NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação

Master Program in Information Management

The Factors Influencing the Success of Agile Software Development Projects

A Portuguese perspective

Eduardo Joia da Costa Moura

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

2018

The Factors Influencing the Success of Agile Software Development Projects.

A Portuguese perspective

Eduardo Jóia da Costa Moura

MGI

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

THE FACTORS INFLUENCING THE SUCCESS OF AGILE SOFTWARE DEVELOPMENT PROJECTS

A PORTUGUESE PERSPECTIVE

by

Eduardo Jóia da Costa Moura

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Systems and Technologies Management.

Advisor: Maria do Rosário Bernardo, PhD

Co Advisor: Carlos Tam Chuem Vai, PhD

July 2018

DEDICATION

First, I would like to express my gratitude to Professor Maria Bernardo and to Professor Carlos Vai as advisors of the present dissertation. Their insights and suggestions were undoubtedly crucial for the successful completion of this work. Thank you for the dedication and for sharing your knowledge with me.

Many thanks to all my colleagues who have backed me up during this process, particularly to Patricia Marcão and to Miguel Lino Ferreira, who were tireless and extremely available.

Natacha Viana was the person who has listened to me the most, thank you for being such a good motivator and for all the strength which kept me going.

I also thank to all my closest friends for their constant presence and support during this time.

Finally, my deepest thank you to all my family, especially to my mother (Maria da Luz Alvarrão Jóia). This dissertation is the result of her endless efforts, sacrifices, and trust during the last 25 years. Thank you for continuously making me a better person.

SUBMISSIONS RESULTING FROM THIS DISSERTATION

"The factors influencing the success of agile software development projects" (Submitted to a journal of quartile one of Scimago index)

"The factors influencing the success of agile software development projects" (Accepted as a Poster Paper in ProjMAN 2018 - International Conference on Project MANagement)

ABSTRACT

Nowadays reality can be characterized by the fast pace through which business necessities change. Newer necessities regarding software often means higher complexity in terms of needed functionalities and subsequently higher project risk, forcing organizations to step away from traditional software development techniques, and move towards agility. Agile has emerged as a set of methodologies that increases projects probability of success by focusing on individuals and interactions, functional software, customer collaboration, and fast response to change. However, success rates on agile software development projects are still falling short of expectations.

Based on existing literature we propose a model consisting of five people-factors that influence the success of agile software development projects in which success is measured in terms cost, time, and customer satisfaction. The study was conducted in Portugal and total of 216 agile practitioners were surveyed. The results obtained using SEM-PLS suggest that “team capability” and “customer involvement” are factors contributing to agile software development project success. By knowing which factors are truly important to achieve success, managers and teams will be able to establish priorities, thereby improving the project outcome. This matter is addressed in the discussion section along with research limitations and future work.

KEYWORDS

Agile methodologies; Software development; People success factors; Agile in Portugal

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ASD	**Adaptive Software Development**
CSF	**Critical Success Factor**
DSDM	**Dynamic System Development Method**
FDD	**Feature Driven Development**
IS	**Information Systems**
ISO	**International Organization for Standardization**
IT	**Information Technology**
PLS	**Partial Least Squares**
RAD	**Rapid Application Development**
SEM	**Structural Equation Modelling**
TDD	**Test Driven Development**
XP	**Extreme Programming**

1. INTRODUCTION

Success in software development projects comes with great difficulty. In fact, one of the greatest challenges in these types of project is to realize how software development can be enhanced in order to avoid its failure (Chow & Cao, 2008). According to Henriksen and Pedersen (2017), publishing the agile manifesto has increased the success rates of agile software development projects, although there is still a need for improvements and to soften its organizational use.

Regarding 2018 as the 17th year since the agile manifesto was first presented, research into the success factors for agile software development projects has revealed those that have been most significant. However, there might be an issue if practitioners continue to use their own predefined set of success factors, which are based on previous professional experiences (Bullen & Rockart, 1981). Each project has its own particularities, and success factors must be properly assessed and considered, avoiding as much as possible a reliance on intuition.

As stated by Persson, Mathiassen, and Aaen (2012), the agile practices are gaining space in the business world at an increasing rate, allowing high-tech companies and IT software development teams to achieve faster results in a wiser way (Henriksen & Pedersen, 2017). Considering that agile methodologies are able to provide innovation and competitiveness, further research is encouraged in order to find new ways to reduce failure rates (Conforto, Amaral, Silva, Di Felippo, & Kamikawachi, 2016). Several authors such as Misra, Kumar, and Kumar (2009) and Stankovic, Nikolic, Djordjevic, and Cao (2013) have helped to mitigate agile software development project failure by unveiling different success factors in distinct dimensions. “People” is one of those dimensions, and it represents a fundamental aspect of the agile movement, involving motivated and flexible individuals in a support based environment (Boehm & Turner, 2005). Regarding the reasons why software projects were failing, Ahimbisibwe, Cavana, and Daellenbach (2015) argued that technical issues were rarely the cause, and that People aspects must be stressed as a way to find the individuals causing problems.

This research seeks to maximize the success probability of future agile software development projects. We have selected and characterized five people-factors from two previous studies by Chow and Cao (2008), and Misra et al. (2009) that proved to be significantly related to agile software development project success. The factors “personal characteristics”, “training and learning”, “societal culture”, “team capability”, and “customer involvement” were combined into a conceptual model and its validity was tested in the Portuguese scenario. The analysis addresses the following question:

What are the people factors influencing the success of agile software development projects?

To fulfil the research objective, we have surveyed 216 agile professionals that were involved in at least one agile software development project. Structural equation modelling (SEM) was the selected statistical method to carry the analysis, whereas the model was estimated using partial least squares (PLS).

Our contribution to the body of literature is twofold. First, to the best of our knowledge, this is the first time that the relevant people factors found by Chow and Cao (2008), and Misra et al. (2009) are

combined to explain the success in agile software development projects. By using the important people factors from these studies we had the opportunity to confirm the factors' validity, unveiling the ones that are truly significant for success. Second, we have built a comprehensive and scalable model that offers a consistent characterization of the People dimension which can be used by agile researchers in the future.

The structure of this work is the following. First, based on literature we introduce the concept of project, project success, and agile software development related topics. Then, the research model and hypotheses are presented, followed by the methods used. Lastly, we discuss the results obtained, mentioning theoretical and managerial implications along with research limitations and future work.

2. LITERATURE REVIEW

2.1. THE CONCEPT OF PROJECT

Throughout the years several authors have used their own project definition. Cleland and King (1983) stated that a project requires effort to achieve the final output, it needs to be time and budget bounded, and is also unique and usually not repetitive in an organization. Turner and Müller (2003) refer to projects as a temporary organization that delivers beneficial change. A consensus has been reached through ISO 21500, which reflects some of the elements specified by the above-mentioned authors where, "A project consists of a unique set of processes consisting of coordinated and controlled activities with start and end dates, performed to achieve project objectives. Achievement of the project objectives requires the provision of deliverables conforming to specific requirements" (ISO, 2012, p. 3).

As affirmed by Pauget and Wald (2013), a project is often perceived as a complex structure. The literature breaks down that complexity by exposing the fundamental dimensions that structure projects. Those dimensions are: tasks, times, and teams (Manning, 2008).

The tasks that need to be performed are described as guides for the project-related activities, which focus not only on project objectives but also on sub-tasks (Manning, 2008). The project objectives are most often associated to the achievement of the project outcome, while the sub-tasks are the project's building blocks, all contributing to attain the stated goals. According to Lundin and Soderholm (1995), project tasks can be classified as unique if they are created for a single purpose in which reapplication is not intended, or as repetitive if they are intended to be used when necessary.

Times control the pace, order, and due dates for each project task (Lundin & Soderholm, 1995). This dimension relates to the scheduling of the whole project and milestones, deciding when critical activities must be completed (Manning, 2008). The times can be renegotiated, which is commonly seen during the project execution, and while negotiating, the iron triangle (time, budget, and quality) is often readjusted and used as success criteria (Manning, 2008).

Teams are a project's third dimension and may involve the project team and sub-teams (Lundin & Soderholm, 1995). Project teams should not be seen as a mere group of individuals that are temporarily working together, but by the positions that those individuals take and the relationships that they establish with others during the project's life-cycle (Bechky, 2006). The relationships established between members can be more or less familiar, which can be both an advantage or a constraint for the project (Manning, 2008).

Seeing projects from a structural point of view, it is clear that tasks, times, and teams are dimensions that can depict the temporary nature of projects, since tasks and the time available are not unlimited, and the project relationships established by the team cease with the project's conclusion (Manning, 2008).

2.2. PROJECT SUCCESS

The ways of measuring project success and how to achieve it have gradually evolved throughout the years. At first, the literature used the iron triangle for project assessment, then critical success factors (CSF) lists were developed, followed by the introduction of the first success frameworks. These frameworks started to emphasize customer focus, something that has continued into the 21st century.

2.2.1. The iron triangle and critical success factors listings

To assess project success the time, cost, and quality were often used as metrics, which are known as the iron triangle of project management (Atkinson, 1999). Atkinson added that time and cost were seen as estimates, calculating both when the project planning phase lacked information, while quality depended on people's beliefs and perceptions, which could be altered throughout the project. According to Lim and Mohamed (1999), and considering the project life-cycle, these metrics were used as success measures of the project implementation phase. However, there was a lack of project assessment after delivery, which could allow a wider perspective in terms of success analysis (Atkinson, 1999). As stated by Jugdev and Müller (2005), measuring success after delivery allows team members to make a project effectiveness analysis in which they assume the stakeholder's perspective about the benefits provided.

