. In addition, this knowledge is useful for managers to build and manage Agile teams more effectively and enhance project success. Practical implications of this study are further discussed in the management summary.

5.2 Limitations and Future Research

It should be noted that this study has limitations. First, the scope of the data is somewhat limited since the data came from 19 different Dutch organizations. Results, therefore, cannot easily be generalized to a bigger population. However, analyses on both the individual and project level suggested overall similar results, making it more likely that results could be generalized. Moreover, these results apply to the domain of Agile Software Development specifically. Since this is a very specific discipline in software development, it seems reasonable that the results could be generalized to a certain extent. The conceptual model might be applicable in other domains as well, outside IT. Projects in general are likely to benefit from high value congruence and a suitable leadership style. Minor changes should probably be made to apply the conceptual model in other domains. Further research is needed to verify this. This study aimed

at the domain of Agile Software Development and we encourage further empirical research in other domains to justify generalizability of results.

Second, this study was cross-sectional rather than longitudinal. Therefore, no conclusive information about the causality between the candidate success factors and project success can be provided. A longitudinal study could examine if value congruence changes over time, and whether this is of significant influence on project success. In addition, it could provide insights into differences between projects that are working Agile for over a longer period of time and Agile projects that just started. It would be interestingly to examine whether experiences and interpretations of the various candidate success factors change over time.

Third, project success was not objectively measured in this study, which might have led to high explained variance. We strived for objectivity by using project success assessments from three different perspectives (team members, Scrum Masters and product owners). Future research should use an objective measure of project success in order to verify the results. In addition, this measurement should not only focus on effectiveness, but also on time and budget (efficiency), since these factors are crucial form a business perspective.

Fourth, degree of agility was not measured using a validated scale. No validated scales exist yet, to empirically measure degree of agility. In this study, degree of agility was included in the model after the explorative interviews. We incorporated this factor as a 'checklist', in order to verify if participants believed they were working Agile. Since prior research did not include degree of agility as a candidate success factor, future research is essential in order to develop an empirical, validated scale for measuring degree of agility. Results suggest, indeed, that there is a significant relationship between degree of agility and project success on both individual and project level, suggesting the relative importance of this factor in the model. Therefore, we argue degree of agility needs to be further empirically examined in future research.

Even though the proposed candidate success factors explained a significant proportion of variance in project success, there is still a part of the variance left unexplained. In this study, we focused on three roles, leaving other aspects such as organizational context and communication towards clients and the rest of the organization out of scope. The study design allowed for the mediating effect of value congruence to be tested, which was expected to be one of the most important aspects of the model. These other factors, however, should be further examined in future research. Other roles that were excluded in this study, such as end users, program managers and (line) organization, could be included in future research. We encourage future research which examines the effect of the proposed candidate success factors outside of projects. This could include the assessment of differences in effective leadership regarding the 'audience': which leadership style is most effective when interacting with clients, or the rest of the organization? These results could complement this study and provide more complete insights into communication-related success factors in Agile Software Development.

Fifth, we used both the terms complexity and large in this study, since it was mentioned in the explorative interviews that interdependence was probably more important than project size. In this study, we only quantitatively measured project size. Contrary to our expectations, project size did not significantly predict project success, suggesting other factors are more important. These results imply that Agile methods could be applied in larger projects, as long as there is high value congruence and high degree of agility. Future research is essential in order to make strong(er) statements about this. We considered interdependence too complex and important to include in this study. The qualitative data, however, supports the argument that project complexity is more important than project size. Complexity, however, can be defined by more than interdependence, for example business processes and technological components. Therefore, we encourage research being done about the division between project complexity and project size in relation to project success.

Last, the results of measures of project size raised several questions. In multiple projects, we found project members having different perceptions of reality regarding project size. Since these scores did not highly deviate, we did not consider averaging scores a problem in this study. It does raise questions though, about how projects are being defined by project members. It is possible that participants did not know exactly how many project members were working on the project, or that this information was not clearly communicated to everyone. Based on the explorative interviews, we argue that openness, a shared mental context (value congruence) and knowing why Agile was chosen, are key factors in successfully applying Agile methods. Mutual perception of project size among all project members seems in line with these factors. Future research should explore awareness of project members in Agile projects on the success factors, in order to examine these disagreements.

6. Conclusion

Agile development methods have gained considerable traction. Many questions remain, however, about successfully applying Agile methods in larger projects and/or larger organizations. Research has shown that Agile methodologies are successful for small teams and projects, and that scaling up these methods is challenging (Cao et al., 2004; Beck, 2000; Reifer, 2003; Boehm, 2002). However, larger organizations are facing the same issues addressed by Agile methodologies (Cao et al., 2004). In such situations, communication-related factors may be determinant. Most projects do not fail due to technology, but due to social and organizational deficits, and a lack of effective communication (Eckstein, 2013). Therefore, it is important to gain better understanding about which social factors are of significant influence in Agile project success. Based on explorative interviews and prior research, a new, more comprehensive conceptual model was developed including five candidate success factors in Agile project success: *transformational leadership*, *communication style*, *value congruence*, *degree of agility* and *project size*. The aim of this research was (1) independently verify some of the identified Agile project success factors; (2) develop a tentative conceptual model regarding candidate success factors in Agile Software Development; and (3) validate this model by examining relationships between these various factors and Agile project success. The model was tested using data from 141 team members, Scrum Masters and product owners from 40 projects from 19 Dutch organizations. Furthermore, we examined the influence of project size on Agile project success.

This study contributes to the empirical identification of (new) communication-related success factors in Agile Software Development, by providing a validated conceptual model. The results of this study reveal three main findings: (1) *value congruence*, *degree of agility* and *transformational leadership as evaluated by Scrum Masters* are the strongest predictors for project success in this model; (2) project size did not significantly predict project success, suggesting Agile methods could be successfully applied in larger (complex) projects as long as there is high value congruence and high degree of agility; and (3) value congruence is a mediating factor between candidate success factors and project success.

However, critical notes were given about the generalizability of our results. Further research on a larger scale, over a longer period of time should be conducted in order to validate the model. In addition, validation of the model in other domains could be examined in future research. In order to further explore the influence of project complexity on project success, we encourage future research on the distinction between project size and project complexity (interdependence, business processes, technological components) among teams and team members. Nevertheless, our results do confirm the importance of several social factors in successfully applying Agile methods also in larger projects.

References

Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J. (2002). Agile software development methods: Review and analysis.

Ambler, S. (2005). Quality in an agile world. *Software Quality Professional, 7(4),* 34–40.

Anantatmula, V. S. (2010). Project manager leadership role in improving project performance. *Engineering Management Journal; EMJ*, *22*(1), 13.

