Analyzing potential barriers of Agile adoption in Chinese software development organizations

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Analyzing potential barriers of Agile adoption in Chinese software development organizations

Analys av potentiella hinder för införandet av Agila metoder i kinesiska mjukvaruföretag

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Abstract
For the last decade the IT industry has been transitioning to Agile software development due to the impending need for a more flexible development process. China’s IT industry is growing drastically, but to stay competitive in the global market the Chinese organizations have to constantly adapt and reorient to today’s market needs. The purpose of this study is to determine if Agile methodologies and practices are suitable for the software industry in China.

The study describes the fundamentals of Agile software development and analyzes the success factors of Agile adoption. Further analysis of Agile and its relation to culture is conducted, as well as an analysis of China, its national and organizational culture, and its software industry.

Several hypothesis regarding potential barriers of Agile adoption in China were constructed to guide the design of the survey questionnaire. In the analysis of the survey data it was concluded that the communication aspect does pose as a barrier for Agile adoption in China, whereas the cognitive, social, organizational culture, competence and recruitment and managerial aspects all are concluded to not be barriers for Agile adoption. The overall result indicates that Agile methodologies are suitable, and should be favorable for the software development organizations in China.
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1 Introduction

In this chapter the problem that is being studied in this master’s thesis is introduced. The problem background will first be described, followed by the research objectives and research questions. The last section covers the delimitations of the conducted study.

1.1 Problem background

Performance depends on the fit between strategy and culture. First you need to know where you want to go, but where you want to go has to fit with your culture. (G. Hofstede)

The IT industry is an area surrounded by buzzwords and ever-emerging new technologies and techniques. In 2001 a new buzzword hit the market, ‘Agile software development’. However, this buzzword turned out to be long lasting - a paradigm shift in software development processes [1]. Today, Agile is globally spread and widely used in software development organizations, from small startup companies to big enterprises.

The essence of Agile is the ability to create and respond to changes in an environment full of turbulence and uncertainty [2]. Agile software development is a collection of methods and approaches that are designed to manage and cope with the development of complex systems where changing user requirements arise rapidly and often [3].

For the last decade the IT industry has been transitioning to Agile software development, moving away and replacing the heavier traditional methodologies. This change has mainly taken place in the US and European countries, whereas the Asian countries, for example, have not been progressing in this transition as much. China appears as an especially interesting case study for Agile adoption, as the author has been working in a Chinese software company for some years and got to personally experience the unique national as well as organizational culture of the country.

China is growing towards becoming the world’s biggest economy. It needs all of its industries to contribute with high growth to achieve this goal, not least the IT industry [4]. As of 2013 China’s software industry had a revenue of 3.06 trillion yuan ($504 billion), with 23.4% year-on-year growth and more than 4.7 million people working in the industry [5]. In order to stay competitive in today's global IT market, the IT industry in China has to constantly adapt and learn to reorient to the market needs. Agile is a weapon for dealing with changes in software development, it is created as a result of the impending need for a development process that is able to handle and adapt changes in order for organizations to take hold of rising opportunities in the competitive market [6].

Organizational change is a complex process that cannot be achieved easily. Adoption of Agile software development requires an understanding of the consequences and potential barriers that such initiative might bring to the organization [7], as the transition would bring essential changes in the organization, and may have severe impacts on the structure, culture and management [8]. Agile software development is based on people and focuses more on creating a flexible culture and communication than strict processes and tools. China’s strong culture, that has emerged over its 5000-year history, will most certainly have an impact on the adoption of the western-based Agile methodologies [9].

This master’s thesis is targeted to study Agile software development in general, and the adoption of Agile methodologies in the Chinese software industry in particular.
1.2 Research Objectives

The overall goal of this thesis is to determine to what extent Agile methodologies and practices are suitable for the software industry in China.

The goal is further divided into the following specific objectives:

- **Objective 1:** To understand the fundamentals of Agile software development.
- **Objective 2:** To understand the Chinese national and organizational culture and its core values.
- **Objective 3:** Identify Agile success and adoption factors and their relation to the presumed characteristics of the Chinese software development industry.
- **Objective 4:** To obtain an understanding of what specific Agile factors might appear as potential barriers for successful Agile adoption in Chinese software development organizations.

1.3 Research Questions

To address the goals of this master’s thesis, which were presented in the previous section, these specific research questions were formulated:

- **Question 1:** What are the underlying principles and values of Agile methodologies?
- **Question 2:** What factors are important for an organization to succeed in adopting Agile methodologies?
- **Question 3:** What are the critical barriers that impact the success of Agile and Agile adoption in Chinese software development organizations?

1.4 Delimitations

In this master’s thesis Agile software development is considered in a general, broader sense as defined by the Agile Manifesto [10], hence no specific Agile methodology will be explained or described in detail. Furthermore, in this study the term ‘Agile adoption’ refers to any of the strategies mentioned in Section 2.1.3, which includes localization, tailoring and adoption. Agile adoption is a transitional process which makes the choice of adoption strategy less important [11]. As an example, and organization that accommodates a localization strategy could reach a higher level of agility than an organization that has just started to implement an Agile adoption strategy.
2 Theoretical Framework

In this chapter the theoretical background of this thesis is presented. The chapter is divided into two parts, where the first part will present the history behind Agile software development and outline how Agile methodologies are fundamentally constructed to give a good understanding of Agile software development, when it should be used and how Agile adoption is successfully achieved. The second part will begin with a description of the Chinese national culture followed by the Chinese societal and organizational culture, and finally end with the Chinese IT industry in numbers. These perspectives form a foundation to further analyze the suitability of Agile methodologies and practices for the software industry in China.

2.1 Agile software development

To understand Agile software development and the profound shift it has made for the software development industry it is important to know the history behind Agile and its preceding development methodologies.

2.1.1 Evolution of Agile

The software development process includes a series of activities that are essential in the development of software systems [3]. According to Sommerville (2007) there are four fundamental steps in every software development process:

1. Software specification, where the functionality of the software and constraints on its operation must be defined.
2. Software design and implementation, where the software to meet the specification must be produced.
3. Software validation, where the software must be validated to ensure that it does what the customer wants.
4. Software evolution, where the software must evolve to meet changing customer needs.

Code-and-fix, Waterfall, Evolutionary and Spiral are four models of software development processes that, standalone and combined, give a good overall picture of the traditional development methods [12].

- The Code-and-fix method is one of the earliest process models used in software development emerging around 1950. The process is aimed for a single person and consist of two very simple steps: writing the code, and then fixing the bugs in the code. This method became highly inadequate as computers started to become popular and their application domain extended from science and engineering where the users were the developers themselves. [12]

- The Waterfall model was able to eliminate many of the limitations of the preceding methodologies which made it powerful and allowed it to remain popular for a long time. It is a plan-driven process which means that all process activities must be planned and scheduled before being worked on, and in each phase, documentation is produced as an input for the subsequent phase. [3, 12] While it worked well for the development of compilers and operating systems, the phase rigidity of the Waterfall model is very strong, and the model is heavily documentation dependent and was of limited help in the development of small business applications and spreadsheets, not to mention that it
was driven to the point of being bureaucratic. All of the above contributed to the model's difficulty to respond to changing customer requirements. [3, 12]

- The *Evolutionary* software development process can be seen as a modified extension of the Waterfall method, where analysis and design is completed upfront similar to Waterfall. The later stages of the Evolutionary process are carried out incrementally, where user is incorporated and can test the system in the early stages to provide adequate feedback for the developers to incorporate in the next development cycle. [3, 12] The Evolutionary model trumps the Waterfall model. However it has a disadvantage in that the existing software is generally harder to adopt and change. A system that has been exposed to users will become an impediment for future development and maintenance [13].