In the 1980s and '90s period the iron triangle was still being used, but lists of CSFs started to emerge (Jugdev & Müller, 2005). The concept of CSF was first presented by Rockart (1979) with the purpose of identifying crucial information for managers to work with (Stankovic et al., 2013). In addition, Kerzner (1987) defined CSFs as the project elements that could not fail, and at this point in time, due to the increasing market competitiveness, the literature was turning attention to stakeholder satisfaction as a metric for project success (Jugdev & Müller, 2005). As stated by Munns and Bjeirmi (1996), to assure quality there is a need to satisfy end-users' necessities, so quality can be defined as a satisfied user. For Clarke (1999) the critical factors influencing project success were based on communication and its effectiveness, clear objectives and scope, splitting the project into manageable blocks, and the use of project plans as living documents. The period comprising the 1980s and '90s witnessed the identification and description of some useful CSFs, whereas the production of the ten success factors list by Pinto and Slevin (1987), as shown in Table 1 has been widely recognized.

After the year 2000 CSF lists were still being created by leading authors such as Cooke-Davies (2002), Jugdev and Müller (2005), and Ika, Diallo, and Thuillier (2012). The Standish Group has also been publishing reports since 1994, studying project successes and failures, especially in the IT area. The 2013 publication revealed that only 39% were considered successfully concluded projects. The main success factors for IT projects were also reported: executive management support, user involvement, optimization, skilled resources, project management expertise, agile process, clear business objectives, emotional maturity, execution, and tools and infrastructure (The Standish Group International, 2013). In spite of all the lists created, there is no standard one that can be applied to all projects (Todorović, Petrović, Mihić, Obradović, & Bushuyev, 2015).

Success Factor	Description
1. Project mission	Clearly defined goals and direction.
2. Top management support	Resources, authority, and power for implementation.
3. Schedule and plans	Detailed specification of implementation process.
4. Client consultation	Communication with and consultation of all stakeholders.
5. Personnel	Recruitment, selection, and training of competent personnel.
6. Technical tasks	Ability of the required technology and expertise.
7. Client acceptance	Selling of the final product to the end users.
8. Monitoring and feedback	Timely and comprehensive control.
9. Communication	Provision of timely data to key players.
10. Trouble-shooting	Ability to handle unexpected problems.

Table 1 – Ten success factor list (Pinto & Slevin, 1987)

2.2.2. Project success frameworks

The project success elements were Morris and Hough's (1987) pioneer framework, in which the authors analysed project success in terms of functionality, management, contractors' commercial performance, and termination. The project functionality evaluates if the financial and technical requirements are met, while project management assesses if the project meets the schedule, budget, and specifications. The contractors' commercial performance understands if the contractors have reached or not a commercial benefit with the project. Finally, project performance concerns an efficient and reasonable decision in case of a possible project cancellation. However, the authors' work did not have much initial impact within the research community, since CSFs lists were still being created and the newly proposed frameworks were not built upon following Morris and Hough's publication (Jugdev & Müller, 2005).

A framework for implementation success was developed by Pinto and Slevin (1988) consisting of three success elements: technical validity, organizational validity, and organizational effectiveness. Technical validity establishes an assessment with the purpose to understand if the project is working as desired. The organizational validity considers if the clients' requirements and needs will be satisfied with the project and if they will use it. Lastly, organizational effectiveness regards the positive contributions offered by the project when delivered to the organization. Both organizational validity and organizational effectiveness are equally significant to the project organization and to the client. This means that project success should be assessed internally, which was the focus of the early literature, and externally, in which the client is central to project success (Pinto & Slevin, 1988). For Munns and Bjeirmi (1996) project success requires progress throughout the implementation phase, end-users' perception about the product, and customer satisfaction. Therefore, the project team should also be present at the project's utilization phase, allowing the confirmation of end-users' requirements (Munns & Bjeirmi, 1996).

Belassi and Tukel (1996) created a holistic framework of industry and firm-related factors. The authors noticed that there was a need for a success factor classification, allowing to associate each factor with a specific category. The classification would also permit an analysis of the established relationships between success factors. To perform that classification four categories were proposed: factors related to the project, project manager and team, organization, and external environment

(Belassi & Tukel, 1996). The authors' work has also shown that success factors can vary according to the industry type, and that top management support is crucial.

A year later Shenhar, Levy, and Dvir (1997) conducted a study that resulted in a proposition of a multidimensional framework to assess project success. As shown in Table 2, project efficiency, impact on the customer, business success, and preparing for the future were the four dimensions proposed (Shenhar et al., 1997). The authors also managed to identify three success clusters: meeting design goals (time, budget, and performance), customer impact, and benefits to the organization. It was also verified that time and budget are resource related while meeting the performance is associated with customer satisfaction. They concluded that customer satisfaction was the main factor to achieve project success, followed by the elements of the iron triangle. The project success includes consequences over a shorter and longer period and some of those consequences are the efficiency of the project, success within the business, and preparation for future events (Shenhar et al., 1997).

Success dimension	**Measures**
1. Project efficiency	Meeting schedule goal
	Meeting budget goal
2. Impact on the customer	Meeting functional performance
	Meeting technical specifications
	Fulfilling customer needs
	Solving customer's problem
	The customer is using the product
	Customer satisfaction
3. Business success	Commercial success
	Creating a large market share
4. Preparing for the future	Creating a new market
	Creating a new product line
	Developing a new technology

Table 2 – Emerged four success dimensions (Shenhar, Dvir, Levy, & Maltz, 2001)

A technically well-accomplished project is no longer enough of a criterion to be classified as successful. Pinto and Slevin (1988) affirmed that a greater importance was being given to how projects were accepted by the client, and Lester (1998) stated that success is dependent on the project stakeholders, involving constant interaction between organizations. Herein we consider it valuable to deepen this theme, something we do in the next section.

2.2.3. Stakeholders involvement

In the early 21st century project success started to be seen as something that both project and client organization should be reaching together (Turner & Müller, 2003). According to Davis (2014) the involvement of major project stakeholders such as the project owner and sponsor has become important for success achievement. Moreover, Turner (2004, p. 350) highlighted four success conditions that encompass the project owner's importance:

1. "Success criteria should be agreed on with the stakeholders before the start of the project, and repeatedly at configuration review points throughout the project.

2. A collaborative working relationship should be maintained between the project owner and project manager, with both viewing the project as a partnership.
3. The project manager should be empowered with the owner giving guidance as to how they think the project should be achieved, but allowing the project manager flexibility to deal with unforeseen circumstances as they see best.
4. The owner should take an interest in the performance of the project."

These four conditions must all be achieved for a successful project, but they cannot guarantee it (Turner, 2004). Supporting Turner's conditions, Davis (2014) mentioned that the project manager should not be the only one taking responsibilities, and that project stakeholders must also be accountable, which includes the project owner. Stakeholder involvement can also help to decrease project risk since the process of managing their needs is facilitated, which impacts project success (Atkin & Skitmore, 2008).

2.2.4. Success attributes

According to Badewi (2016), time and cost are still being used as attributes to assess project performance. Both of these attributes have been applied within different business areas, such as engineering and construction as indicated by Lim and Mohamed (1999), or agile software development, as reported in Stankovic et al. (2013). The time attribute refers to on-time delivery, while cost emphasizes the compliance with the estimated budget (Toor & Ogunlana, 2010). As reported by Badewi (2016), in addition to finishing on time and within cost, project stakeholders also need to extract benefits from the project's output to justify their investment, which leads to customer satisfaction. The customer satisfaction relates to how the customer perceives the performance of the final product which involves its adherence to a pre-defined set of goals; if expectations were lower than the actual performance, then customer satisfaction would be reached (Haverila & Fehr, 2016). For Alvertis et al. (2016), success is highly dependent on how the software solution fulfils the expectations of the users addressed. In this research, we use the term "customer" as a reference to the end-user.

Considering the previous statements and this research dependent variable "agile software development project success", we have delineated our success definition based on time, cost, and customer satisfaction.

2.3. AGILE SOFTWARE DEVELOPMENT

In February 2001 a group of 17 leading software process methodologists participated in a summit to uncover better ways to develop software (Chow & Cao, 2008). The participants' efforts resulted in the agile manifesto for software development, which addresses the inflexibility inherent to traditional project methodologies and its negative impact on software project results (Lechler & Yang, 2017). According to Campanelli and Parreiras (2015), the manifesto gathered principles and values from already well established agile methods and approaches, transposing them to the software development business.

The agile manifesto values are the following:

- "Individuals and interactions
- Working software

- Customer collaboration
- Responding to change" (Campanelli & Parreiras, 2015, p.86)

The Agile Alliance (2001) has also published 12 Agile principles being them:

- Valuable software delivery on an early and continuous basis
- Requirements changes are welcome
- Deliver software frequently
- Constant interaction between business people and developers
- Motivated working people
- Prioritize face-to-face communication
- Working software is progress
- Keep a constant working pace
- Good design allied to technical excellence
- Work simplicity
- Self-organizing teams
- Improve continuously

As evidenced by Fernandez and Fernandez (2008), agile and traditional (plan-driven) methodologies are substantially different. Defined as an incremental and iterative approach, agile avoids some of the plan-driven characteristics, such as low customer collaboration and projects with fixed scopes; these are described in the literature as symptoms of unsuccessful projects (Serrador & Pinto, 2015). Additional information about the differences between the two approaches may be found in Table 3.