Augustine, S., Payne, B., Sencindiver, F., & Woodcock, S. (2005). Agile project management: steering from the edges. *Communications of the ACM*, *48*(12), 85-89.

Baron, R.M., & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.

Bass, B.M. (1985). *Leadership and performance beyond expectations*. New York: Free Press.

Bass, B. M. & Aviolo, B. J. (1998). Improving Organizational Effectiveness through Transformational Leadership. In: G.R. Hickman (Ed.), *Leading Organizations*, *Perspectives for a New Era* (135-140). Thousand Oaks: Sage Publications.

Bass, B.M. & Riggio, R.E. (2012). *Transformational leadership*. Psychology Press.

Baumeister, H. (2004). Extreme programming and agile processes in software engineering.

Beck, K. (2000). *Extreme programming explained: embrace change*. Addison-Wesley Professional.

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J. & Thomas, D. (2001). Manifesto for Agile Software Development *Manifesto for Agile Software Development*.

Bennis, W. (2001). Leading in unnerving times. *MIT Sloan Management Review, 42,* 97–102.

Bloch, M., Blumberg, S., & Laartz, J. (2011). Delivering large-scale IT projects on time, on budget, and on value. *Harvard Business Review*.

Boehm, B. (2002). Get ready for agile methods, with care. *Computer*, *35*(1), 64-69.

Boehm, B. & Turner, R. (2003). Using risk to balance agile and plan-driven methods. *Computer*, *36*(6), 57-66.

Boehm, B. & Turner, R. (2003). People factors in software management: lessons from comparing agile and plan-driven methods. *CrossTalk: The Journal of Defense Software Engineering*, *16*(12), 4-8.

Boyd, N. G., & Taylor, R. R. (1998). A developmental approach to the examination of friendship in leader-follower relationships. *The Leadership Quarterly*, *9*(1), 1-25.

Cao, L., Mohan, K., Xu, P., & Ramesh, B. (2004). How extreme does extreme programming have to be? Adapting XP practices to large-scale projects. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on* (pp. 10-pp). IEEE.

Cartwright, D. & Zander, A. (Eds.). (1968). *Group dynamics: Research and theory* (3rd ed.). New York:

Harper & Row.

Ceschi, M., Sillitti, A., Succi, G., & De Panfilis, S. (2005). Project management in plan-based and agile companies. *Software, IEEE*, *22*(3), 21-27.

Chow, T., & Cao, D. B. (2008). A survey study of critical success factors in agile software projects *Journal of Systems and Software*, *81(6)*, 961-971.

Cockburn, A. (2000). Agile software development. *Cockburn* Highsmith Series Editor*.

Cockburn, A., & Highsmith, J. (2001). Agile software development: The people factor. *Computer*, *34*(11), 131-133.

Cockburn, A., & Williams, L. (2003). Agile software development: It's about feedback and change. *Computer*, *36*(6), 0039-43.

Curtis, B., Krasner, H., & Iscoe, N. (1988). A field study of the software design process for large systems. *Communications of the ACM*, *31*(11), 1268-1287.

Daft, R.L. & Lengel, L.H. (1984). Information Richness: A New Approach to Manager Information Processing and Organization Design," in Staw, B. & Cummings, L.L. (Eds.) *Research in Organizational Behavior*. Greenwich: JAI Press.

Dalcher, D., Benediktsson, O., & Thorbergsson, H. (2005, April). Development life cycle management: a multiproject experiment. In *Engineering of Computer-Based Systems, 2005. ECBS'05. 12th IEEE International Conference and Workshops on the* (pp. 289-296). IEEE.

Dose, J. J., & Klimoski, R. J. (1999). The diversity of diversity: Work values effects on formative team processes. *Human Resource Management Review*,*9*(1), 83-108.

Dulewicz, V. & Higgs, M.J. (2003). *Design of a new instrument to assess leadership dimensions and styles*. Reading, UK, University of Reading (Henley Working Paper Series, (HWP 0311)).

Dybå, T. (2000). Improvisation in Small Software Organizations: Implications for Software Process Improvement. *IEEE Software*, *17*(5), 82-87.

Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and software technology*, *50*(9), 833-859.

Eckstein, J. (2013). *Agile software development in the large: Diving into the deep*. Addison-Wesley.

Edwards, J. R., & Cable, D. M. (2009). The value of value congruence. *Journal of Applied Psychology, 94*(3), 654.

Erdogan, B., Kraimer, M. L., & Liden, R. C. (2004). Work Value Congruence And Intrinsic Career Success: The Compensatory Roles Of Leader-Member Exchange And Perceived Organizational Support. *Personnel Psychology*, *57*(2), 305-332.

Evans, J.R. & Mathur, A. (2005). The value of online surveys. *Internet Research, 15*(2), 195-219.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Gillham, B. (2005). *Research Interviewing: The Range of Techniques: A Practical Guide*. McGraw-Hill International.

Hackman, J. R. (1987). The design of work teams. In J. Lorsch (eds.). *Handbook of organizational*

behavior, pp. 315-342. New York: Prentice Hall.

Hackman, J.R. (1990). *Groups that work (and those that don't)*. San Francisco: Jossey-Bass.

Hayes, A. F. (2008). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

Henttonen, K., & Blomqvist, K. (2005). Managing distance in a global virtual team: the evolution of trust through technology-mediated relational communication. *Strategic Change*, *14*(2), 107-119.

Highsmith, J. (2003). Agile project management: Principles and Tools. *Agile Project Management Advisory Service Executive Report*.

Hoegl, M. & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization Science*, *12*(4), 435-449.

Hummel, M., Rosenkranz, C., & Holten, R. (2013). The Role of Communication in Agile Systems Development. *Business & Information Systems Engineering*,*5*(5), 343-355.

Ilieva, S., Ivanov, P., & Stefanova, E. (2004, August). Analyses of an agile methodology implementation. In *Euromicro Conference, 2004. Proceedings. 30th* (pp. 326-333). IEEE.

Jehn, K. A. (1994). Enhancing effectiveness: an investigation of advantages and disadvantages of value based intra-group conflict. *International Journal of Conflict Management*, *5*(3), 223-238.

Jehn, K.A. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative Science Quarterly*, *40(2)*, pp. 256-83.

Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field study of diversity, conflict and performance in workgroups. *Administrative science quarterly*, *44*(4), 741-763.

Jones, M. C., & Harrison, A. W. (1996). IS project team performance: an empirical assessment. *Information & Management*, *31*(2), 57-65.