- The *Spiral model* was introduced by Boehm in 1988. It was unique in the sense that it was the first ever risk-driven software development approach, where its predecessors was either code- or document-driven. The Spiral model works in an iterative manner and is represented as a spiral where the center is the start of the project. Each loop in the spiral contains the following four stages: objective setting, risk assessment and reduction, development and validation, planning. [3, 12]

As a direct counteract to the documentation heavy and Waterfall based processes the lightweight methods were starting to emerge in the mid-1990s. In a renowned meeting in Snowbird, Utah in 2001, seventeen senior developers and architects gathered and agreed upon a common perspective of how successful software development should be carried out. Their collective thoughts and beliefs were formalized and named the ‘Manifesto for Agile Software Development’. [13]

This was the biggest shift from the Waterfall model and has later been referred to as a paradigm shift in software development [1]. The foundation of Agile software development are described in the next section.

### 2.1.2 What is Agile

The essence of Agile is the ability to create and respond to changes in an environment of turbulence and uncertainty [2].

Agile software development can be explained in a three level hierarchy to illustrate the relation between values, principles and practices that together form the foundation of an Agile methodology [6]. *Figure 2.1* visualizes the hierarchical relationship between Agile values, principles and practices that, together, establish an Agile methodology. The core of being Agile is the ability to respond to change, and to achieve that, there is a set of values formed to create the optimal foundation for a software development process. On top of the values there is a set of principles for further guidance that represents the characteristics of an Agile process. The outer ring represents the specific practices that will help practitioners to achieve agility, and they are grouped in a unique set for each Agile methodology.
There are a big variety of Agile methodologies being practiced, with the most popular and widely used, in sequence, being: Scrum, Scrum/XP hybrid, Kanban, custom hybrid, ScrumBan, Kanban and Lean [14]. Each methodology has a different focus, where some (e.g. Scrum) concentrate more on the development process and management practices, whereas others (e.g. XP) revolve around best practices in software development [15].

Although the Agile methodologies share the same philosophy and values, each method has its own unique terminology, tactics and set of practices [16]. All Agile methodologies have a common characteristic: they are software development methods where software specification, development and delivery are carried out incrementally in an iterative manner [3]. These methods are designed to manage and cope with the development of complex systems where changing user requirements arise rapidly and often [3]. They focus on the collaboration between developers and stakeholders to identify and implement the most important features first, with the intention to deliver working software quickly to achieve high customer satisfaction [17].

### 2.1.2.1 Agile Values

The underlying philosophy in Agile software development is identified by the four values stated in the Agile manifesto [10]. It is crucial to acknowledge the significance of these values and actually incorporate them during the transition to Agile. Agile software development cannot be seen as just a process to follow, since no practices or tools alone could make an organization Agile without the underlying understanding of its values and principles [18]. The core Agile values are stated in the manifesto as:

- **Individuals and interactions over processes and tools**
- **Working software over comprehensive documentation**
- **Customer collaboration over contract negotiation**
- **Responding to change over following a plan**
It is important to emphasize that both sides of each statement hold significance in Agile software development, however, the left side of the statement should always be valued over the right side [6].

*Individuals and interactions over processes and tools* emphasizes the importance of putting individuals and interaction in focus in Agile projects. For example a development process can not compensate for the team members shortcoming, rather, it is the right people who will manage to deliver a great products regardless of the choice of process [19]. A process will never compensate for people's shortcomings, and great people will manage to deliver independent of the choice of process [19]. Processes and tools should not be avoided at all cost. In fact, all Agile methodologies describe some sort of development process to follow and many suggest usage of tools. However, all processes and tools must be reviewed and examined with consideration of the limitations and consequences they might impose on the people and their interaction with each other [20].

*Working software over comprehensive documentation* pledges that the purpose of Agile software development is to deliver high quality software. Coding should start as soon as possible to obtaining an early understanding of the product, instead of being preceded by extensive planning and documentation [20]. Documentation alone does not bring value to the customer, hence the target should be to produce just enough documentation, no more and no less [18].

*Customer collaboration over contract negotiation* encourages a customer centric approach, as an active customer is better at handling and managing changes that inevitably emerge in all software development projects [20]. A contract that prevents new or changing functionality to be incorporated in a product would result in less customer value delivered [18].

*Responding to change over following a plan* stresses on the importance of having a process that allows and embraces change, even late in the development lifecycle, because customers cannot foresee and accurately plan all requirements of a product in advance [20].

**2.1.2.2 Agile Principles**

As an extension to the four core values of Agile, the Agile manifesto states twelve principles that explain the characteristics of Agile software development and explain in greater detail what all Agile methodologies strive to achieve. They are:

- The highest priority is to satisfy the customer through early and continuous delivery of valuable software.
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
- Business people and developers must work together daily throughout the project.
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- Working software is the primary measure of progress.
- Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
- Continuous attention to technical excellence and good design enhances agility.
- Simplicity--the art of maximizing the amount of work not done--is essential.
- The best architectures, requirements, and designs emerge from self-organizing teams.
At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

These principles must be comprehended and used as guidance to succeed in implementing Agile methodologies and to achieve agility within an organization [18].

2.1.2.3 Agile Practices

Agile practices are the “how” of Agile development, which aim to help practitioners to pursue the Agile values and principles described in the Agile manifesto [10]. There is a wide range of Agile practices, whereby each Agile methodology advocates a set of practices which is believed to form a great foundation in conforming to Agile software development [21]. However, it is important to understand that executing a practice, or even a set of practices, will not necessarily make a team or organization Agile [18].

Every Agile practice must be carried out with the awareness of the underlying Agile values that it is trying to live up to [2]. As we learn more about how software is best developed, and with the rise of new technologies, the Agile practices used today will undoubtedly change and new Agile practices will emerge [6]. In Table 2.1 the top most commonly used Agile practices, according to VersionOne (2014), are described.