It is unanimously accepted that agile methodologies allow for better handling of unstable requirements when compared to the traditional approaches, delivering high-quality software in a short period of time and under budget (Campanelli & Parreiras, 2015). Agile methodologies are also able to improve productivity, flexibility, and business alignment (Henderson-Sellers & Ralyté, 2010).

	Traditional development	**Agile development**
Fundamental assumption	Systems are fully specifiable, predictable, and are built through meticulous and extensive planning	High-quality adaptive software is developed by small teams using the principles of continuous design improvements and testing based on rapid feedback and change
Management style	Command and control	Leadership and collaboration
Knowledge management	Explicit	Tacit
Communication	Formal	Informal
Development model	Life-cycle model (waterfall, spiral or some variation)	The evolutionary-delivery model
Desired organizational form/structure	Mechanistic (bureaucratic with high formalization), aimed at large organizations	Organic (flexible and participative encouraging cooperative social action), aimed at small and medium-sized organizations
Quality control	Heavy planning and strict control Late, heavy testing	Continuous control of requirements, design and solutions Continuous testing

Table 3 – Main differences between traditional development and agile development (Moe, Dingsøyr, & Dybå, 2010)

Despite all the benefits provided by the agile methodologies, their adoption is still complex due to within-firm features like change resistance, organizational culture, lack of management support and involvement (Chow & Cao, 2008; Dyba & Dingsoyr, 2009). Even so, agile methodologies are a viable option to face the challenges proposed by the software development industry since they prioritize certain features such as quality, budget, time, and business strategy (Santos, Bermejo, Oliveira, & Tonelli, 2011).

2.3.1. Agile software development methodologies

Currently, some of the most popular agile methodologies for software development are Extreme Programming (XP), SCRUM, Kanban, Lean, Feature Driven Development (FDD), Dynamic System Development Method (DSDM), Adaptive Software Development (ASD) and Crystal (Campanelli & Parreiras, 2015). It is important to note that these methodologies were conceived to use minimal amounts of documentation, thereby increasing flexibility and responsiveness to changing requirements which contrasts with the plan-driven methodologies (Serrador & Pinto, 2015).

XP is a lightweight methodology that helps relatively small teams to develop software when requirements are not explicit and change with frequency (Kent & Gamma, 2000). The authors have also stated that this methodology focuses on budget savings, unit tests before and during the coding activities, releases of working software within a predefined schedule, and simplicity of design. XP also prioritizes customer satisfaction, communication, simplicity, and feedback, where the ability to respond to a possible change of customer requirements and to deliver high-quality software is required (Stankovic et al., 2013).

As a process framework, SCRUM aims to deliver highly valuable products by solving complex situations (Schwaber & Sutherland, 2016). SCRUM is characterized by its simplicity and productivity, being that responsible for its increased popularity in the software development community (Stankovic et al., 2013). As stated by Moe, Dingsøyr, and Dybå (2010), this framework has acquired its foundations based on the complexity theory, system dynamics, and on the theory of knowledge creation where existing knowledge and experience are used for decision making (Schwaber & Sutherland, 2016). SCRUM uses short iteration development called “Sprints”, in which the team is highly empowered and responsible for their own tasks, and that involves planning, scheduling, and work distribution (Moe et al., 2010).

Kanban is a methodology for software development that focus on what needs to be accomplished, providing a quality output within time (Lei, Ganjeizadeh, Jayachandran, & Ozcan, 2017). The authors have also affirmed that important tasks are prioritized in order to decrease their incompletion risk and a workflow is defined along with the delivery schedule. This methodology provides high visibility for the project, which is translated into visual contact with the tasks that are being handled by each of the developers (Lei et al., 2017).

The Lean methodology was reworked from Lean manufacturing in order to serve the purposes of software development (Kupiainen, Mäntylä, & Itkonen, 2015). The authors have also stressed that waste elimination, learning amplification, fast deliveries, team empowerment, and integrity were some of the lean principles adapted to software development. With this methodology, feedback is always provided informing the project team about the daily performance, and efforts are made to permanently solve any problem (Middleton, 2001). Since Lean had the capability to change how

manufacturing industries were working, the same effect is trying to be replicated, but this time on the software development business (Middleton, 2001).

FDD is an agile methodology that focus on the quality of both software developing process and scheduled deliveries (Abrahamsson, Salo, Ronkainen, & Warsta, 2002). According to Stankovic et al. (2013), FDD is a short-iteration process that starts with the definition of an overall model and needed features. Those features are assembled in work packages which can be concluded within a single iteration, providing the client with fully functional software (Stankovic et al., 2013).

DSDM is often used as a framework for rapid application development (RAD), where software is delivered using prototyping techniques, iterative design, and testing (Almasri, 2016). According to Abrahamsson et al. (2002), DSDM focuses on the amount of resources and time available to create the necessary features, whereas customer should be actively involved (Sani, Firdaus, Jeong, & Ghani, 2013).

Instead of optimizing the process improvement techniques, Adaptive Software Development (ASD) methodology emphasizes the production of high-value results through rapid adaptation to internal and external factors (Meso & Jain, 2006). ASD acts as a flexible guide to lower the probability of failure within software projects. (Abrahamsson et al., 2002).

Crystal or Crystal family is a group of methodologies that are meant to serve different types of projects since it depends on size and criticality level (Abrahamsson et al., 2002). Crystal uses agreed periods of time where a team or a single individual works progressively towards the accomplishment of the objective (Campanelli & Parreiras, 2015).

2.3.2. Success factors in agile software development projects

Considering the success factors in agile software projects, Chow and Cao (2008) conducted a study to identify the most imperative factors that would contribute to a successful agile software development project. Their research has managed to collect many success factors that were cited in previous agile literature.

Success was defined using four attributes: Quality (delivering a good product or project outcome), Scope (meeting all requirements and objectives), Time (delivering on time), and Cost (delivering within estimated cost and effort) (Chow & Cao, 2008).

After a reliability and factor analysis that provided 12 possible success factors, these were systematized into Organizational, People, Process, Technical, and Project dimensions. Table 4 illustrates the selected possible factors and the respective dimension. The multiple regression analysis results have demonstrated that a correct delivery strategy, proper use of agile software techniques, and high calibre team were critical factors for agile software project success. However, some other factors like team environment, project management process, and customer involvement can also be considered as critical to a certain extent (Chow & Cao, 2008). Of the five factor categories proposed, both People and Technical were considered as the most important dimensions for agile software development project success. However, the study failed to prove that some popular factors such as strong executive support, strong sponsor commitment, ready availability of physical agile facility, or agile-appropriate project types were indeed prerequisites for a successful project.

Dimension	Factor
Organizational	Management Commitment
	Organizational Environment
	Team Environment
People	Team Capability
	Customer Involvement
Process	Project Management Process
	Project Definition Process
Technical	Agile Software Techniques
	Delivery Strategy
Project	Project Nature
	Project Type
	Project Schedule

Table 4 – Consolidated success factors (Chow & Cao, 2008)

Years later, Stankovic et al. (2013) extended Chow and Cao's (2008) work. The same 12 possible CSFs were utilized to study the former Yugoslavian perspective about agile software development project success. The investigation revealed that project nature can be considered as a critical factor attending to time and cost attributes, in which project type and project definition process can also be regarded as critical, but solely in terms of cost. Noteworthy is the fact that their research did not manage to prove that the CSFs identified by Chow and Cao (2008) were indeed critical for a successful agile software development project.

Following the same line of thought, Misra et al. (2009) described a hypothetical framework of success factors for projects seeking to adopt the agile software development practices. Their research focused on two specific dimensions, namely Organizational and People, whereas project success was defined using five criteria which captured time, cost, and quality. Multiple regression analysis was used to understand the relationship between the 14 factors identified, which are represented in Table 5, and the success of the project. The customer satisfaction, customer collaboration, customer commitment, decision time, training and learning, control, personal characteristics, societal culture, and corporate culture were the nine variables that emerged as statistically significant, concerning the agile software development project success. The remaining five variables (team distribution, team size, planning, technical competency, communication and negotiation) were not significantly related to success (Misra et al., 2009).

Dimension	Factor
People	Competency
	Personal Characteristics
	Communication and Negotiation
	Societal Culture
	Training and Learning
Organizational	Customer centric issues (Customer Satisfaction, Collaboration, and commitment)
	Decision Time
	Team Distribution
	Team Size
	Corporate Culture
	Planning
	Control

Table 5 – Hypothesized success factors (Misra et al., 2009)

Based on the conclusions reported in the earlier studies, we have designed our own research model, which is centred on people and related factors, as described in the next section.

3. RESEARCH MODEL AND HYPOTHESES

The present research addresses people and people factors in a way that allows agile software development projects to establish priorities, and to maximize their chances of success. We have built a research model, as shown in Figure 1, composed of six theoretically well-grounded variables. The agile software development project success, which is this study's dependent variable, is defined in terms of time (i.e. on-time delivery), cost (i.e. on or under budget), and customer satisfaction (i.e. overcoming customer's expectations regarding product performance). As independent variables, five people factors that are proven to be significantly related to agile software development project success were selected. The factors are: personal characteristics, training and learning, and societal culture by Misra et al. (2009), team capability, and customer involvement by Chow and Cao (2008).