Jung, D. I., & Avolio, B. J. (2000). Opening the black box: An experimental investigation of the mediating effects of trust and value congruence on transformational and transactional leadership. *Journal of organizational Behavior*, *21*(8), 949-964.

Kahkonen, T. (2004). Agile methods for large organizations-building communities of practice. In *Agile Development Conference, 2004* (pp. 2-10). IEEE.

Katz, R., & Allen, T. J. (1988). Investigating the not invented here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R&D project groups. In M.L. Tushman, W.L. Moore (eds.). *Readings in the Management of Innovations*, pp. 293-309. Cambridge, MA: Ballinger Publishing Company.

Katz, D. & Kahn, R.L. (1978). *The Social Psychology of Organizations*. New York: Wiley.

Kettunen, P., & Laanti, M. (2008). Combining agile software projects and large-scale organizational agility. *Software Process: Improvement and Practice*,*13*(2), 183-193.

Larman, C. (2004). *Agile and iterative development: a manager's guide*. Addison-Wesley Professional.

Layman, L., Williams, L., & Cunningham, L. (2004, June). Exploring extreme programming in context: An industrial case study. In *Agile Development Conference, 2004* (pp. 32-41). IEEE.

Lindvall, M., Basili, V., Boehm, B., Costa, P., Dangle, K., Shull, F., ... & Zelkowitz, M. (2002). Empirical findings in agile methods. In *Extreme Programming and Agile Methods—XP/Agile Universe 2002* (pp. 197-207). Springer Berlin Heidelberg.

Lindvall, M., Muthig, D., Dagnino, A., Wallin, C., Stupperich, M., Kiefer, D., ... & Kahkonen, T. (2004). Agile software development in large organizations.*Computer*, *37*(12), 26-34.

Liang, T. P., Wu, J. C. H., Jiang, J. J., & Klein, G. (2012). The impact of value diversity on information system development projects. *International Journal of Project Management*, *30*(6), 31-739.

Lu, Y., Xiang, C., Wang, B. & Xiaopeng, W. (2010). What affects information systems development team performance? An exploratory study from the perspective of combined socio-technical theory and coordination theory. *Computers in Human Behavior, 27*(2), 811-822.

Mannaro, K., Melis, M., & Marchesi, M. (2004). Empirical analysis on the satisfaction of it employees comparing xp practices with other software development methodologies. In *Extreme Programming and Agile Processes in Software Engineering* (pp. 166-174). Springer Berlin Heidelberg.

Martin, R. C. (2000). Extreme programming development through dialog. *Software, IEEE*, *17*(4), 12-13.

McMahon, P. (2005). Extending agile methods: A distributed project and organizational improvement perspective. *CrossTalk, May*.

Mackenzie, A., & Monk, S. (2004). From cards to code: How extreme programming re-embodies programming as a collective practice. *Computer Supported Cooperative Work (CSCW)*, *13*(1), 91-117.

Medinilla, Á. (2012). *Agile Management: Leadership in an Agile Environment*. Springer.

Meglino, B. M., & Ravlin, E. C. (1998). Individual values in organizations: Concepts, controversies, and research. *Journal of management*, *24*(3), 351-389.

Melnik, G., & Maurer, F. (2004). Direct verbal communication as a catalyst of agile knowledge sharing. In *Agile Development Conference, 2004*, IEEE, 21-31.

Miller, G. G. (2001). The characteristics of agile software processes. In*Technology of Object-Oriented Languages, International Conference on* (pp. 0385-0385). IEEE Computer Society.

Müller, R., & Turner, J. R. (2007). Matching the project manager's leadership style to project type. *International Journal of Project Management*, *25*(1), 21-32.

Misra, S. C., Kumar, V., & Kumar, U. (2006). Success Factors of Agile Software Development. In *Software Engineering Research and Practice*, 233-239.

Misra, S. C., Kumar, V., & Kumar, U. (2009). Identifying some important success factors in adopting agile software development practices. *Journal of Systems and Software*, *82*(11), 1869-1890.

Müller, R. (2003). Communication of information technology project sponsors and sellers in buyer seller relationships. *DBA Thesis*. *UK: Henley Management College, Henley-on-Thames*.

Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Communications of the ACM*, *48*(5), 72-78.

Nerur, S., & Balijepally, V. (2007). Theoretical reflections on agile development methodologies. *Communications of the ACM*, *50*(3), 79-83.

Nohria, N., & Ghoshal, S. (1994). Differentiated fit and shared values: Alternatives for managing headquarters-subsidiary relations. *Strategic Management Journal*, *15*(6), 491-502.

Ouchi, W.G. (1980). Markets, bureaucracies, and clans. *Administrative Science Quarterly (34)*, 21-37.

Petersen, K. (2010). *Implementing Lean and Agile software development in industry*.

Pikkarainen, M., Haikara, J., Salo, O., Abrahamsson, P., & Still, J. (2008). The impact of agile practices on communication in software development. *Empirical Software Engineering*, *13*(3), 303-337.

Reifer, D.J. (2003). XP and the CMM. *IEEE Software, 20 (3)*.

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *Bmj*,*320*(7227), 114-116.

Reifer, D. J., Maurer, F., & Erdogmus, H. (2003). Scaling agile methods.*Software, IEEE*, *20*(4), 12-14.

Riege, A. (2005). Three-dozen knowledge-sharing barriers managers must consider. *Journal of knowledge management*, *9*(3), 18-35.

Robinson, H., & Sharp, H. (2004). The characteristics of XP teams. In *Extreme Programming and Agile Processes in Software Engineering* (pp. 139-147). Springer Berlin Heidelberg.

Robinson, H. & Sharp, H. (2005). The social side of technical practices. *Extreme Programming and Agile Processess in Software Engineering* (pp. 100-108). Springer Berlin Heidelberg.

Schwaber, K. & Beedle, M. (2002). *Agile Software Development with SCRUM*.

Shaw, M.E. (1981). *Group Dynamics: The Psychology of Small Group Behaviour* (3rd ed.). New York: McGraw-Hill.

Sircar, S., Nerur, S. P., & Mahapatra, R. (2001). Revolution or evolution? A comparison of object oriented and structured systems development methods. *MIS Quarterly*, 457-471.

The Standish Group (2009). Chaos Summary Report 2009: The 10 laws of CHAOS. Technical Report. Boston, MA: The Standish Group International.

Truex, D. P., Baskerville, R., & Klein, H. (1999). Growing systems in emergent organizations. *Communications of the ACM*, *42*(8), 117-123.

Turner, J. R., & Müller, R. (2004). Communication and co-operation on projects between the project owner as principal and the project manager as agent. *European Management Journal*, *22*(3), 327-336.