<table>
<thead>
<tr>
<th>Agile practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Standup</td>
<td>Is a short meeting where the attendants stand up and communicate what they have done, what they will do and any impediments</td>
</tr>
<tr>
<td>Iteration planning</td>
<td>Is a meeting held before each new iteration that structures and defines the scope of the work to be completed by the team</td>
</tr>
<tr>
<td>Unit Testing</td>
<td>Is a set of small pass/fail-tests that enable repeatable automated testing of the source code</td>
</tr>
<tr>
<td>Retrospective</td>
<td>Is a meeting held after each iteration where the team reflects upon its work and work process and adjust accordingly</td>
</tr>
<tr>
<td>Release Planning</td>
<td>Is a meeting to create a release plan that spans the whole project, and is used as base for iteration planning</td>
</tr>
<tr>
<td>Burn-down</td>
<td>Is a chart that displays the remaining work in the current iteration</td>
</tr>
<tr>
<td>Velocity</td>
<td>Is the estimated amount of work the team can handle based on the outcome of previous iterations</td>
</tr>
<tr>
<td>Coding Standards</td>
<td>Is a set of rules that the team agree upon to keep the code uniform and easier to read and understand</td>
</tr>
<tr>
<td>Continuous Integration</td>
<td>Is a technique that requires all developers to frequently add their code into a common repository</td>
</tr>
<tr>
<td>Automated Builds</td>
<td>Is a practice where scripting is used to automate the process of compiling the program code</td>
</tr>
</tbody>
</table>

| Table 2.1: Description of Agile practices [22] |

2.1.2.4 Agile Roles

Agile is fundamentally different from traditional development methodologies, where teams are usually formed around function and competence area. Instead it advocates cross-functional teams that possess knowledge in all parts of the development process such as requirement
analysis, system design, coding and testing. A cross-functional team structure is a presumption to be able to deliver working software after each iteration [23].

Roles involved in the process of software development vary in different Agile methodologies. Cohen (2005) describes the Agile team with the following four primary roles:

Customer

The customer has a central role in Agile software development and in the Agile manifesto, see Section 2.1.2.1. The customer is a concept rather than a role in Agile methodologies and can either be the client who pays for the product to be built, the end-users, stakeholders or a combination of all three [24]. Agile advocates close presence of the customer during the whole development process and underlines the team’s ultimate mission as satisfying the customer [10].

Agile Manager

The role of Agile manager is essentially different from the traditional software development manager and is focused on coaching as well as protecting the Agile team from external disturbance [25]. Agile managers should not micromanage the team and should instead facilitate it, enhancing collaboration and helping the team to take the right decisions and use its competence in the right way [19]. An Agile manager defines the framework and creates the environment for the team to achieve their goals with ingenuity [2].

Product Owner

The product owner’s main responsibility is to communicate and set a clear vision for the developing product, and to maximize the project’s return of investment [24]. A product owner is fundamentally a stakeholder representative in the Agile team whose main task is to prioritize the work to be done and, if necessary, prioritize tasks among stakeholders with divergent interests [18].

Developer

Cohen (2005) group everyone involved in the development of the product as developers, e.g.: programmers, testers, analysts, database engineers, usability experts, technical writers, architects, and designers. The cornerstone of this grouping is a shared responsibility and a joint ownership of the product developed [18].

2.1.3 Agile adoption

As described by Javdani (2013) there are various strategies to incorporate Agile methodologies into a project. Agile adoption signifies an essential process change, where the project is committed to incorporate one or several Agile methods with few internal or external restrictions to obey. This is different from Agile localization where some Agile practices are deliberately cut out due to organizational limitations or lack of experience. An even more limiting method would be Agile tailoring which tries to keep the organizational structure intact while utilizing just a few Agile practices [26].

Agile should be seen a as culture rather than a process and might require a substantial change in mindset to adopt [27]. This implies that Agile adoption is not a binary state. Instead it is the level of agility that the organization has reached, and how to further improve that level, that must be contemplated [10].
2.1.3.1 Motivations for Agile adoption

One of the main drivers for software development organizations in considering the transition to Agile development might in fact be the shortcomings of the previous development methodologies: the need of a stable environment; value planning, predictability and control; and complete requirement specified prior to development [28]. The heavy traditional development methods are simply not adequate for most of today’s complex development projects and the rapid changing IT market [28].

A survey conducted by VersionOne (2014) identified the top three reasons why organizations adopt Agile software development as: accelerated time to market, manage changing priorities and better align IT and business [14]. In a publication by Manzo (2002), a side-by-side comparison of Agile and traditional software development in the same project showed at least 100 percent increase in delivery speed by the Agile team [2].

The top benefits gained as a result of Agile adoption, according to VersionOne (2014), are listed in Table 2.2. The number to the left shows the percentage of respondents who experienced an improvement in the particular factor, and the right number present respondent’s experienced worsening of the same factor. Other surveys present similar results [29]. According to Standish Group (2011) overall project success is almost three times higher in Agile projects compared to Waterfall [30].

<table>
<thead>
<tr>
<th>Factor</th>
<th>Improved</th>
<th>Worsen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ability to manage changing priorities</td>
<td>92 %</td>
<td>1 %</td>
</tr>
<tr>
<td>2 Increased productivity</td>
<td>87 %</td>
<td>2 %</td>
</tr>
<tr>
<td>3 Improved project visibility</td>
<td>86 %</td>
<td>2 %</td>
</tr>
<tr>
<td>4 Improved team morale</td>
<td>86 %</td>
<td>4 %</td>
</tr>
<tr>
<td>5 Enhanced software quality</td>
<td>82 %</td>
<td>3 %</td>
</tr>
<tr>
<td>6 Reduced risk</td>
<td>82 %</td>
<td>1 %</td>
</tr>
<tr>
<td>7 Faster time-to-market</td>
<td>83 %</td>
<td>1 %</td>
</tr>
<tr>
<td>8 Better alignment between IT &amp; business objectives</td>
<td>82 %</td>
<td>2 %</td>
</tr>
<tr>
<td>9 Simplify development process</td>
<td>78 %</td>
<td>4 %</td>
</tr>
<tr>
<td>10 Improved/increased engineering discipline</td>
<td>74 %</td>
<td>4 %</td>
</tr>
<tr>
<td>11 Enhanced software maintainability/extensibility</td>
<td>75 %</td>
<td>2 %</td>
</tr>
<tr>
<td>12 Manage distributed teams</td>
<td>67 %</td>
<td>4 %</td>
</tr>
</tbody>
</table>

*Table 2.2: The top benefits gained from Agile development [14]*

Despite the reported success of Agile projects and its presumed benefits, it does not mean Agile is without criticism. Misra et al. (2012) summarize some authors criticism about Agile [31]:

- It is difficult to get the right people involved
- There is limited support for building reusable artifacts
- There is limited support for developing large, complex software
- Requires significant cultural change for adoption in projects
- Will work only when senior development team members are involved
- Contractual negotiations may be difficult to attain
- Does not work for development projects for safety critical and reliable systems
- Will work only when the performance requirements are explicitly stated at the outset of the projects, and suitable test plans are planned

However, the authors conclude that most of the criticism can be debatable.
Theoretical Framework

2.1.3.2 Challenges in Agile adoption

Organizational change is a complex process that does not come easily. Adoption of Agile software development requires an understanding of the consequences and potential barriers that such initiative might bring to the organization [7], as the transition would bring essential changes in the organization, and may have severe impacts on the structure, culture and management [8].

The choice as to which Agile methodology should be adopted comes as a first challenge, and without an in-depth understanding of different methodologies’ capabilities and the organization's ability, this critical choice of whether to use or not to use a certain method and practices will be difficult to make [26].