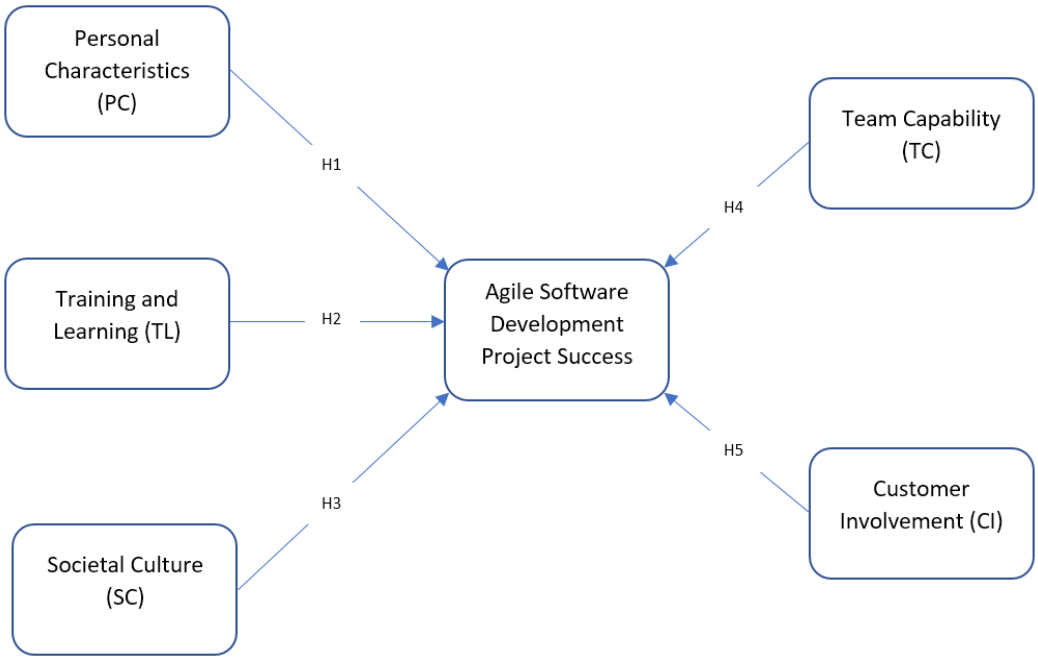

Figure 1 – Research model

By assembling these five factors in our research model we believe that together they can offer a consistent characterization of the people dimension. In sum, we postulate that the previously mentioned people factors are important contributors for agile software development project success.

3.1. PERSONAL CHARACTERISTICS

As stated by Shipper et al. (2017), personal characteristics accent certain qualities that are not cognitive, such as communication skills, empathy, and resiliency. In this study we characterize and measure this factor according to the attributes used by Misra et al. (2009), which apart from communication and interpersonal skills, also emphasize honesty, motivation, collaborative attitude, sense of responsibility, and readiness to learn. In terms of projects, the communication and interpersonal skills, honesty, collaborative attitude, and work with others are part of the necessary set of personal and interpersonal competences for an individual to achieve a good performance in a project, programme, or portfolio, leading to its success (International Project Management

Association, 2015). It was also found by Yang, Huang, and Wu (2011) that teamwork, which involves communication, cohesiveness, and collaboration between team members can be impactful on a project performance. Considering the above statements and the context of our research, we state the following hypothesis:

H1: Personal characteristics is a factor that contributes to the success of agile software development projects.

3.2. TRAINING AND LEARNING

According to Misra et al. (2009), training and learning refers to information sharing and continuous learning capabilities that increase the success probability of agile software development practices. Training is an important success factor for large-scale agile transformations, and teams that are not properly trained often struggle to make a correct application of the agile practices (Dikert, Paasivaara, & Lassenius, 2016). However, these practices do not rely on formal training for knowledge sharing. Instead, there is a focus on mentoring and professionally guided discussions, which provides better results (Misra et al., 2009). Since agile practices and techniques do not follow a strict "how-to" guide, the learning process is done through continuous experimentation (Dikert et al., 2016). Considering the above statements and the context of our research, we state the following hypothesis:

H2: Training and learning is a factor that contributes to the success of agile software development projects.

3.3. SOCIETAL CULTURE

Similarly to any other activity undertaken by humans, the inherent regional culture can greatly influence software development, which becomes a relevant factor for agile software development project success (Misra et al., 2009). Societal culture is a system composed of the shared values, beliefs, and norms that are learned and perpetuated over generations and reflected in the society's laws, policies, and actions (Aycan et al., 2000; Thomas et al., 2010). There is risk of cultural friction when employees have different societal cultures since the established relationships are composed of a mixture of different perspectives (Thomas et al., 2010; Thomas, Au, & Ravlin, 2003). According to Misra et al. (2009), societal culture affects the degree to which individuals, in general, are more or less communicative, dynamic, and progressive. Regarding the above statements and the context of our research, we state the following hypothesis:

H3: Societal culture is a factor that contributes to the success of agile software development projects.

3.4. TEAM CAPABILITY

This factor refers to the utilization of knowledge along with the conditions that allow teams to accomplish their tasks successfully (Haas, 2006). According to Misra et al. (2009), a highly capable team allows fast deliveries of working software that attends to the customer's requirements. Besides technical competence and expertise, some other attributes were used by Chow and Cao (2008), such as team members' motivation and commitment, agile knowledgeable managers with an adaptive management style, and proper provision of technical training to the project team. Aspects such as commitment and technical expertise are, according to Ahimbisibwe et al. (2015), drivers that allow

teams to better deal with risks, thus improving the likelihood of project success. Considering the above statements and the context of our research, we state the following hypothesis:

H4: Team capability is a factor that contributes to the success of agile software development projects.

3.5. CUSTOMER INVOLVEMENT

As stated by Carbonell, Rodríguez-Escudero, and Pujari (2009), customer involvement reflects the interactions between customer representatives and the company throughout the project duration. An investigation undertaken by Ahimbisibwe et al. (2015) reported that the degree of customer participation is closely related to the success of a software development project, so projects tend to be more successful with higher levels of customer involvement. According to Bendapudi and Leone (2003), involving customers can also benefit the project in terms of customer satisfaction, and their satisfaction is highly advocated by the first principle of the agile manifesto (Agile Alliance, 2001). This factor will be characterized by customer commitment, authority in the project, and a good relationship with the project organization (Chow & Cao, 2008). Considering the above statements and the context of our research we state the following hypothesis:

H5: Customer involvement is a factor that contributes to the success of agile software development projects.

4. METHODS

4.1. MEASUREMENT

The measurement items used in the present research were modified based on relevant agile literature. Personal characteristics (PC), training and learning (TL), and societal culture (SC) were adapted from Misra et al. (2009); team capability (TC), customer involvement (CI), and agile software development project success (S) came from Stankovic et al. (2013). We include all the items in Appendix A.

The target population consisted of individuals who were involved in at least one agile software development project, either as a team member or stakeholder (this was the sole participation requirement). Portugal was the country selected to conduct the investigation.

4.2. DATA

This research used an online survey, as shown in Appendix B, to collect the necessary data. The questionnaire was developed in English, and we have not restricted it to professionals from a specific industry or region in Portugal. To find respondents we used the professional social network LinkedIn, searching for keywords such as “Agile methodologies” and “Agile Project Management”. The survey was also included in the Portuguese Project Management Association’s (APOGEP) April newsletter.

Apart from the introduction and conclusion, the web survey had three distinct sections, which were the questionnaire itself, a demographic data area, and a reserved space for any research related comments. The first section bearing the questionnaire was about people factors, where each factor was measured by several items. This same section also assessed the respondents’ perception about project success in terms of cost, time, and customer satisfaction. The 7-point Likert Scale, ranging from totally disagree (1) to totally agree (7), was used to understand the respondents’ agreement level toward each item, except on the perceived level of project success, where the scale ranged from very unsuccessful (1) to very successful (7). All respondents were asked to select a relevant agile software development project, either successful or unsuccessful, where they participated. The demographic section collected personal and agile related data, while the reserved space for respondents’ feedback (third section) received several comments which varied between personal opinion about the subject matter and contacts to receive the final results. The respondents’ feedback was not considered for statistical analysis.

Before sending the final survey, we made a quality and validity pre-test. The quality pre-test was conducted among five agile-knowledgeable individuals who were asked to provide feedback in terms of clear and objective language, making the survey easier to understand. The feedback provided was incorporated before the validity pre-test, which was applied to a group of 30 agile professionals. The validity pre-test group had the exact same answering conditions as in the final survey population since no additional recommendations were made. The data from the validity pre-test were not included in the final analysis.

The final survey was online from 20 March to 29 April and a total of 216 answers were collected. To make sure that no systematic bias was influencing the data, a common method bias test was

performed using the marker variable technique (Lindell & Whitney, 2001; Malhotra, Kim, & Patil, 2006). The results suggested the absence of significant common method bias in our data.

Considering the characteristics of our sample, most respondents (around 96.8%) attended higher education. The remaining 3.2% are individuals who completed the 12th grade or equivalent. Regarding professional status, most individuals (roughly 96.3%) are professionally active, while the remaining 3.7% are either unemployed or students. Considering the respondents knowledge about agile practices and methods, we verified that most respondents (about 69%) have been agile-knowledgeable for more than three years. In terms of agile experience, the results suggest that around 41.2% have at least five years of usage experience. SCRUM is the methodology most used by the participants, accounting for 97.7% of the responses. Regarding the role undertaken by the survey respondents in the specified project, SCRUM Master is the most popular position, obtaining 90 entries, which accounts for roughly 41.7% of all respondents. According to our sample, "Computer-related" is the main industry in which agile software development is being used in Portugal. Additional details are provided in Tables 6 and 7.