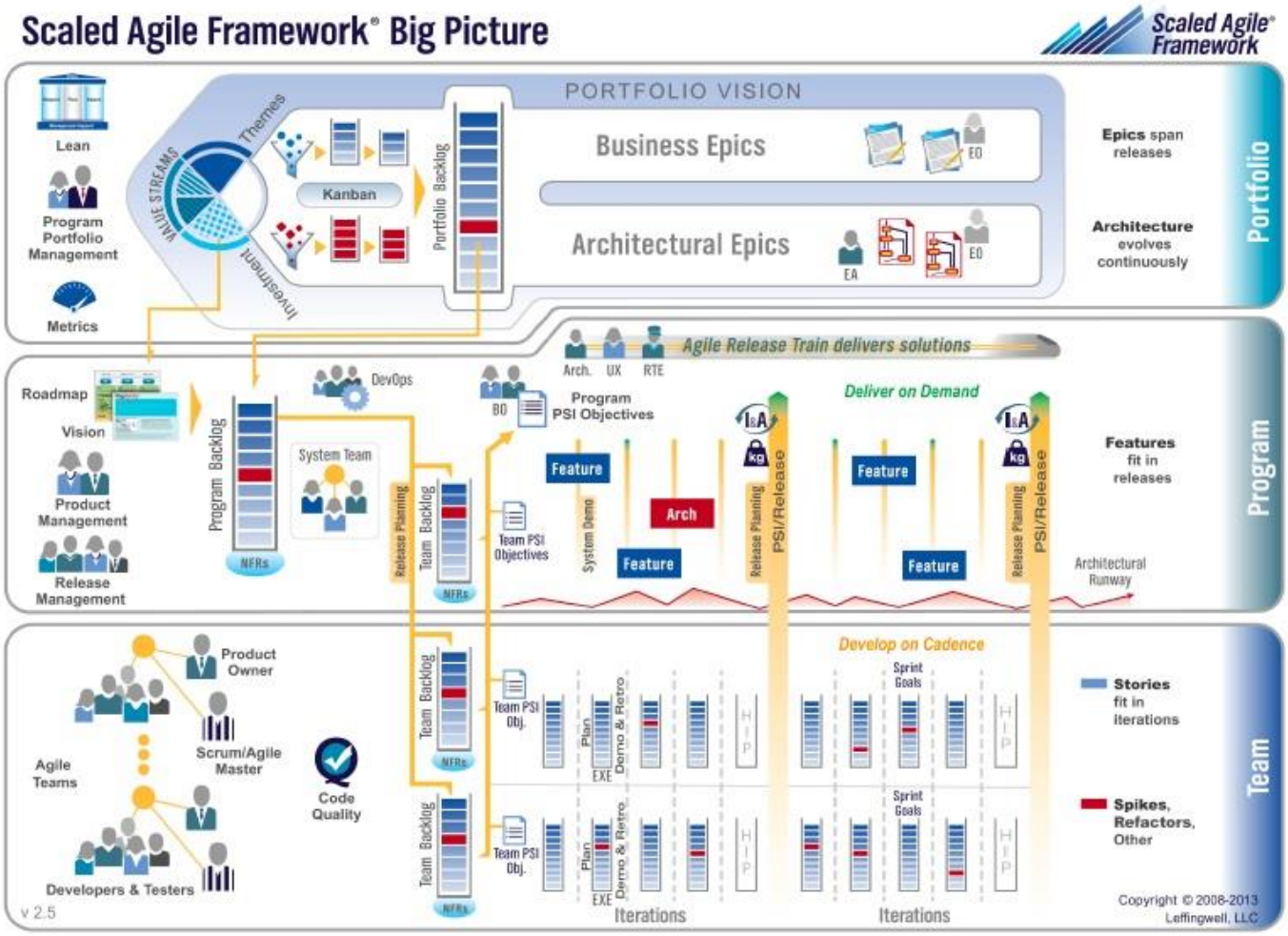
Wang, E. T., Wei, H. L., Jiang, J. J., & Klein, G. (2006). User diversity impact on project performance in an environment with organizational technology learning and management review processes. *International Journal of Project Management*, *24*(5), 405-411.

Waters, M., & Bevan, J. (2005). Journey to lean [lean practices in aerospace product development].

Engineering Management, *15*(4), 10-13.

Zmud, R. W. (1980). Management of large software development efforts. *MIS Quarterly*, 45-55.

Appendix A: Scaled Agile Framework (SAFe).



Appendix B: Distilled summaries of the explorative interviews.

A) General information about projects

Reasons to start applying Agile methods differed among participating organizations. In some cases, it was acknowledged that a cultural change was required, and Agile methods suited this change. In these cases, the whole organization changed and applying Agile methods was more of a change in mind-set. In other cases, Agile was considered suitable for one (or several) projects solely. A part of the organization started working Agile, while the rest of the organization was not. Sometimes, this led to misunderstandings or less motivated project members. In most cases however, partially applying Agile was no problem whatsoever, according to the respondents. Most of the participating organizations applied the Scaled Agile Framework (SAFe)[12] when implementing Agile practices at enterprise scale. The main conclusion was that the Agile method of choice needed to suit the project, organization and project members. It had to be clear to all who were involved why the choice was being made to start applying Agile methods, how it would help and what was expected of those who were involved. degree of agility differed among respondents, suggesting that when degree of agility was high, project success was evaluated higher as well.

In terms of project size, an important outcome of the interviews was that it was interdependence of teams rather than number of teams that was crucial in collaboration, and therefore project success. Physical proximity, informal communication and value diversity seem to be of significantly greater importance for interdependent teams. This suggests that the number of teams is not most important when scaling Agile, but rather the degree of interdependence between teams: the more teams are interdependent, the more complex and harder it is to apply Agile successfully. Interdependence will not be measured in this study, since it is considered as something that should be explored in a follow-up study due to the expected importance and complexity.

B) Agile and Leadership

One of the most often mentioned outcomes regarding Agile and Leadership, was that a Scrum Master should act in a facilitating, coaching way. In several interviews, it was mentioned that a good Scrum Master facilitates, coaches, motivates, gives constructive feedback and shows personal involvement. As a Scrum Master, it is important to interfere as little as possible with the content and how team members work, but rather be concerned with the process. This does not mean that project leaders are not involved in the content and work, it means that project leaders act in a way that allows them to keep an overview. They provide support when needed or asked for, show that they trust the team members and make sure that main goals and sub goals remain distinct. Furthermore, it was often mentioned that Scrum Masters that were able to inspire and (intrinsically) motivate project members could contribute to project success.