Organizations with a strong hierarchical structure and centralized decision-making might find it especially difficult to adopt Agile methods due to conflicting agendas of top-management and the team members [32]. A potential issue in a transition to Agile development is project managers that are accustomed to, and possibly fond of, a command and control management style would find it hard and even unwilling to change this to a leadership and collaboration style [26]. Established processes and routines, that is not aligned with an Agile way of working, can also obstruct adoption in a significant way [33].

Another problematic aspect of Agile adoption concerns the customer. A customer that is not on-site and available to answer upcoming questions from the development team, but instead provide static requirement documentation, will make it harder to respond to change [19]. Thereto, finding actively involved customers for complex systems has proven to be hard [8]. However, if an active customer lacks an in-depth understanding of the requirements because of system complexity and size, it could also form a threat to agility [33].

Within the team there are certain factors that can make Agile methodologies hard to adopt. To have the team taking on higher responsibility for the project in all its stages and being involved in decision-making with the managers can be a challenging shift [8]. It can be hard to adapt to a process that is highly focused around communication and collaboration with the wrong team members, especially senior developers with a background from traditional development might find it hard to embrace such a different mindset and consequently cause friction in the team [26]. Inflexible people without the ability to change, at any level of the organization, might pose an overwhelming challenge to Agile adoption [34].

2.1.3.3 Success factors of Agile adoption

There are different attributes associated with the success of an Agile software development project. Chow and Cho (2008) found the following elements to be critical for success in Agile software development projects: delivering a good product or project outcome, meeting all requirements and objectives, delivering on time and delivering within estimated cost and effort as the key attributes to measure project success [35]. Other researchers concluded similar criteria with some additions such as: time, budget, functionality, quality, addresses a need, product is used, customer is satisfied and team is satisfied [36]. The success factors of Agile adoption in this thesis are anchored in the above mentioned attributes.

The identified success factors in this thesis are classified into: cognitive aspects, collaboration aspects, communication aspects, knowledge sharing aspects, social aspects, corporate cultural aspects, competence and recruitment aspects, managerial aspects, software project management aspects and technical aspects. The specific factors that impact Agile and Agile adoption from these areas are summarized and described in the Hypothetical Framework presented in Chapter 4.
2.1.4 Agile and culture

Organizational culture has been defined to constitute “the collective values, beliefs and principles of organizational members and is a product of such factors as history, product, market, technology, and strategy, type of employees, management style, and national culture” [37].

The above definition highlights many important areas of Agile software development, from a perspective where organizational culture is identified as the key factor in Agile adoption [38, 39] yet at the same time the one factor causing the most friction [40]. In its essence Agile takes a cultural approach to reach professionalism in software development, where the organizational culture emerges from the changing behavior of the developers, managers and customers based on the Agile values and practices [41].

The following list highlights the observations and conclusions of various authors in the subject of Agile and organizational culture:

- Inability to create a functional symbiosis between the organizational culture and the Agile methodology will impede adoption, whereas the right culture will enhance agility in the organization [18].

- Agile development is better incorporated in companies with a collaborative and adaptive culture rather than bureaucratic or power culture, even if Agile can be adopted by the latter it might raise more difficulties and barriers to overcome [42].

- Siakas and Siakas put Agile in the context of clan, hierarchical, democratic and disciplined organizational culture, and conclude that its absence of hierarchy, and focus on flexibility and extemporary make the democratic culture best suited for adopting Agile methodologies. [27]

- A plan-driven culture advocates an environment with more strict policies and clearly defined roles and tasks. Moving to Agile from such culture will inevitably result in difficulties in changing the organization's core values and practices. [43]

- Iivari and Iivari (2001) discuss about the perceived symbiotic effects between Agile and culture and how an Agile transition enforces characteristics on the present organizational culture simultaneously, as the organizational culture will strengthen certain elements of the chosen Agile methodology [44].

In conclusion, there is a strong cause-and-effect relationship between Agile adoption and the cultural context it is implemented in. Cultural barriers of different degrees will emerge in each and every software development organization that undertakes a transition to Agile methodologies. The coming section will present the Chinese software development industry in a cultural perspective.

2.2 China

In order to apprehend the Chinese organizational culture, it is vital to first understand its national culture as such, since, according to Hofstede (1983), although not being identical phenomena, an organizational culture is dependent on the national culture in which it acts [45].
2.2.1 Chinese National Culture

The Chinese civilization, dating back to more than 10,000 years, is not only one of the oldest in the world but has also remained essentially the same throughout its history, as contrasted and compared to other civilizations. China is hence the oldest continuous and homogeneous civilization in the world, despite the fact that it was alternated between periods of political unity and disunity, and has occasionally been conquered by external groups of people, some eventually being assimilated into the Chinese population. [46]

The Chinese society and cultural identity has to a great extent been formed by the Chinese thinker Master Kong (known in the Western world as Confucius) who lived around 500 BC. Confucianism is mainly characterized by human relations and the importance of an individual’s consciousness of his or her place in the society and the respect for the hierarchy that must exist in order for the society to be stable and in harmony. This virtue of hierarchy and the consequent unequal relationships as a necessary basis for stability in society has continued to be an essential element of the Chinese culture for more than 2000 years, expressing itself as the obligation of a subject who has a low position in the hierarchy to respect and serve a higher positioned subject. [46, 47].

The Chinese culture identifies collectivism as a central ideology, in which individuals act more in the interests of the society and groups they belong to, rather than focusing on their own goals and achievements [48]. Another important attribute of the Chinese society is guanxi. The term guanxi literally means “relationship” and the implication it brings goes a long way down the Chinese history as a collectivist society and is deeply rooted in the Chinese culture [46].

The Chinese culture has been categorized by Lewis (2005) as a reactive culture, as opposed to linear-active or multi-active cultures. Reactive in this context is conceptualized by people valuing courtesy and consideration, being introvert, patient and respectful and achieving harmony by being careful and non-confrontational [48].

2.2.2 Chinese Personal Characteristics

The basic identity of the Chinese people is obtained from the Chinese tradition and culture in which their beliefs, attitudes and behaviors are shaped and guided [49].

The Chinese people work best together with other people of the same societal group. The collectivist personality of the Chinese employees causes them to feel more indebted and thankful to the company, especially their leaders, whose role is to take good care of the employees’ welfare on a personal level. Loyalty is supreme in a collectivist culture. The Chinese employees generally take responsibility for fellow members in their group, as the society fosters strong relationships. [50]

Open criticisms or negative comments directed toward the superiors is a taboo, as the threat of losing face would be destructive to the relationship, and to them it is of utmost importance to keep a high regard on hierarchy, respect the authority, and avoid conflicts to maintain harmony [51].

Hall (1977) classified China as being a high-context culture. This means that the Chinese people communicate indirectly with implicit messages, where the actual meaning and non-verbal signs are expected to be aware of and understood [52]. This has also, to a great extent, resulted from the importance of the culture in maintaining harmonious relations. The Chinese employees seldom relay their thoughts regarding the organization’s development to the management due to the strong power distance, which can bring negative effects on effective communication and good leadership [51].
In a study by Ying (2000), the author reviews and adds to previous research about Chinese characteristics and concludes an updated list where he and other experts give a broad picture and understanding of the Chinese people. The author argues that there are some contradicting traits as well as the issue with China being such a big country with quite some varieties within. Ying concludes a list of 71 Chinese characteristics, in which some to mention are: hard working, commitment, deference to authority, avoiding confrontation, collectivism, compromise, contented with one’s position in life [49].