Education	N	%	**Professional Status**	N	%
Basic education	0	0	Unemployed	6	2.8
12th grade or equivalent	7	3.2	Employee	197	91.2
Bachelor's degree	111	51.4	Self-employed	11	5.1
Master's degree	98	45.4	Retired	0	0
Doctoral degree	0	0	Student	2	0.9
Agile knowledge	N	%	**Agile experience**	N	%
Less than 1 year	8	3.7	Less than 1 year	19	8.8
1 - 3 years	59	27.3	1 - 3 years	64	29.6
3 - 5 years	57	26.4	3 - 5 years	43	19.9
Greater than 5 years	92	42.6	Greater than 5 years	89	41.2
			Not applicable	1	0.5

Table 6 – Demographic data

Methodology	**N**	**%**	**Role**	**N**	**%**	**Industry**	**N**	**%**
SCRUM	211	97.7	SCRUM Master	90	41.7	Computer-related (Hardware, Software)	74	34.3
Kanban	128	59.3	Developer/Tester	47	21.8	Banking/Insurance	37	17.1
Lean	52	24.3	Product Owner	41	19.0	Consulting	28	13
XP	44	20.4	Agile Coach	13	6.0	Telecommunications	26	12
FDD	19	8.8	Project Manager	6	2.8	Business supplies/services	12	5.6
ASD	4	1.9	SCRUM Master & Developer/Tester	4	1.9	Consumer retail/wholesale	7	3.2
TDD	4	1.9	Delivery Manager	3	1.4	Entertainment	7	3.2
DSDM	2	0.9	Head of Technology	3	1.4	Medical/health care	5	2.3
Others	12	6	Unit Director	2	0.9	Government	4	1.9
			Others	7	3.2	Manufacturing/distribution	4	1.9
						Aerospace	3	1.4
						Engineering/construction	2	0.9
						Hospitality	2	0.9
						Education/Research	2	0.9
						Others	3	1.4

Table 7 – Demographic data

5. RESULTS

After gathering the data, we performed the analysis using structural equation modelling (SEM), which is a statistical method to test and estimate causal relationships by using a mixture of statistical data and qualitative causal assumptions. As indicated by Chin, Marcolin, and Newsted (2003), partial least squares (PLS) is a common method used in IS/IT research, so we used it to test our model hypotheses, ensuring that the outcome of the structural relationships established is obtained from a set of measurement instruments with psychometric attributes. In terms of analytical software to examine the relationships established in our research model, we selected Smart PLS 2.0.M3.

5.1. MEASUREMENT MODEL

Composite reliability (CR) was used to test construct reliability. As shown in Table 8 the results suggest that our model has good internal consistency, since all constructs scored above 0.7 (Straub, 1989). An indicator reliability test was also conducted, and according to Churchill (1979) and Henseler, Ringle, and Sinkovics (2009), loadings should be greater than 0.7 and every loading below 0.4 should be removed from the model. Table 9 depicts the PLS loadings and cross-loadings that were extracted from our model. In bold we have represented the loadings, in which the majority scored above 0.7, except for PC1 and PC2. The items PC1 and PC2 scored 0.67 and 0.68 respectively, which are values below 0.7, but still higher than 0.4. The items SC4 and TC1 were excluded for low loading. The convergent validity was tested through the average variance extracted (AVE), which has a minimum reference value of 0.50, indicating that the latent variables explain more than half of the variance of their indicators (Hair, Hult, Ringle, & Sarstedt, 2014; Henseler et al., 2009). The AVE values (Table 8) are above the minimum reference 0.5 for each construct, which ensures convergence. The results obtained guarantee that the measures utilized in this research are valid and reliable. To evaluate the discriminant validity of the constructs the Fornell-Larcker criterion and the cross-loadings approach were used. The first requires the AVEs' square root value to be higher than the correlations between the construct (Fornell & Larcker, 1981). The diagonal values, (AVEs' square root) in Table 8, are greater than the correlation amongst each pair of constructs (values in off-diagonal). Considering the cross-loadings criterion, it requires the item loading to be greater than all cross-loadings (Chin, 1998; Götz, Liehr-Gobbers, & Krafft, 2010; Grégoire & Fisher, 2006). As seen in Table 9, the values of the loadings are higher than the cross-loadings, which meets the criterion. Besides a good internal consistency, the results from the measurement model demonstrate that the model also has a favourable indicator reliability, convergent validity, and discriminant validity, allowing the use of all constructs to test the structural model.

Constructs	Mean	SD	CR	CA	PC	TL	SC	TC	CI	S
Personal Characteristics (PC)	5.65	0.86	0.89	0.85	**0.75**					
Training and Learning (TL)	5.40	1.13	0.90	0.78	0.68	**0.91**				
Societal Culture (SC)	5.18	0.93	0.88	0.80	0.58	0.58	**0.84**			
Team Capability (TC)	5.27	1.07	0.87	0.80	0.59	0.51	0.59	**0.79**		
Customer Involvement (TC)	4.86	1.28	0.88	0.79	0.36	0.35	0.33	0.48	**0.84**	
Agile Software Development Project Success (S)	5.15	1.14	0.88	0.81	0.43	0.41	0.42	0.62	0.53	**0.85**

Table 8 – Latent variables means, standard deviations (SD), composite reliability (CR), Cronbach's Alpha (CA), and validity (AVE) measures

Constructs	Indicator	PC	TL	SC	TC	CI	S
Personal Characteristics (PC)	PC1	**0.67**	0.40	0.39	0.30	0.24	0.23
	PC2	**0.68**	0.48	0.37	0.40	0.26	0.30
	PC3	**0.79**	0.43	0.42	0.55	0.26	0.39
	PC4	**0.81**	0.53	0.50	0.45	0.31	0.36
	PC5	**0.81**	0.53	0.42	0.47	0.31	0.31
	PC6	**0.73**	0.68	0.48	0.42	0.27	0.32
Training and Learning (TL)	TL1	0.66	**0.93**	0.53	0.52	0.35	0.42
	TL2	0.55	**0.88**	0.53	0.40	0.28	0.33
Societal Culture (SC)	SC1	0.37	0.39	**0.75**	0.33	0.23	0.24
	SC2	0.49	0.49	**0.86**	0.46	0.22	0.31
	SC3	0.56	0.56	**0.92**	0.63	0.36	0.46
Team Capability (TC)	TC2	0.58	0.55	0.57	**0.74**	0.34	0.47
	TC3	0.33	0.35	0.34	**0.70**	0.38	0.45
	TC4	0.47	0.34	0.47	**0.87**	0.42	0.54
	TC5	0.46	0.40	0.48	**0.84**	0.35	0.48
Customer Involvement (CI)	CI1	0.27	0.25	0.20	0.37	**0.84**	0.39
	CI2	0.28	0.30	0.26	0.35	**0.83**	0.40
	CI3	0.34	0.33	0.36	0.46	**0.84**	0.51
Agile Software Development Project Success (S)	S1	0.32	0.29	0.29	0.43	0.38	**0.85**
	S2	0.39	0.32	0.36	0.52	0.39	**0.87**
	S3	0.38	0.41	0.41	0.60	0.54	**0.83**

Table 9 – Measurement model loadings and cross-loadings

5.2. STRUCTURAL MODEL

For the structural model estimation, both R^2 measures and path coefficients level of significance were used. As seen in Figure 2 this study's dependent variable "Agile Software Development Project Success" has scored an R^2 of 0.46. We have also assessed the significance of the path coefficients through a bootstrapping procedure with 5000 resampling iterations (Hair et al., 2014). Besides path coefficients, Figure 2 presents the t-value results between parentheses.

The R^2 suggests that the model explains 46% of the variation in agile software development project success, having as statistically significant variables, team capability ($\hat{\beta} = 0.42$; $p < 0.001$), and customer involvement ($\hat{\beta} = 0.29$; $p < 0.001$). Therefore, hypotheses H4 and H5 are confirmed. Regarding the results of the remaining factors, personal characteristics ($\hat{\beta} = 0.02$; $p < 0.001$), training and learning ($\hat{\beta} = 0.07$; $p < 0.001$), and societal culture ($\hat{\beta} = 0.03$; $p < 0.001$) suggest that these people factors are not statistically significant for agile software development project success, so their respective hypotheses H1, H2, and H3 are not confirmed. Summarizing, of the five hypotheses, only two are confirmed.