[12] Scaledagileframework.com

Another important task of the Scrum Master, according to the outcomes of the interviews, was that they should facilitate a shared mental context among project members. This shared mental context could also be referred to as shared values: project members with shared (work) values will be more trusting, productive and satisfied. Creating shared values starts with getting to know each other. It was mentioned that, as a project leader, you serve as a role model and facilitator. Talking about beliefs and values will help getting to know each other, building trust, and improve collaboration and might therefore enhance project success.

Equal division of power was considered another success factor in Agile projects. Within Agile projects, there should not be strived for a hierarchical structure, but rather for an equal division of power and responsibility. This presumes that there is mutual trust between project members; trust is essential here. The earlier mentioned facilitating, coaching role of the project leader is considered crucial here by the interviewees. Scrum Masters should serve as role models, showing that they trust project members enough to make decisions. According to the interviews, it is most effective when decisions are being made by those who concerns it and know the most about it. Some respondents mentioned that taking responsibility was often an issue: not everyone is willing to do so, or is afraid to take responsibility. Again, project leaders can play a crucial role here by acting in a way that motivates, inspires and shows trust and personal involvement.

A last valuable insight concerns the required flexibility and adaptability of Scrum Masters. Interviewees suggested that Scrum Masters should be able to 'adapt to their audience'. They often operate as 'the man in the middle', interacting frequently with both team members and product owners. Issues considered highly important by team members could be considered less important by product owners and vice versa. Furthermore, the same issue, problem or question sometimes needs to be explained or discussed in different ways to team members and product owners. Scrum Masters should be able to make some sort of translations in order to ensure alignment.

In sum, Scrum Masters should fulfil a facilitating, motivating, coaching role within Agile projects, and focus on the process to enhance project success (Highsmith, 2003; Medinilla, 2012; Cockburn & Highsmith, 2001). They serve as role models, and should express trust in project members. Division of power and decision making can help enhance project success since it can decrease decision time and meetings (Moe et al., 2009). By getting to know project members, shared values can be created which can contribute to effective and successful collaboration (Nohria & Ghoshal, 1994; Jehn, 1994; Jehn et al., 1999). Finally, Scrum Masters should be flexible and adaptive (Augustine et al., 2005) in order to ensure alignment among project members.

C) Agile and Communication

One of the most important outcomes of the interviews regarding Agile and Communication relates to the earlier mentioned importance of knowing fellow project members. Communication can contribute to these interpersonal relationships in a highly effective manner. According to the interviewees, one of

the most important aspects is that informal face-to-face contact in the beginning of a project is crucial in building trust and in building valued interpersonal relationships. Once Scrum Masters established valued relationships, discussions become more effective and productive, and shared values can be created, which in turn can enhance project success. As mentioned above, Scrum Masters play a key role in this establishment of relationships, trust and shared values. Openness and honesty are crucial elements for project success as well, according to the interviews. Respondents considered it important that everyone involved in the project knew what was going on, why certain decisions were made and that everyone had access to the product backlog at all times. The product backlog provides the basis for the shared mental context, or values. Knowing what is going on and why enhances involvement and motivation, as stated by respondents.

Based on the interviews, both communication style and communication channel can contribute to shared values and project success. In terms of communication style, several insights were gained from the interviews. Agile methods value and require high frequency of face-to-face communication[13] (Beedle, et al., 2001). Therefore, it seems reasonable that informal communication is an essential part as well. According to the respondents, informal communication (e.g. spontaneous conversations, conversations in the coffee corners and conversations about non-work-related topics) are crucial in establishing trust and relationships. This does not only hold for team members, but for everyone involved in the project. Informal communication between team members and Scrum Masters, between team members and product owners, and between Scrum Masters and product owners stimulates equivalence and therefore project success. Frequent informal communication can decrease perceived physical proximity and enhance interpersonal relationships among all levels.

In terms of communication channel, so called 'rich mediums' were considered more effective and valuable than mediums that are less 'rich'. Rich mediums enable communication that is rich in cues: verbal and non-verbal cues can be perceived through rich mediums (Daft & Lengel, 1986). Face-to-face communication is the richest medium, conference calls are a little less rich, but still allow for both visual and verbal cues to be perceived. Mediums like e-mail and letters are considered poor media, since they do not allow for synchronous communication or noticing verbal or visual cues. Face-to-face communication was considered the most important medium, which is in line with the Agile principles. Especially in the beginning of projects, face-to-face communication is highly important in order to get to know each other and establish interpersonal relationships and shared values. Physical proximity, therefore, was considered crucial in the beginning of Agile projects. As projects endure, and project members already know each other and have valued interpersonal relationships, communication channel becomes less crucial in some situations, according to the interviewees: particular meetings could take place via conference calls, where they would held face-to-face in the beginning of a project.

[13] Agile manifesto. *Online at http://www.agilemanifesto.org*.

In short, communication style serves an important function in establishing interpersonal relationships between all project members. Informal communication can contribute to building trust and shared values (Nerur et al., 2005; Lindvall et al., 2002; Müller, 2003; Henttonen & Blomqvist, 2005), which can enhance interpersonal relationships within groups and reduce conflict (Hackman, 1990; Jehn, 1994). Note that trust, shared values and interpersonal relationships were considered crucial success factors in (Agile) projects (Nerur et al., 2005; Nohria & Ghoshal, 1994; Jehn, 1994; Jehn et al., 1999; Liang, Wu, Jiang & Klein, 2012; Storck, 2000; Henttonen & Blomqvist, 2005). Communication channels that allow for synchronous communication and therefore perceiving non-verbal and verbal cues, were considered most successful in Agile projects by respondents. Especially in the beginning of projects, physical proximity was crucial according to the interviewees, since it enables informal face-to-face communication.

Appendix C: Questionnaire for Team Members.

Page 1.

Thank you for participating in our research about communication around Agile. This study focuses on the role of communication and leadership style in Agile Software Development. With your participation, you play an important role in the scientific research about Agile Software Development.

The link to the online questionnaire can be found at the bottom of this email. Filling out the survey will take about 15 minutes. All questions relate to your opinion and experiences; no wrong answers can be given. As researchers, we adhere to the law of personal protection and the "Conduct for the use of personal information in scientific research" of Tilburg university. The questionnaire is completely anonymous and confidential.

Good luck!
Evelyn van Kelle

Page 2.

1. Company name

2. Project name

3. Team name

4. The project is

0 Concluded
0 Ongoing
0 About to start

5. Project size

Please estimate the total number of project members.

6. Project role

0 Team Member

0 Scrum Master/Project leader

0 Product owner

7. Gender

0 Male

0 Female

8. Age

Page 3.