2.2.3 Chinese organizational culture

Organizational culture is important in aligning behaviors of the members and laying the foundation of common values in the company. The culture of an organization is mainly formed by the practices it implements [53]. The managerial practices in Chinese organizations are greatly impacted by the Chinese cultural values, which are rooted in the very influential Confucian ideologies that incorporated the need for harmony by avoiding conflicts, the Chinese concept of face and the respect for age and hierarchy, among many others [54].

Indications of the strong hierarchical system can still be observed in the practices of the Chinese company structures these days, even though the imperial dynasties that first caused this phenomenon have now long passed [54]. Authority and superiority is held with great regard in the Chinese organization, causing the centralization and unbalanced distribution of power [55].

Personal connections or guanxi plays a significant role in Chinese organizations. Guanxi is described as networks of connection and systems of favors built on trust, often highly reciprocal and personal [46]. Being the key to successful business and in achieving cooperation from the employees, guanxi is indispensable both within and outside of an organization [51].

2.2.4 Chinese Software Development Industry

The Chinese software development industry has been growing steadily for many years and is starting to become an important part of the country's economic growth strategy. China is still behind the more developed countries but is catching up rapidly. A statistical report from Ministry of Industry and Information Technology of the People's Republic of China present the following impressive data about China’s software industry in 2013 [5]:

- China has 33,000 software and IT services companies
- The industry had a revenue of 3.06 trillion yuan with 23.4% of annual growth
- Research and development (R&D) expenditures of 259.8 billion yuan was allocated to software and IT service industry
- In 2013, the added value of the software industry brought in more than 1 trillion yuan to the society
- China's has 4.7 million software professionals, 1.8 million software developers.
- China's domestic enterprises continued to be the main force

Even if the above data is impressive it is still highly important that China continues to drive R&D and increases innovation to go up in the forefront of the industry, and at the same time learns how to quickly adjust to the ever changing landscape of today’s software industry.
3 Method

In this chapter the strategies and methods used in this master’s thesis will be explained. Firstly, the literature analysis and the design of theoretical framework will be described, followed by the related survey and the statistical methods used to validate and analyze the results.

In science there are two ways of making conclusions, based on either an inductive or a deductive reasoning. Inductive reasoning is understood as a bottom-up approach that commences on a specific observation and data, followed by identifying patterns which are then formulated as hypothesis; and finally theories or general conclusions are formed. On the contrary, deductive reasoning is a top-down approach that goes the other way, from the general to the specific. [56]

Both inductive and deductive reasoning have been used in a combination throughout the research process in this master’s thesis to achieve concrete conclusions, which is a common approach in scientific research [56]. Figure 3.1 visualizes the deductive and inductive reasoning approaches used in this thesis.

![Diagram of deductive and inductive reasoning]

Figure 3.1: The deductive and inductive reasoning approach

To reach the aim of this master’s thesis, a quantitative research approach was chosen to obtain the perceived view of a wider range of people in the Chinese software development industry. Qualitative research relies on data that can be formed into numbers and sets, where statistical analysis is used to formulate facts and draw conclusions about the common, average or representative views of a general population. Quantitative research is a structured approach that can be used when the idea is to show how strong certain relations are or to what extent a phenomenon occurs. [56]

The research process used in this study is illustrated in Figure 3.2.
3.1 Literature review

Review and study of relevant previous research makes up the basis of this study and has been a recurring event throughout the whole research process. More than 100 publications of various resource types were collected with different levels of examination done, in order to get a collective view from the previously conducted research and a deep understanding of the research area.

Based on the primary information need “are Agile software development suitable for China”, several secondary information needs have been further identified such as:

- Agile adoption factors
- Agile and culture
- Chinese organizational culture
- Agile software development in China

In pursuing the answers to these secondary information needs, an iterative search process was applied. In this process the set of search strings are modified and evolved based on what was found in each of the previous steps, until a relevant result is found [57].

The bibliographical database Web of Science\(^1\), KTHB Primo\(^2\) and IEEE Xplore\(^3\) were used as main databases to find resources of interest. KTHB Primo was mainly used to obtain the

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\(^1\) Accessed via http://www.webofscience.com
\(^2\) Accessed via https://www.kth.se/en/kthb
\(^3\) Accessed via http://ieeexplore.ieee.org
original publications via the many research subscriptions available. EndNote\textsuperscript{4} was utilized to manage and hold the collection of references and resources found.

The main parts of the literature analysis are presented in the theoretical and hypothetical framework in Chapter 2 and Chapter 4 respectively.

3.2 Hypothetical framework

The hypothetical framework in this master’s thesis aims to address the research question about critical barriers that impact the success of Agile and Agile adoption in Chinese software development organizations. The framework is based upon published research on Agile adoption, Chinese personal characteristics and Chinese organizational culture. The hypothesis formed was analyzed and either accepted or rejected based on survey data obtained from respondents.

To construct the hypothetical framework a two-step approach was used, where success factors of Agile adoption were first studied, followed by a review and analysis of the Chinese characteristics.

The first part was initiated by assembling a list of success factors of Agile and Agile adoption based on various previous studies done by other authors. Factors linking to direct usage of an Agile methodology, such as “using backlog”, “lack of Agile knowledge” were omitted. The list of factors was then further reduced by eliminating duplicates, i.e. factors with similar meaning. The last step was to iterate the factors and group them into aspects that together cover an essential part of Agile adoption.

In the second part of designing the hypothetical framework a list of Chinese characteristics was assembled, mainly taken from the work of Ying (2000) and his research on Chinese culture. The list was then extended with traits of the Chinese organizational and national culture. An iterative approach was utilized to find Chinese features that could influence an Agile adoption factor in a negative or positive way. After that, a hypothesis was formulated accordingly. The hypothetical framework resulted in five hypothesized barriers and three hypothesized non-barriers for Agile adoption in China, all related to different important aspects in Agile software development.

An aspect is defined as a barrier for Agile adoption in China, if the majority of the population perceive their organization to possess a behavior, in this particular aspect, that is predominantly negative in an Agile perspective. Correspondingly, an aspect is defined as a non-barrier for Agile adoption in China if the majority of the population, in contrary, perceive their organization to possess a positive behavior.

3.3 Survey questionnaire

The survey questionnaire was designed on the basis of the hypothetical framework. An online survey questionnaire was chosen to collect the data due to the long distance and time difference between the respondents and the researcher, which can both be easily bridged with the chosen approach.

The survey questionnaire consisted of 35 questions divided into two parts. The first part covered general background information such as: which region, years in the industry and prior Agile knowledge. The second part had 29 dichotomous questions regarding Agile adoption factors. A

\textsuperscript{4} EndNote X7 by Thomson Reuters
Method

short and focused questionnaire was made as a conscious goal, since long questionnaires with many questions can have a negative effect on the response rate [56].