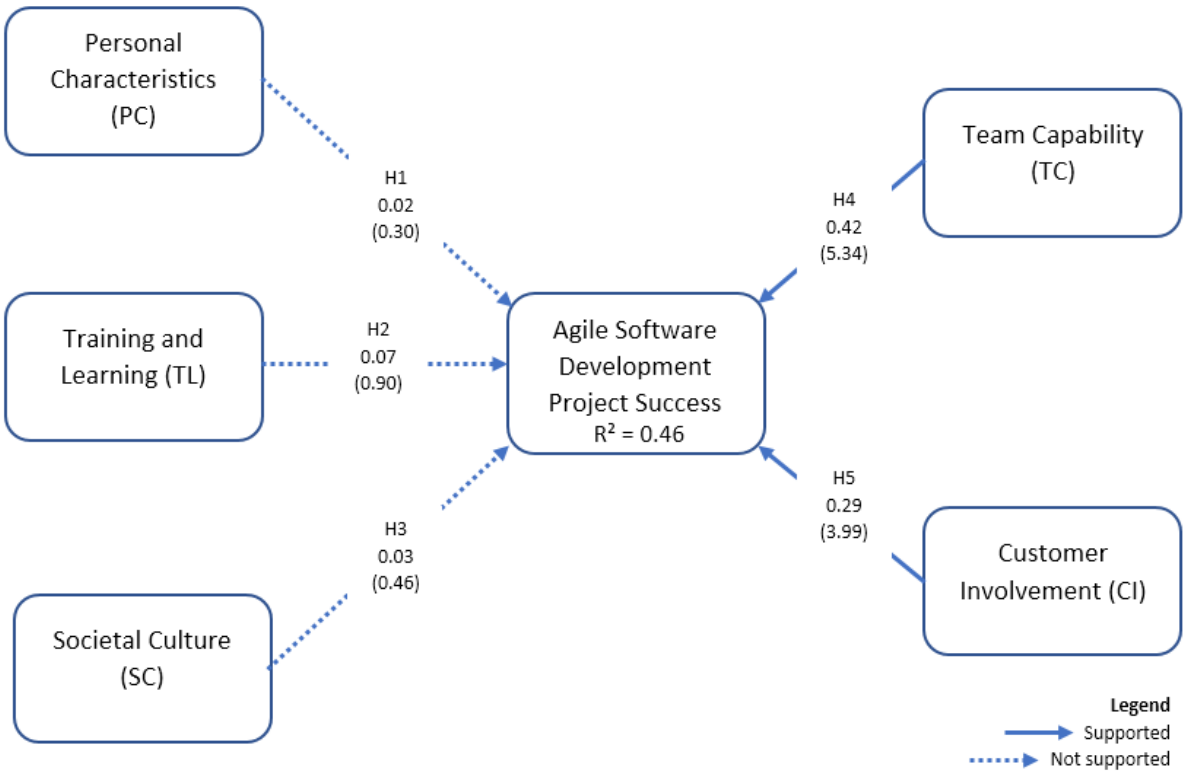

Figure 2 – Research model with results

6. DISCUSSION

6.1. THEORETICAL IMPLICATIONS

This study has combined people factors to explain agile software development project success. After performing the PLS-SEM analysis, the conditions are now favourable to provide a concise answer to our research question. The model composed by the variables personal characteristics, training and learning, societal culture, team capability, and customer involvement has managed to explain 46% of the variation in agile software development project success. Of these five variables, only team capability and customer involvement have emerged as statistically significant, indicating that they are factors contributing to the success of agile software development projects (confirming H4 and H5 respectively). Results also indicate that team capability has a greater impact on agile software development project success than customer involvement. In sum, to maximize the chances of project success, team capability should be the priority, followed closely by customer involvement.

Our results are consistent with those reported by Chow and Cao (2008) regarding the people dimension. The relevance of both factors was somehow expected since they are supported by the agile manifesto for software development. However, Stankovic et al. (2013) did not find them as influential, which might be explained by their sample characteristics. Team capability can be fitted within the fifth principle of the manifesto, in which individual's motivation and support are advocated (Agile Alliance, 2001; Chow & Cao, 2008). Customer involvement is consistent with the findings of Sheffield and Lemétayer (2013), and the factor was indicative of software project agility in successful projects. Customer involvement is also cited on the third value of the manifesto, and it can also be compared to the fourth principle, which refers to the importance of having business people (customer representatives) and developers working jointly throughout the project's duration (Agile Alliance, 2001; Chow & Cao, 2008). Regarding the lack of statistical significance found on the proposed people factors by Misra et al. (2009), we see their study as a contradiction to our results. Our findings indicate that societal culture, training and learning, and personal characteristics cannot be considered as significant influential factors for agile software development project success.

The most surprising finding was perhaps the lack of significance verified in personal characteristics, since it involves essential soft-skills such as collaborative attitude and the ability to communicate and to establish interpersonal relationships, which are somehow the foundations of the first value presented in the agile manifesto. Regarding the literature, we have not managed to find supporting evidence that could sustain the results obtained by this construct. However, we speculate that Portuguese agile teams may be prioritizing processes and tools over individuals and their interactions. In other words, practitioners might still be focusing on procedural and methodological issues related to agile instead of people, which might have influenced the significance of those factors that emphasize individuals, such as societal culture, and their interactions, like training and learning. In sum, agile may not be used to its full potential in Portugal.

Unlike earlier research, this study has focused on a single dimension, "People", and we intend to reach those agile projects in which success might be conditioned by human capital. From our perspective, we have created a scalable and comprehensive model, referring to important features that characterize people and their actions that can be used by future agile researchers.

6.2. MANAGERIAL IMPLICATIONS

After demonstrating the people factors influencing agile software development project success, some practical implications will be disclosed as a way to help managers to make informed decisions.

According to our findings, customers should always be involved in the project, and the lack of their involvement may be translated into a substantial increase of project risks and subsequent failure (Wallace, Keil, & Rai, 2004). The frequent delivery of working software, which is advocated by the Agile Alliance (2001), is dependent on customers' collaboration, and the more involved a customer is the more satisfied he may be with the project (Bendapudi & Leone, 2003). Therefore, we emphasize that agile software development projects should have at least one customer representative working as an active member of the project team. The customer representative should be empowered to make project-related decisions such as approvals, disapprovals, and to establish priorities in terms of project requirements. Another important aspect is related to the maintenance of a favourable relationship with the customer. Due to the nature of agile, which focusses on face-to-face interactions and customer collaboration, a favourable relationship between the customer and the project team is crucial. This relationship will most likely dictate how well the agile methodology will be applied, which could be mirrored in the project's outcome.

Regarding team capability, we stress that a project team should be composed, if possible, of highly motivated professionals who can commit to project success. Proper technical training should also be provided, with a focus on the subject matter and on agile processes, assuring team synchronization. Considering the team facilitator role, it must be held by an individual knowledgeable in agile processes and principles, who should also undertake an adaptive management style, encouraging continuous adaptation and flexibility.

Summarizing, an agile software development environment should be created around talented, committed, and professional people. Using this information, managers and teams will be able to establish priorities and act accordingly when deciding about which factors they should be focusing on to maximize the probability of project success.

6.3. LIMITATIONS AND FUTURE WORK

We must acknowledge some limitations. First, we recognize the inherent complexity of our variables, suggesting that there are certainly more items that could have been used to better characterize each people factor or even project success. Future research should focus on validating and scaling up our model, finding additional items to measure aspects such as "individual's capability to respond to change", which was not included in our study and plays an important role in agile software development. Second, the study was undertaken in a single country (Portugal), which is a constraint on generalizability. Future works should gather data from different countries combining different perspectives. Additionally, it would be interesting to have a comparison between different nations, and further on to study the differences between geographic regions, for instance, northern and southern countries in Europe.

7. CONCLUSIONS

Since agile software development relies on human capital to be successful, our research has focused on disclosing the people factors contributing for the success of these types of project. After an extensive review of the literature, we built a model of factors that were proven to be influential for agile software development project success, and their validity was thus retested in the Portuguese context. The conceptualized model offered a concise characterization of the people dimension. Future researchers are invited to validate and build upon our work, making the model more detailed and reliable.

A total of 216 agile professionals were surveyed from a variety of business areas. The results obtained using PLS-SEM indicates that team capability and customer involvement can greatly explain the variance in agile software development project success. However, we did not manage to find evidence suggesting that personal characteristics, training and learning, or societal culture are important factors in this context.

This work offers a valuable contribution for agile practitioners who are currently or will be involved in an agile software development project. According to our findings, managers are encouraged to select a highly capable team, and to promote customer involvement and collaboration, since these factors are more likely to lead an agile software development project to success.

8. BIBLIOGRAPHY

Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J. (2002). Agile software development methods: Review and analysis. *VTT Publications*, *478*, 3–107.

Agile Alliance. (2001). Manifesto for agile software development. Retrieved October 15, 2017, from http://agilemanifesto.org

Ahimbisibwe, A., Cavana, R. Y., & Daellenbach, U. (2015). A contingency fit model of critical success factors for software development projects: A comparison of agile and traditional plan-based methodologies. *Journal of Enterprise Information Management*, *28*(1), 7–33.

Almasri, A. K. (2016). A Proposed Hybrid Agile Framework Model For Mobile Applications. *International Journal of Software Engineering & Applications*, *7*(2), 1–9.

Alvertis, I., Koussouris, S., Papaspyros, D., Arvanitakis, E., Mouzakitis, S., Franken, S., … Prinz, W. (2016). User Involvement in Software Development Processes. *Procedia Computer Science*, *97*, 73–83.

Atkin, B., & Skitmore, M. (2008). Stakeholder management in construction. *Construction Management and Economics*, *26*(6), 549–552.

Atkinson, R. (1999). Project management : Cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, *17*(6), 337–342.

Aycan, Z., Kanungo, R. N., Mendonca, M., Yu, K., Deller, J., Stahl, G., & Kurshid, A. (2000). Impact of culture on human resource management practices: A 10-country comparison. *Applied Psychology: An International Review*, *49*(1), 192–221.

Badewi, A. (2016). The impact of project management (PM) and benefits management (BM) practices on project success: Towards developing a project benefits governance framework. *International Journal of Project Management*, *34*(4), 761–778.