9. Perceived Agility

Please indicate how the project scores on the following statements. (Slider)

1. Communication is open, based on trust and mostly face to face.	0	100
2. Team members work together in physical proximity.	0	100
3. Teams are self-organizing, cross-functional and exist of 7 +/- 2 members.	0	100
4. Frequency of delivery working software (0 = twice a year, 100 = every week)	0	100
5. Teams are able to execute changes: goals are met.	0	100
6. There is not too much and not too little planning, and the planning can be modified.	0	100
7. Progression is measured in business value.	0	100
8. Progression is measured in working software.	0	100

Page 4.

10. Leadership style

The following statements relate to the Scrum Master (or project leaders) of the project in which you are/were involved. The statements are about how you perceived his/her leadership style during the project.

Please give your opinion about the following statements:

		Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always
1.	My Scrum Master provides others with assistance in exchange for their efforts.	O	O	O	O	O
2.	My Scrum Master re-examines critical assumptions to question whether they are appropriate.	O	O	O	O	O
3.	My Scrum Master fails to interfere until problems become serious.	O	O	O	O	O
4.	My Scrum Master focuses attention on irregularities, mistakes, expectations, and deviations from standards.	O	O	O	O	O
5.	My Scrum Master avoids getting involved when important issues arise.	O	O	O	O	O
6.	My Scrum Master talks about my most important values and beliefs.	O	O	O	O	O
7.	My Scrum Master is absent when needed.	O	O	O	O	O
8.	My Scrum Master seeks differing perspectives when solving problems.	O	O	O	O	O
9.	My Scrum Master talks optimistically about the future.	O	O	O	O	O
10.	My Scrum Master instils pride in others for being associated with him/her.	O	O	O	O	O
11.	My Scrum Master discusses in specific terms who is responsible for achieving performance targets.	O	O	O	O	O

12.	My Scrum Master waits for things to go wrong before he/she takes action.	O	O	O	O	O
13.	My Scrum Master talks enthusiastically about what needs to be accomplished.	O	O	O	O	O
14.	My Scrum Master specifies the importance of having a strong sense of purpose.	O	O	O	O	O
15.	My Scrum Master spends time teaching and coaching.	O	O	O	O	O
16.	My Scrum Master makes clear what one can expect to receive when performance goals are achieved.	O	O	O	O	O
17.	My Scrum Master shows that he/she is a firm believer in “if it ain’t broke, don’t fix it”.	O	O	O	O	O
18.	My Scrum Master goes beyond self-interest for the good of the group.	O	O	O	O	O
19.	My Scrum Master treats others as individuals rather than just as a member of the group.	O	O	O	O	O
20.	My Scrum Master demonstrates that problems must become chronic before he/she takes action.	O	O	O	O	O
21.	My Scrum Master acts in ways that build others’ respect for him/her.	O	O	O	O	O
22.	My Scrum Master concentrates his/her full attention on dealing with mistakes, complaints and failures.	O	O	O	O	O
23.	My Scrum Master considers the moral and ethical consequences of decisions.	O	O	O	O	O
24.	My Scrum Master keeps track of all mistakes.	O	O	O	O	O
25.	My Scrum Master displays a sense of power and confidence.	O	O	O	O	O
26.	My Scrum Master articulates a compelling vision of the future.	O	O	O	O	O
27.	My Scrum Master directs his/her attention toward failures to meet standards.	O	O	O	O	O

28.	My Scrum Master avoids making decisions.	O	O	O	O	O
29.	My Scrum Master considers an individual as having different needs, abilities and aspirations from others.	O	O	O	O	O
30.	My Scrum Master gets others to look at problems form many different angles.	O	O	O	O	O
31.	My Scrum Master helps others to develop their strengths.	O	O	O	O	O
32.	My Scrum Master suggests new ways of looking at how to complete assignments.	O	O	O	O	O
33.	My Scrum Master delays responding to urgent questions.	O	O	O	O	O
34.	My Scrum Master emphasizes the importance of having a collective sense of mission.	O	O	O	O	O
35.	My Scrum Master expresses satisfaction when others meet expectations.	O	O	O	O	O
36.	My Scrum Master expresses confidence that goals will be achieved.	O	O	O	O	O

Page 5.

11. Communication style

The following statements relate to the communication style between team members and project leader/Scrum Master.

Please give your opinion about the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. There is frequent face-to-face contact between team members and the Scrum Master.	O	O	O	O	O
2. Team members and Scrum Masters communicate often in spontaneous meeting, phone conversations, etc.	O	O	O	O	O

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3. Meetings between team members and Scrum Masters are rather informal in nature.	O	O	O	O	O
4. There are frequent discussions between team members and Scrum Masters.	O	O	O	O	O
5. Discussions are productive.	O	O	O	O	O
6. There is frequent formal communication (documentation etc.).	O	O	O	O	O
7. Communication between team members and Scrum Masters is more informal than formal.	O	O	O	O	O
8. I find myself more often in spontaneous conversations about work than in planned conversations about work.	O	O	O	O	O

Page 6.

12. Value Diversity

The following statements relate to the shared values of the whole project team.

Please give your opinion about the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The values of all project members are similar	O	O	O	O	O
Project members have similar work values	O	O	O	O	O
Project members have similar goals	O	O	O	O	O
Project members have strongly held beliefs about what is important within the project	O	O	O	O	O
All project members agree on what is important within the project	O	O	O	O	O

Page 7

13. Project Success

The following statements relate to how successful the project was in your opinion.

Please give your opinion about the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Project goals are met	O	O	O	O	O
The expected amount (scope) of work is completed	O	O	O	O	O
The expected quality of work is achieved	O	O	O	O	O
Task operations are carried out efficiently	O	O	O	O	O
Task operations are carried out as fast as possible	O	O	O	O	O

Page 8

14. End of survey

This is the end of the survey.

Thank you for participating in this study.

If you have any questions or suggestions please contact me via e.vankelle@sig.eu.

Appendix D: Questionnaire for Scrum Masters.

Page 1.

Thank you for participating in our research about communication around Agile. This study focuses on the role of communication and leadership style in Agile Software Development. With your participation, you play an important role in the scientific research about Agile Software Development.

The link to the online questionnaire can be found at the bottom of this email. Filling out the survey will take about 15 minutes. All questions relate to your opinion and experiences; no wrong answers can be given. As researchers, we adhere to the law of personal protection and the "Conduct for the use of personal information in scientific research" of Tilburg university. The questionnaire is completely anonymous and confidential.

Good luck!
Evelyn van Kelle

Page 2.