In the Agile adoption part of the survey, dichotomous questions were chosen to make the survey shorter and more comprehensible, in order to lower the thresholds of completion and obtain more responses and data. Dichotomous questions consist of only two response alternatives, which imposes a limitation to the scope of analysis on the acquired data. However, this was not considered to have an impact on the answers the study tried to obtain.

It is of high importance that the respondents clearly understand the meaning of each question, and since English is not widely spread and commonly used in China, a translation of the original questionnaire to simplified Chinese was produced.

Some questions were inspired from prior studies to get reliable and tested questions. To validate the questions further, the questionnaire was reviewed and changed accordingly with a person who is experienced in Agile methodologies, and later the Chinese version of the questionnaire was reviewed and quality assured by an experienced Team leader of a Chinese software development team to reflect the proper terms of Agile and software development.

The initial idea was to distribute the survey questionnaire among two companies with similar profiles in terms of size, assignments and set ups, but differentiating in software development processes, where one practices Agile methodologies and the other uses a traditional approach. However, it was proven hard to find two such companies that were willing to participate in the study. The research approach was therefore slightly altered and a more general population of participants were sought, mainly via renowned Chinese development forums (CSDN\(^5\) and Baidu forums\(^6\)) and a few personal contacts. This impediment to the research process is likely to have had partial effects on how the data analysis and the interpretation of the result was carried out.

3.4 Data analysis

To analyze the survey data a set of statistical methods were used to validate the data, correlate variables and draw conclusions. The following sections cover the methods chosen to achieve a broad understanding of the survey data obtained. SPSS\(^7\) in combination with Excel\(^8\) was used to conduct the analysis.

3.4.1 Principal Component Analysis

A principal component analysis (PCA) is conducted to “reduce the dimensionality of a data set consisting of a large number of interrelated variables”. Additionally, it can be used when there is a need to identify irregularities in a multidimensional array of data. As its name suggests, the PCA identifies the principal components of interest in the data array. It does so by identifying the dimensions with the highest variance. [58]

The SPSS software was utilized to conduct the PCA on the data set of this study.

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\(^5\) CSDN accessed via: http://bbs.csdn.net/
\(^7\) IBM SPSS Statistics version 22
\(^8\) Microsoft Excel 2013
3.4.2 Cronbach’s alpha

Cronbach’s alpha is commonly used to determine an estimated reliability of a test or a scale. The measure ranges between 0 and 1, where a value closer to 1 indicates a strong internal consistency. The test is carried out on items (questions) that measure the same concept (aspect) to assess the strength and direction of their relationship.

For example, a correlation test between Agile practicing and an aspect concluded to be a barrier, can indicate how strong the barrier is to overcome in terms of Agile transition.

3.4.3 Binomial Probability Distribution

Hypothesis tests with the binomial probability distribution are used to test a hypothesis and either assert or reject it, by calculating the probability for a set of trials that can result in one of two outcomes - success or failure, to occur, against a predefined null hypothesis with predefined or known probabilities of the two outcomes [59].

An alpha level is determined to set the level of significance by which the hypothesis should be asserted or rejected. The most common $\alpha = .05$ was chosen for this study, which gives a significance level equals to correctly asserting or rejecting a hypothesis in 19 out of 20 conducted tests.

If the outcome of the conducted trials deviates enough from the expected outcome in the binomial probability distribution, so that its value is in the rejection region, then the null hypothesis is rejected and the alternative hypothesis is asserted. In such case it is concluded with a confidence level of 95% (1-alpha) that the null hypothesis and its predefined probabilities of success in each trial do not hold true, due to the low probability of obtaining the result which was obtained via the conducted test.

The formula for the binomial distribution is:

$$P(Y = y) = \frac{n!}{y! (n-y)!} p^y q^{(n-y)}$$

where $n$ is the number of trials (respondents), $p$ is the probability of success, meaning the probability for a respondent to answer in favor of Agile adoption, and $q = 1 - p$ is hence the probability of failure. $Y$ is the number of successes in $n$ trials, i.e the number of positive replies for agility among all the respondents. Finally, the sum of $P(Y = y)$ for all $Y \geq y$, expressed as $P(Y \geq y)$, is the cumulative binomial distribution seeked.

In this study an aspect is defined to be a barrier for Agile adoption if it can be concluded, with high significance, that the probability of the respondents to choose the alternative answer favorable for Agile adoption is higher than 50%. Correspondingly, an aspect is defined not to be considered a barrier (non-barrier) for Agile adoption if it can be concluded, with high significance, that the probability of the respondents not to choose the alternative answer favorable for Agile is higher than 50%.

For the aspects that are hypothesized to be barriers for Agile adoption the null and alternative hypothesis is defined as:

$$H_0: p \geq .5 ; H_1: p < .5$$

Correspondingly, for the aspects that are hypothesized not to be barriers for Agile adoption the null and alternative hypothesis is defined as:
\[ H_0: p \leq .5; H_1: p > .5 \]

A one-tailed test is computed since we are primarily looking for deviations in one direction. However, if the null hypothesis is accepted and the alternative hypothesis rejected, an inverted test is conducted to identify if the opposite could be concluded. At a confidence level of \( \alpha = .05 \) we are looking for \( P(Y \geq y) > .95 \) or \( P(Y \leq y) < .05 \) to be able to accept the alternative hypothesis.

### 3.4.4 Pearson product-moment correlation coefficient

The Pearson product-moment correlation coefficient \((r)\) was used to measure correlation. In this test the dependency between two known variables are calculated, revealing the correlation and its strength and direction. The resulting value range between 1 and -1, where 1 indicates a very strong positive relation and -1 indicate a very strong negative relation.
Hypothetical Framework

4 Hypothetical Framework

This chapter serves to present a hypothetical framework for this master’s thesis based on an analysis of literature findings and author intuition about Agile adoption and characteristics of the Chinese software industry. Each section covers one aspect that, according to the hypothesis, will either be considered as a barrier or a non-barrier for Agile adoption in China. Section 4.9 covers other aspects that are not included in the hypothesis in terms of being presumed as either a barrier or not, but are still considered by the author to be important in the general discussion of Agile adoption and thus relevant to include in the framework. In the last section the hypothetical framework is summarized.

The hypothetical framework aims to answer the research questions of this master’s thesis and serve as guidance for the structure and design of the survey. It is based on success factors for Agile in general and Agile adoption in particular, according to various studies on Agile in different countries performed by other researchers. Furthermore, each aspect and factor is being looked at from a Chinese cultural perspective, and with the support from previous research work made on this field the hypothesis about Chinese software development organizations adoptability to Agile software development will be formed.

4.1 Cognitive Aspect

Cognition means processes related to perception, memory, judgment and reasoning. These processes are important components in Agile software development and can thus have an impact on the success of an Agile project.