Bechky, B. A. (2006). Gaffers, Gofers, and Grips: Role-Based Coordination in Temporary Organizations. *Organization Science*, *17*(1), 3–21.

Belassi, W., & Tukel, O. I. (1996). A new framework for determining critical success/failure factors in projects. *International Journal of Project Management*, *14*(3), 141–151.

Bendapudi, N., & Leone, R. P. (2003). Psychological Implications of Customer Participation in Co-Production. *Journal of Marketing*, *67*(1), 14–28.

Boehm, B., & Turner, R. (2005). Management challenges to implementing agile processes in traditional development organizations. *IEEE Software*, *22*(5), 30–39.

Bullen, C., & Rockart, J. (1981). A Primer on critical success factors. *Information Systems Research*, *69*.

Campanelli, A. S., & Parreiras, F. S. (2015). Agile methods tailoring - A systematic literature review. *The Journal of Systems and Software*, *110*, 85–100.

Carbonell, P., Rodríguez-Escudero, A. I., & Pujari, D. (2009). Customer involvement in new service development: An examination of antecedents and outcomes. *Journal of Product Innovation Management*, *26*(5), 536–550.

Chin, W. W. (1998). Issues and Opinion on Structural Equation Modeling. *MIS Quarterly*, *22*(1), 7–25.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects : Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion / Adoption Study. *Information Systems Research*, *14*(2), 189–217.

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.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, *16*(1), 64–73.

Clarke, A. (1999). A practical use of key success factors to improve the effectiveness of project management. *International Journal of Project Management*, *17*(3), 139–145.

Cleland, D. I., & King, W. R. (1983). *Systems Analysis and Project Management*. New York: McGraw-Hill.

Conforto, E. C., Amaral, D. C., Silva, S. L., Di Felippo, A., & Kamikawachi, D. S. L. (2016). The agility construct on project management theory. *International Journal of Project Management*, *34*(4), 660–674.

Cooke-Davies, T. (2002). The "real" success factors on projects. *International Journal of Project Management*, *20*(3), 185–190.

Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International Journal of Project Management*, *32*(2), 189–201.

Dikert, K., Paasivaara, M., & Lassenius, C. (2016). Challenges and success factors for large-scale agile transformations: A systematic literature review. *Journal of Systems and Software*, *119*, 87–108.

Dyba, T., & Dingsoyr, T. (2009). What do we know about agile software development? *IEEE Software*, *26*(5), 6–9.

Fernandez, D. J., & Fernandez, J. D. (2008). Agile Project Management - Agilism Versus Traditional Approaches. *Journal of Computer Information Systems*, *49*(2), 10–17.

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1), 39–50.

Götz, O., Liehr-Gobbers, K., & Krafft, M. (2010). Evaluation of structural equation models using the partial least squares (PLS) approach. In *Handbook of partial least squares*. Springer Berlin Heidelberg.

Grégoire, Y., & Fisher, R. J. (2006). The effects of relationship quality on customer retaliation. *Marketing Letters*, *17*(1), 31–46.

Haas, M. R. (2006). Knowledge Gathering, Team Capabilities, and Project Performance in Challenging Work Environments. *Management Science*, *52*(8), 1170–1184.

Hair, J. F., Hult, G. T., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least square structural equation modeling (PLS-SEM)*. US: SAGE.

Haverila, M. J., & Fehr, K. (2016). The impact of product superiority on customer satisfaction in project management. *International Journal of Project Management*, *34*(4), 570–583.

Henderson-Sellers, B., & Ralyté, J. (2010). Situational Method Engineering: State-of-the-Art Review. *Journal of Universal Computer Science*, *16*(3), 424–478.

Henriksen, A., & Pedersen, S. A. R. (2017). A qualitative case study on agile practices and project success in agile software projects. *Journal of Modern Project Management*, *5*(1), 63–73.

Henseler, J., Ringle, C. M., & Sinkovics, R. (2009). The use of partial least squares path modeling in international marketing. In *New Challenges to International Marketing* (Vol. 20, pp. 277–319). Emerald Group Publishing Limited.

Ika, L. A., Diallo, A., & Thuillier, D. (2012). Critical success factors for World Bank projects: An empirical investigation. *International Journal of Project Management*, *30*(1), 105–116.

International Project Management Association. (2015). *Individual Competence Baseline for Project, Programme & Portfolio Management.* Zurich: IPMA.

ISO. (2012). *ISO 21500:2012. Guidance on project management*. Geneva.

Jugdev, K., & Müller, R. (2005). A retrospective look at our evolving understanding of project success. *Project Management Journal*, *36*(4), 19–31.

Kent, B., & Gamma, E. (2000). *Extreme programming explained: embrace change*. Boston: Addison-Wesley Longman Publishing Co., Inc.

Kerzner, H. (1987). In Search of Excellence in Project Management. *Journal of Systems Management*, *38*(2), 30–40.

Kupiainen, E., Mäntylä, M. V., & Itkonen, J. (2015). Using metrics in Agile and Lean software development - A systematic literature review of industrial studies. *Information and Software Technology*, *62*, 143–163.

Lechler, T. G., & Yang, S. (2017). Exploring the Role of Project Management in the Development of the Academic Agile Software Discourse: A Bibliometric Analysis. *Project Management Journal*, *48*(1), 3–18.

Lei, H., Ganjeizadeh, F., Jayachandran, P. K., & Ozcan, P. (2017). A statistical analysis of the effects of Scrum and Kanban on software development projects. *Robotics and Computer-Integrated Manufacturing*, *43*, 59–67.

Lester, D. H. (1998). Critical Success Factors for New Product Development. *Research-Technology Management*, *41*(1), 36–43.

Lim, C. S., & Mohamed, M. Z. (1999). Criteria of project success : An exploratory re-examination. *International Journal of Project Management*, *17*(4), 243–248.

Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology*, *86*(1), 114–121.

Lundin, R., & Soderholm, A. (1995). A theory of the temporary organization. *Scandinavian Journal of Management*, *11*(4), 437–455.

Malhotra, N. K., Kim, S. S., & Patil, A. (2006). Common Method Variance in IS Research: A Comparison of Alternative Approaches and a Reanalysis of Past Research. *Management Science*, *52*(12), 1865–1883.

Manning, S. (2008). Embedding projects in multiple contexts – a structuration perspective.

International Journal of Project Management, *26*(1), 30–37.

Meso, P., & Jain, R. (2006). Agile software development: adaptive systems principles and best practices. *Information Systems Management*, *23*(3), 19–30.

Middleton, P. (2001). Lean Software Development: Two Case Studies. *Software Quality Journal*, *9*(4), 241–252.

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.

Moe, N. B., Dingsøyr, T., & Dybå, T. (2010). A teamwork model for understanding an agile team: A case study of a Scrum project. *Information and Software Technology*, *52*(5), 480–491.

Morris, P. W. G., & Hough, G. H. (1987). *The anatomy of major projects: a study of the reality of project management*. Chichester: John Wiley & Sons Ltd.

Munns, A. K., & Bjeirmi, B. F. (1996). The role of project management in achieving project success. *International Journal of Project Management*, *14*(2), 81–87.

Pauget, B., & Wald, A. (2013). Relational competence in complex temporary organizations: The case of a French hospital construction project network. *International Journal of Project Management*, *31*(2), 200–211.

Persson, J. S., Mathiassen, L., & Aaen, I. (2012). Agile distributed software development: Enacting control through media and context. *Information Systems Journal*, *22*(6), 411–433.

Pinto, J. K., & Slevin, D. P. (1987). Critical Factors in Successful Project Implementation. *IEEE Transactions on Engineering Management*, *34*(1), 22–27.

Pinto, J. K., & Slevin, D. P. (1988). Project success: definitions and measurement techniques. *Project Management Journal*, *19*(1), 67–72.

Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard Business Review*, *57*(2), 81–93.

Sani, A., Firdaus, A., Jeong, S. R., & Ghani, I. (2013). A Review on Software Development Security Engineering using Dynamic System Method (DSDM). *International Journal of Computer Applications*, *69*(25), 37–44.

Santos, M. A., Bermejo, P. H. S., Oliveira, M. S., & Tonelli, A. O. (2011). Agile Practices: An Assessment of Perception of Value of Professionals on the Quality Criteria in Performance of Projects. *Journal of Software Engineering and Applications*, *4*(12), 700–709.

Schwaber, K., & Sutherland, J. (2016). The scrum guide. The Definitive Guide to Scrum: The Rules of the Game. *The Definitive Guide to Scrum: The Rules of the Game*. Retrieved November 10, 2018, from https://www.scrum.org/

Serrador, P., & Pinto, J. K. (2015). Does Agile work? - A quantitative analysis of agile project success. *International Journal of Project Management*, *33*(5), 1040–1051.

Sheffield, J., & Lemétayer, J. (2013). Factors associated with the software development agility of successful projects. *International Journal of Project Management*, *31*(3), 459–472.

Shenhar, A. J., Dvir, D., Levy, O., & Maltz, A. C. (2001). Project success: A multidimensional strategic concept. *Long Range Planning*, *34*(6), 699–725.

Shenhar, A. J., Levy, O., & Dvir, D. (1997). Mapping the dimensions of project success. *Project Management Journal*, *28*(2), 5–13.

Shipper, E. S., Mazer, L. M., Merrell, S. B., Lin, D. T., Lau, J. N., & Melcher, M. L. (2017). Pilot evaluation of the Computer-Based Assessment for Sampling Personal Characteristics test. *Journal of Surgical Research*, *215*, 211–218.