1. Company name

2. Project name

3. Team name

4. The project is

0 Concluded
0 Ongoing
0 About to start

5. Project size

Please estimate the total number of project members.

6. Project role

0 Team Member

0 Scrum Master/Project leader

0 Product owner

7. Gender

0 Male

0 Female

8. Age

Page 3.

9. Perceived Agility

Please indicate how the project scores on the following statements. (Slider)

1. Communication is open, based on trust and mostly face to face.	0	100
2. Team members work together in physical proximity.	0	100
3. Teams are self-organizing, cross-functional and exist of 7 +/- 2 members.	0	100
4. Frequency of delivery working software (0 = twice a year, 100 = every week)	0	100
5. Teams are able to execute changes: goals are met.	0	100
6. There is not too much and not too little planning, and the planning can be modified.	0	100
7. Progression is measured in business value.	0	100
8. Progression is measured in working software.	0	100

Page 4.

10. Leadership style

The following statements relate to the leadership style you prefer.

Please give your opinion about the following statements:

		Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always
1.	I provide others with assistance in exchange for their efforts.	O	O	O	O	O
2.	I re-examine critical assumptions to question whether they are appropriate.	O	O	O	O	O
3.	I fail to interfere until problems become serious.	O	O	O	O	O
4.	I focus attention on irregularities, mistakes, expectations, and deviations from standards.	O	O	O	O	O
5.	I avoid getting involved when important issues arise.	O	O	O	O	O
6.	I talk about my most important values and beliefs.	O	O	O	O	O
7.	I am absent when needed.	O	O	O	O	O
8.	I seek differing perspectives when solving problems.	O	O	O	O	O
9.	I talk optimistically about the future.	O	O	O	O	O
10.	I instil pride in others for being associated with me.	O	O	O	O	O
11.	I discuss in specific terms who is responsible for achieving performance targets.	O	O	O	O	O
12.	I wait for things to go wrong before I take action.	O	O	O	O	O
13.	I talk enthusiastically about what needs to be accomplished.	O	O	O	O	O
14.	I specify the importance of having a strong sense of purpose.	O	O	O	O	O
15.	I spend time teaching and coaching.	O	O	O	O	O
16.	I make clear what one can expect to receive when performance goals are achieved.	O	O	O	O	O

17.	I show that I am a firm believer in "if it ain't broke, don't fix it".	O	O	O	O	O
18.	I go beyond self-interest for the good of the group.	O	O	O	O	O
19.	I treat others as individuals rather than just as a member of the group.	O	O	O	O	O
20.	I demonstrate that problems must become chronic before I take action.	O	O	O	O	O
21.	I act in ways that build others' respect for me.	O	O	O	O	O
22.	I concentrate my full attention on dealing with mistakes, complaints and failures.	O	O	O	O	O
23.	I consider the moral and ethical consequences of decisions.	O	O	O	O	O
24.	I keep track of all mistakes.	O	O	O	O	O
25.	I display a sense of power and confidence.	O	O	O	O	O
26.	I articulate a compelling vision of the future.	O	O	O	O	O
27.	I direct my attention toward failures to meet standards.	O	O	O	O	O
28.	I avoid making decisions.	O	O	O	O	O
29.	I consider an individual as having different needs, abilities and aspirations from others.	O	O	O	O	O
30.	I get others to look at problems form many different angles.	O	O	O	O	O
31.	I help others to develop their strengths.	O	O	O	O	O
32.	I suggest new ways of looking at how to complete assignments.	O	O	O	O	O
33.	I delay responding to urgent questions.	O	O	O	O	O
34.	I emphasize the importance of having a collective sense of mission.	O	O	O	O	O
35.	I express satisfaction when others meet expectations.	O	O	O	O	O
36.	I express confidence that goals will be achieved.	O	O	O	O	O

Page 5.

11. Communication style

The following statements relate to the communication style between team members and project leader/Scrum Master.

Please give your opinion about the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. There is frequent face-to-face contact between team members and the Scrum Master.	O	O	O	O	O
2. Team members and Scrum Masters communicate often in spontaneous meeting, phone conversations, etc.	O	O	O	O	O
3. Meetings between team members and Scrum Masters are rather informal in nature.	O	O	O	O	O
4. There are frequent discussions between team members and Scrum Masters.	O	O	O	O	O
5. Discussions are productive.	O	O	O	O	O
6. There is frequent formal communication (documentation etc.).	O	O	O	O	O
7. Communication between team members and Scrum Masters is more informal than formal.	O	O	O	O	O
8. I find myself more often in spontaneous conversations about work than in planned conversations about work.	O	O	O	O	O

Page 6.

12. Value Diversity

The following statements relate to the shared values of the whole project team.

Please give your opinion about the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The values of all project members are similar	O	O	O	O	O
Project members have similar work values	O	O	O	O	O
Project members have similar goals	O	O	O	O	O
Project members have strongly held beliefs about what is important within the project	O	O	O	O	O
All project members agree on what is important within the project	O	O	O	O	O

Page 7

13. Project Success

The following statements relate to how successful the project was in your opinion.

Please give your opinion about the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Project goals are met	O	O	O	O	O
The expected amount (scope) of work is completed	O	O	O	O	O
The expected quality of work is achieved	O	O	O	O	O
Task operations are carried out efficiently	O	O	O	O	O
Task operations are carried out as fast as possible	O	O	O	O	O

Page 8

14. End of survey

This is the end of the survey.

Thank you for participating in this study.

If you have any questions or suggestions please contact me via e.vankelle@sig.eu.

Appendix E: Questionnaire for Product Owners.

Page 1.

Thank you for participating in our research about communication around Agile. This study focuses on the role of communication and leadership style in Agile Software Development. With your participation, you play an important role in the scientific research about Agile Software Development.

The link to the online questionnaire can be found at the bottom of this email. Filling out the survey will take about 15 minutes. All questions relate to your opinion and experiences; no wrong answers can be given. As researchers, we adhere to the law of personal protection and the "Conduct for the use of personal information in scientific research" of Tilburg university. The questionnaire is completely anonymous and confidential.

Good luck!
Evelyn van Kelle

Page 2.

1. Company name

2. Project name

3. Team name

4. The project is

0 Concluded
0 Ongoing
0 About to start

5. Project size

Please estimate the total number of project members.

6. Project role

0 Team Member

0 Scrum Master/Project leader

0 Product owner

7. Gender

0 Male

0 Female

8. Age

Page 3.