The members of an Agile development team need to have a strong sense of responsibility to form self-organizing and autonomous teams that can be trusted with the authority to take important decisions, as well as solving problems independently [19]. To succeed with Agile, the team members also need to feel great motivation. This principles is even expressed in the Agile Manifesto itself, where it is stated: "Build projects around motivated individuals." [10]. The importance of motivation can also be observed in the light of Medinilla’s principle: "Every great product ever created that made a huge difference in the market was created by a highly motivated individual or team. As a corollary, never in history, at no place on earth, a demotivated individual or workforce gave birth to a great product" [18].

It is an important ability for an organization to be in possession of a progressive attitude if the organization shall manage to cope with changes and continuously improve itself, even during the transition to Agile [39]. In the complex environment of software development, where it is impossible for one single individual to hold a complete understanding of everything, team members need to work together and take joint decisions to reach their common goal, hence team collaboration becomes another essential factor to succeed with Agile development [2].

Previous research suggest that the characteristics of Chinese developers, from the perspective of the above described cognitive aspect, are somewhat disadvantageous for successful Agile adoption. Chinese employees are often described as persons that generally have a resistance to take on responsibilities and making decisions; they are most often passed up to a higher level in the organization, and both the employees and managers seem to conform to this behavior [54]. Being conservative and contented with one’s position in life are two other characteristics of the Chinese culture, which could suggest that Chinese software organizations lack a progressive attitude and interest in change [49] - values that are essential to adopt and succeed with Agile adoption.
The first hypothesis in our hypothetical framework is thus:

\[ H1: \text{The cognitive aspect of developers and personnel in Chinese software development organizations is a barrier in Agile adoption in China.} \]

### 4.2 Customer Collaboration Aspect

Customer collaboration is one of the cornerstones of Agile software development. It is stated in the Agile manifesto that “customer collaboration is valued over contract negotiation” [10], and it has been shown that the greater the customer collaboration and customer commitment are, the more likely it is to succeed with an Agile project [39].

Close customer collaboration helps to establish a common vision for everyone working on the project and will also make it easier to set paths for the goals to be reached [24]. Close interaction between the customer and the team creates an environment that will better cope with changes, which is common in every software development project [20]. Paulk (2002) emphasizes the importance of close and effective customer collaboration and concludes that failure in establishing such collaboration will make it hard to adopt Agile methods [21].

A good guanxi is based on mutual support and essentially means collaboration [46]. The presence of good guanxi between the customer and the organization can be a catalyst for agility as the Chinese community emphasizes relationship-based businesses, and one must satisfy their obligations in the guanxi in order to maintain the kinship of the connection [60].

Based on the above, the second hypotheses in the theoretical framework is:

\[ H2: \text{The customer collaboration aspect in Chinese software development organizations is not a barrier in Agile adoption in China.} \]

### 4.3 Communication Aspect

An organization with strong oral culture which emphasizes on direct communication that encourages information and knowledge sharing, showing interest and hence better knowing each other, will grow better teams and foster close collaboration and high efficiency which is important to Agile [61].

Succeeding with Agile methodologies requires frequent and direct face-to-face communication and constant interaction and has been acknowledged to be a benefit and a key factor in developing trust [35] - a vital element in an Agile organization [19].

In China there is a strong culture of indirect communication, meaning a Chinese person will sometimes not be forthright with their intention, and instead they expect the listener to be observant and understand the underlying intention [62]. Good collaboration can be hard to achieve in a communication environment that is implicit and indirect, hence customer collaboration is assumed to be low and therefore a negative factor in adopting Agile in a Chinese software organization. However, it is argued that this phenomenon might have changed over time with the rapid growth of the Chinese economy [63].

Despite the possible transformation mentioned above, I formulate the third hypothesis for the theoretical framework as:

\[ H3: \text{The communication aspect within Chinese software development organizations is a barrier in Agile adoption in China.} \]
4.4 Knowledge Sharing Aspect

Agile is characterized by its nature of being an iterative development process that enables projects to quickly respond to changing requirements [2]. Additionally, this gives the team a recurring opportunity to reflect upon itself and make necessary adjustments accordingly, in order to improve and achieve higher efficiency [10]. However, this process and the subsequent constructive outcomes presuppose the willingness to learn.

Sharing knowledge within and among development teams enables an organization to scale Agile development, and contributes to a deeper common understanding with many positive effects from both an organizational and innovative point of view. [64].

In China, the extent of knowledge sharing observed among members within a certain group of people; or in this case, an organization, is rather high. The reason for this ought to be the collectivist society that has laid a foundation of highly exclusive in-group fraternity built on trust. [65]

Based on the observations above and the conclusive studies made, the fourth hypothesis is formulated as:

\[ H4: \text{The knowledge sharing aspect among team members in Chinese software development organizations is not a barrier in Agile adoption in China.} \]

4.5 Social Aspect within the Team

People-oriented aspects, such as interpersonal trust and honesty, are the fundamental elements in Agile software development [19]. Agile methodologies are centered on social aspects that strongly contribute to the success of Agile adoption [66]. The lack of trust in an Agile software development team will cause disturbance and result in increased costs and wasted time [41], and has been recognized as devastating for good and effective communication [61]. Honesty, being a prerequisite for trust, is another important social factor in order to succeed in Agile software development [39].

Besides creating a supportive working culture, a mentoring environment is also of importance in enhancing the performance of in-group members. Fostering a mentoring environment will reduce the need for formal training, and simultaneously amplify a constant learning mentality that is vital for the success of Agile software development [39].

Based on the author’s own observations, Chinese people belonging to a particular group are very interactive, show a high level of trust and are generally very social within the group. This observation is confirmed in another relevant research, describing Chinese people as trustworthy, sincere, willing to compromise and being group oriented [49], all of which are considered positive traits for the successful practice of Agile software development.

The fifth hypothesis is thus formed as:

\[ H5: \text{The social aspects within teams in Chinese software development organizations is not a barrier in Agile adoption in China.} \]
4.6 Organizational Cultural Aspect

One organizational culture factor that has shown to be important for Agile software development is trust; i.e. that the organization has both an internal and external culture of people trusting each other. Hence, trust needs to be high between the customer and the organization, within the organization in general and specifically between the managers and the software development team, and consequently between the members within the software development team [19].

As an extension of trust, Agile software development also advocates in having empowered teams that are trusted to take necessary technical decisions and to pragmatically solve problems at hand; e.g. by altering their work processes as they find appropriate [40].

Honesty is another enabler in succeeding with Agile software development projects. It is of great importance that managers are being honest with their intentions in a specific project, e.g. they should refrain from communicating unrealistic plans that might mislead the team to make shortcuts on quality or increase the risks and threats just to get the team to work harder. As important, is that the development team is being honest in its communication with the manager, brings up relevant issues that arise; e.g. matters of deadlines that might be missed, and gives clearly explained time estimations including the quality and risk implications of a suggested or adopted plan. [16]

Besides the organizational structure, it is necessary that the organization as a whole is willing to reflect upon itself and embark the changes that it finds necessary in order to improve [39]. Responding to changes is something that is stated in the Agile manifesto and is thus considered to be a cornerstone of agility [10].