Stankovic, D., Nikolic, V., Djordjevic, M., & Cao, D. B. (2013). A survey study of critical success factors in agile software projects in former Yugoslavia IT companies. *Journal of Systems and Software*, *86*(6), 1663–1678.

Straub, D. W. (1989). Validating instruments in MIS research. *MIS Quarterly*, *13*(2), 147–169.

The Standish Group International. (2013). *The CHAOS Manifesto: Think Big, Act Small*. Boston: The Standish Group.

Thomas, D. C., Au, K., & Ravlin, E. C. (2003). Cultural variation and the psychological contract. *Journal of Organizational Behavior*, *24*(5), 451–471.

Thomas, D. C., Fitzsimmons, S. R., Ravlin, E. C., Au, K. Y., Ekelund, B. Z., & Barzantny, C. (2010). Psychological contracts across cultures. *Organization Studies*, *31*(11), 1437–1458.

Todorović, M. L., Petrović, D. Č., Mihić, M. M., Obradović, V. L., & Bushuyev, S. D. (2015). Project success analysis framework: A knowledge-based approach in project management. *International Journal of Project Management*, *33*(4), 772–783.

Toor, S., & Ogunlana, S. O. (2010). Beyond the "iron triangle": Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects. *International Journal of Project Management*, *28*(3), 228–236.

Turner, J. R. (2004). Five necessary conditions for project success. *International Journal of Project Management*, *22*(5), 349–350.

Turner, J. R., & Müller, R. (2003). On the nature of the project as a temporary organization. *International Journal of Project Management*, *21*(1), 1–8.

Wallace, L., Keil, M., & Rai, A. (2004). How software project risk affects project performance: An investigation of the dimensions of risk and an exploratory model. *Decision Sciences*, *35*(2), 289–321.

Yang, L. R., Huang, C. F., & Wu, K. S. (2011). The association among project manager's leadership style, teamwork and project success. *International Journal of Project Management*, *29*(3), 258–267.

9. APPENDIX

9.1. APPENDIX A. ITEMS

Constructs	Items	Adapted from
Personal Characteristics	PC1 - The project team consisted of people with strong interpersonal and communication skills. PC2 - The project team consisted of people who were honest. PC3 - The project team consisted of people who were motivated. PC4 - The project team consisted of people who had collaborative attitude. PC5 - The project team consisted of people who had sense of responsibility. PC6 - The project team consisted of people who had readiness to learn.	(Misra et al., 2009)
Training and Learning	TL1 - The project team members were, in general, always willing to continuously learn from one another. TL2 - The project team members were, in general, always willing to train each other through mentoring and professionally guided discussions than through formal training.	(Misra et al., 2009)
Societal Culture	SC1 - The people of our country who worked on the project were, in general, communicative. SC2 - The people of our country who worked on the project were, in general, dynamic. SC3 - The people of our country who worked on the project had, in general, a progressive attitude. SC4 - The project team had similar social culture, even though they might belong to different nationalities or provinces.	(Misra et al., 2009)
Team Capability	TC1 - The project team members had high technical competence and expertise (i.e. problem-solving, programming, subject matter). TC2 - The project team members had a great motivation and were committed to the project success. TC3 - The project provided appropriate technical training to the team, including training on the subject matter and agile processes. TC4 - The project team facilitator/coordinator was knowledgeable in agile principles and processes. TC5 - The project team facilitator/coordinator had light-touch and/or adaptive management style (i.e. encouraging a creative, flexible working environment while taking advantage of mutual interactions amongst the project's various parts and steering them toward continuous learning and adaptation).	(Stankovic et al., 2013)
Customer Involvement	CI1 - The project had strong customer commitment and presence (i.e. having at least one customer representative on site working hard and full-time as a member of the project team). CI2 - The customer representative on the project had full authority and knowledge to make decisions on-site, such as approving, disapproving, and prioritizing project requirements and changes. CI3 - There was a good customer relationship within the project.	(Stankovic et al., 2013)
Agile Software Development Project Success	S1 - Regarding costs (i.e. delivered under or within budget) the project was… S2 - Regarding time (i.e. on-time delivery) the project was… S3 - Regarding customer satisfaction (i.e. the product's performance managed to overcome the end-user's expectations) the project was …	(Stankovic et al., 2013)

9.2. APPENDIX B. SURVEY INSTRUMENT

The Factors Influencing the Success of Agile Software Development Projects: A Portuguese Perspective

Contributing to the conclusion of my Master's program, I present you the following questionnaire, whose main objective is to get insights about which people related factors are most likely to influence the success of agile software development projects.

If you have ever participated in an Agile project, then your response will be an important input to this research, helping us to understand which are the most relevant factors in this context.

All the collected data will be subject to a strict confidentiality and anonymity criterion.

It will take approximately 5 minutes to answer.

For any doubts or questions, do not hesitate to contact me at m2016243@novaims.unl.pt

Thank you for making this research possible!

Eduardo Moura

People Factors

To answer the following sections, please select one Agile software project (either successful or failed) where you have participated and that you consider most relevant.

Mark your option on a scale from 1 to 7, where 1 is "Strongly Disagree" and 7 is "Strongly Agree".

Personal Characteristics

---

1. The project team consisted of people with strong interpersonal and communication skills.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

2. The project team consisted of people who were honest.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

3. The project team consisted of people who were motivated.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

4. The project team consisted of people who had collaborative attitude.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

5. The project team consisted of people who had sense of responsibility.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

6. The project team consisted of people who had readiness to learn.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Training and Learning

---

7. The project team members were, in general, always willing to continuously learn from one another.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

8. The project team members were, in general, always willing to train each other through mentoring and professionally guided discussions than through formal training.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Societal Culture

---

9. The people of our country who worked on the project were, in general, communicative.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

10 The people of our country who worked on the project were, in general, dynamic.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

11. The people of our country who worked on the project had, in general, a progressive attitude.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

12. The project team had similar social culture, even though they might belong to different nationalities or provinces.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Team Capability

---

13. The project team members had high technical competence and expertise (i.e. problem-solving, programming, subject matter).

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

14. The project team members had a great motivation and were committed to the project success.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

15. The project provided appropriate technical training to the team, including training on the subject matter and agile processes.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

16 The project team facilitator/coordinator was knowledgeable in agile principles and processes.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

17. The project team facilitator/coordinator had light-touch and/or adaptive management style (i.e. encouraging a creative, flexible working environment while taking advantage of mutual interactions amongst the project's various parts and steering them toward continuous learning and adaptation).

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Customer Involvement

---

18. The project had strong customer commitment and presence (i.e. having at least one customer representative on site working hard and full-time as a member of the project team).

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

19. The customer representative on the project had full authority and knowledge to make decisions on-site, such as approving, disapproving, and prioritizing project requirements and changes.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

20. There was a good customer relationship within the project.

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Agile Project Success

Regarding your perceived level of success of the Agile Software Project that you have considered, please rate it on a scale from 1 to 7, adopting the following scale:

1 - Very Unsuccessful
2- Unsuccessful
3- Somewhat Unsuccessful
4 - Neutral
5 - Somewhat Successful
6 - Successful
7 - Very Successful

21. Regarding costs (i.e. delivered under or within budget) the project was...

Very Unsuccessful	1	2	3	4	5	6	7	Very Successful

22. Regarding time (i.e. on-time delivery) the project was...

Very Unsuccessful	1	2	3	4	5	6	7	Very Successful

23. Regarding customer satisfaction (i.e. the product's performance managed to overcome the end-user's expectations) the project was ...

Very Unsuccessful	1	2	3	4	5	6	7	Very Successful

Position/Role

---

24. Please specify your job responsibility in the project.

1 Scrum Master
2 Agile Coach
3 Developer/Tester
4 Product Owner
5 Other:_____

Demographic information

25. Education:

1 Basic education
2 12º grade or equivalent
3 Bachelor's degree
4 Master's degree
5 Doctoral degree

26. Professional status:

1 Unemployed
2 Employee
3 Self-employed
4 Retired
5 Other:_____

27. I have become knowledgeable about agile practices and methods for:

1 Less than 1 year
2 1-3 years
3 3-5 years
4 Greater than 5 years

28. Please specify the company's primary identity where the project was undertaken.

1 Banking/Insurance
2 Telecommunications
3 Computer-related (Hardware, Software)
4 Real estate
5 Business supplies/services

6 Education/Research
7 Entertainment
8 Hospitality
9 Medical/healthcare
10 Government
11 Engineering/construction
12 Consulting
13 Legal Services
14 Manufacturing/distribution
15 Consumer retail/wholesale
16 Non-profit organization
17 Electrical machines
18 Aerospace
19 Other:_____

29 Please specify for how long have you been using agile practices and methods.

1 Less than 1 year
2 1 - 3 years
3 3 - 5 years
4 Greater than 5 years
5 Not applicable

30. Please specify which agile methodologies have you ever used.

1 Extreme Programming (XP)
2 SCRUM
3 Kanban
4 Lean
5 Feature Driven Development (FDD)
6 Adaptive Software Development (ASD)
7 Dynamic System Development Method (DSDM)
8 Crystal
9 Other:_____

Additional information and feedback.

31. Knowledge level with the topic of this study.

Very Limited	1	2	3	4	5	6	7	Very Good

32. Knowledge level with NOVA IMS.

Very Limited	1	2	3	4	5	6	7	Very Good

33. If applicable, please provide us your feedback or thoughts about the present research.