9. Perceived Agility

Please indicate how the project scores on the following statements. (Slider)

1. Communication is open, based on trust and mostly face to face.	0	100
2. Team members work together in physical proximity.	0	100
3. Teams are self-organizing, cross-functional and exist of 7 +/- 2 members.	0	100
4. Frequency of delivery working software (0 = twice a year, 100 = every week)	0	100
5. Teams are able to execute changes: goals are met.	0	100
6. There is not too much and not too little planning, and the planning can be modified.	0	100
7. Progression is measured in business value.	0	100
8. Progression is measured in working software.	0	100

Page 4

10. Project Success

The following statements relate to how successful the project was in your opinion.

Please give your opinion about the following statements:

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Project goals are met	O	O	O	O	O
The expected amount (scope) of work is completed	O	O	O	O	O
The expected quality of work is achieved	O	O	O	O	O
Task operations are carried out efficiently	O	O	O	O	O
Task operations are carried out as fast as possible	O	O	O	O	O

Page 5

11. End of survey

This is the end of the survey.

Thank you for participating in this study.

If you have any questions or suggestions please contact me via e.vankelle@sig.eu.

Appendix F: Model 1, Regression analysis individual level.

Model 1

Summary of regression analysis for variables predicting project success, evaluation of Scrum Masters.

	B	*SE B*	β
Constant	- 0.81	1.12	
Transformational leadership			
Evaluated by Scrum Masters	0.56	.21	.35**
Value Congruence	0.34	.14	.33*
Perceived Agility	0.02	.01	.25[a]
Informal Communication	.12	.17	.09
Project Size	0.00	.00	.01
R^2	.36		
F	4.85		

Note: * p < .05, ** p < .01

[a] = p = .08

Appendix G: Model 2, Regression analysis individual level.

Model 2

Summary of regression analysis for variables predicting project success, evaluation of team members.

	B	*SE B*	β
Constant	1.63	.56	
Transformational leadership			
Evaluated by team members	0.16	.13	.19
Value Congruence	0.41	.13	.50**
Perceived Agility	0.13	.15	.14
Informal Communication	- 1.44	.15	- 1.14
Project Size	0.00	.00	.07
R^2	.39		
F	5.13		

Note: * p < .05, ** p < .01

Appendix H: Model 3, Regression analysis project level.

Model 3

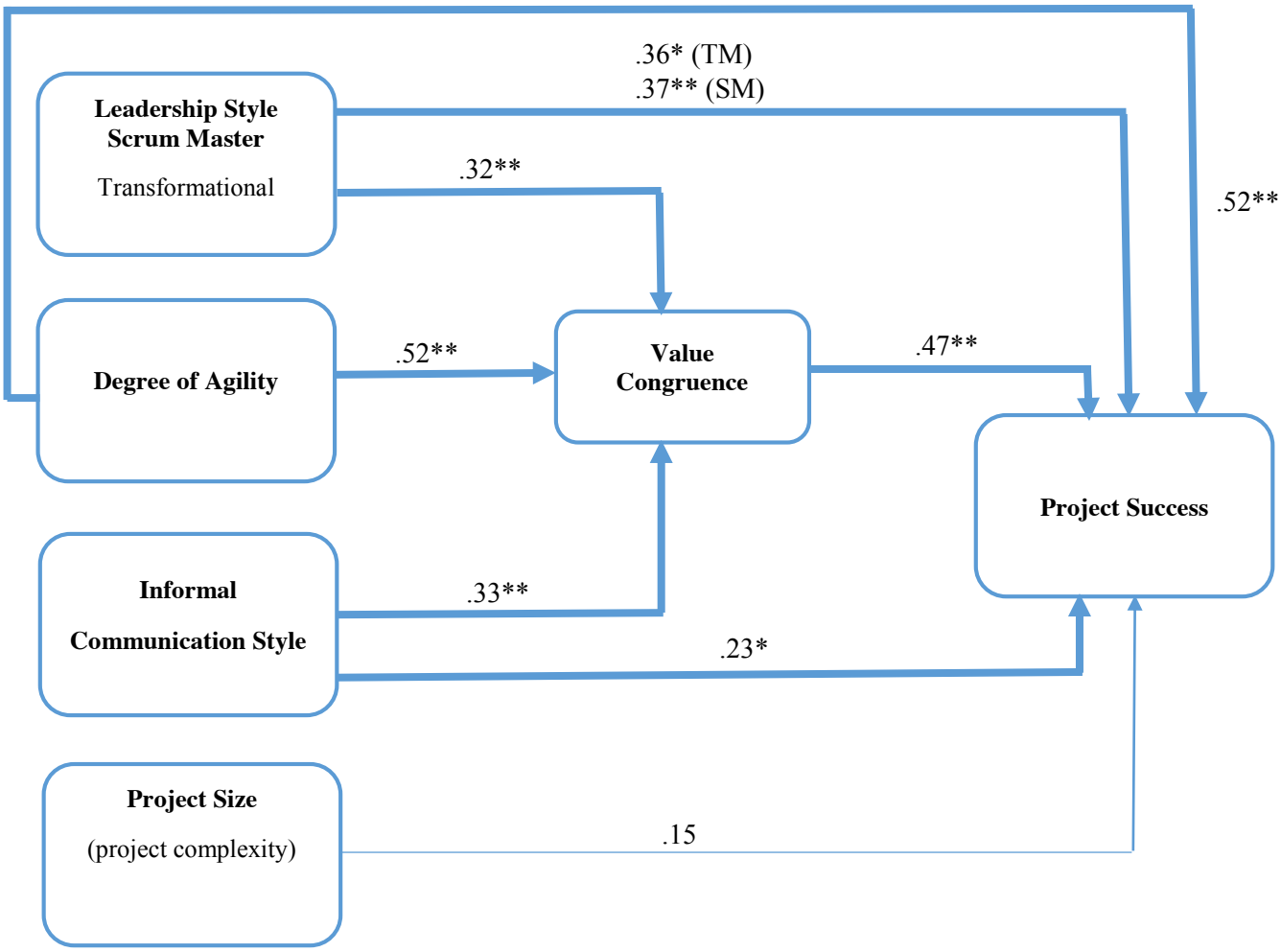
Summary of regression analysis for variables predicting project success on project level.

	B	*SE B*	β
Constant	0.06	.95	
Value Congruence	0.25	.13	.27*[a]
Perceived Agility	0.61	.16	.56**
Transformational Leadership			
Evaluated by Scrum Masters	0.18	.16	.15
Evaluated by team members	-0.11	.11	-.13
Informal Communication	0.01	.17	.01
Project Size	0.00	.00	.00
R^2	.50		
F	5.46		

Note: * p < .05, ** p < .01

[a] = p = .06

Appendix I: Model 3, Revised conceptual model on the individual level.



Appendix J: Model 3, Revised conceptual model on project level.