China is known as a low-trust society with relatively high trust within the family but low trust outside of it [63]. This phenomenon is a disadvantage for the Chinese organizations when attempting to adopt to Agile methods, where trust, as has been described above, is a crucial component. Low level of trust will also have negative effects on the relationships between a software development team and its managers. In addition, the strong presence of mianzi (save/lose-face) in the Chinese society contributes to honesty-related issues that the team members might have with the management of the organization [51].

Based on the research analyzed, the level of power distance is observed to be very high in China. The society has a power inequality between individuals which is based on hierarchical status - an inequality that is known and accepted by the subordinates. This, in addition to the general deference to authority among Chinese people, opposes the empowerment of development teams. [39, 51, 55]

The sixth hypothesis for organizational culture is formed as:

\[ H6: \text{The cultural aspect of Chinese software development organizations is a barrier in Agile adoption in China.} \]

4.7 Competence and Recruitment Aspect

Agile software development lays its focus on recurring reviews and adjustments to constantly improve the way of working [10]. To improve and raise the competence of the team members, appropriate technical training is critical [35]. The management team hence needs to be ready to invest in training for the team.
In order to form a strong, self-organizing, efficient and high performance team, the members need to have a relatively high level of seniority and experience. To achieve such a team is difficult if the majority of the team members are junior developers. Having competent team members is also crucial to succeed with Agile software development projects. It is therefore suggested to use fewer but more competent people and to establish a recruitment policy in the organization that actually matches this belief. [38]

China's history and current condition of having a great workforce, has resulted in the favoring of quantity over quality when it comes to recruitment, which is disadvantageous to the company in recruiting the right competence [67]. Using personal relationships and connections to attain a position is also common in China, which is something that can further lead to recruitment of the wrong person [68].

Apart from the recruitment process that is unsatisfactory for agility, the Chinese high-tech organizations are also reported to lack on-the-job training for their employees [67], which contradicts the Agile belief of constant improvement of personal and organizational capability.

Based on the above arguments, the seventh hypothesis in the competence and recruitment aspect is:

**H7: The competence and recruitment aspect of Chinese software development organizations is a barrier in Agile adoption in China.**

### 4.8 Managerial Aspect

Management and the managers’ way of managing their teams is of high significance in Agile methodologies. The management in an organization needs to create an open and safe environment where mistakes should be considered as possibilities for both learning and improvements. Agile software development relies on managers with a light-touch or adaptive management style to systematically improve management and resource management by monitoring and evaluating, as well as continuously learning from the outcome [39].

Agile methodologies encourage a stimulating and motivating environment for developers. Many experts agree that such an environment is only achievable if the management strives for a constant but balanced workload, honoring normal working hours and minimizing the amount and occurrence of overtime for the software development teams [35]. An increased workload, even temporary, will decrease the level of engagement, which is a clear anti-pattern for succeeding with Agile software development.

The Chinese people and Chinese managers generally have a conservative mindset [49], which can become an issue for an organization adopting and working with Agile methods, where a more adaptive management style is preferred.

With the above arguments, the last hypothesis is formulated as:

**H8: The managerial aspect in Chinese software development organizations is a barrier in Agile adoption in China.**

### 4.9 Other Aspects

There are aspects important for Agile software development that are not possible to include in the hypothesis from a strict Chinese perspective. The software project process aspect and the technical aspect are two such aspects that consequently will not be part of the theoretical
framework in this master’s thesis, but nonetheless form a part of the survey questionnaire and hence they are described below.

The software project process of Agile software development focuses on developing tasks with the highest priority, so that the most important features reach the customers first [18]. Iteration is essential in the Agile software development process, where software is evolved incrementally in recurring cycles, which allows working software to be shipped frequently [10, 13].

There is also an important technical aspect to Agile software development. However, there are no technical procedures or tools that alone and by themselves can make an organization Agile, but there are technical factors that can ease a transition and thus increase agility. A few examples of such technical factors are to always pursue a simple design, to have the right amount of documentation and to use tools to deploy automation [10, 35].

### 4.10 Summary

The hypothetical framework combines the success factors for the adoption of Agile Software Development and the Chinese characteristics, forming an expected reference outcome of the Agile adoption survey results. A graphical representation of the hypothetical framework is illustrated in Figure 4.1. The signs of the hypothesis indicate whether the hypothesis is considered a barrier (-) for Agile adoption or not a barrier (+).

![Figure 4.1: Visualization of the hypothetical framework](image)

*Table 4.1* summarizes the proposed hypothesis extracted from the literature. A survey questionnaire was designed according to the factors behind each formed hypothesis, as shown in Appendix A.
<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1-   The cognitive aspect of developers and personnel in Chinese software development organizations is a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H2+   Customer collaboration within Chinese software development organizations is not a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H3-   The type of communication within Chinese software development organizations is a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H4+   Knowledge sharing among team members in Chinese software development organizations is not a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H5+   The social aspects within teams in Chinese software development organizations is not a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H6-   The cultural aspect of Chinese software development organizations is a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H7-   The competence and recruitment aspects of Chinese software development organizations is a barrier in Agile adoption in China.</td>
</tr>
<tr>
<td>H8-   The managerial aspects in Chinese software development organizations is a barrier in Agile adoption in China.</td>
</tr>
</tbody>
</table>

Table 4.1: Summary of hypothesis in the hypothetical framework

After analyzing previous research made in the relevant field and forming a good understanding of both adoption of Agile Software Development and the cultural society of China, it has become clear that there are some interesting relations between these two to uncover. In the next chapter the survey data will be presented and analyzed with the aim to prove the formulated hypothesis right or wrong.
5 Result and Analysis

In this chapter the validation of the hypothetical framework is conducted based on the data collected from the survey questionnaire. General statistics from the data are presented in the first section, followed by findings from the factor analysis and the reliability test. The result and analysis of each aspect in the hypothetical framework is presented in Section 5.4.1 to 5.4.9.

Table 5.1 presents the coding used in this analysis. As an example, the table shows that hypothesis H1 in the hypothetical framework is related to cognitive aspect, and consists of four questions: Q11, Q12, Q13 and Q14.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Aspect</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Cognitive aspect</td>
<td>Q11, Q12, Q13, Q14</td>
</tr>
<tr>
<td>H2</td>
<td>Collaboration aspect</td>
<td>Q21</td>
</tr>
<tr>
<td>H3</td>
<td>Communication aspect</td>
<td>Q31, Q32</td>
</tr>
<tr>
<td>H4</td>
<td>Knowledge sharing aspect</td>
<td>Q41</td>
</tr>
<tr>
<td>H5</td>
<td>Social aspect</td>
<td>Q51, Q52, Q53</td>
</tr>
<tr>
<td>H6</td>
<td>Organisational cultural aspect</td>
<td>Q61, Q62, Q63, Q64</td>
</tr>
<tr>
<td>H7</td>
<td>Competence and recruitment aspects</td>
<td>Q71, Q72, Q73</td>
</tr>
<tr>
<td>H8</td>
<td>Managerial aspect</td>
<td>Q81</td>
</tr>
</tbody>
</table>

Table 5.1 Codings

5.1 Survey Statistics

The total sample consists of 27 respondents, all originating from and working in China. The majority (70.4%) of the respondents work in a private owned company. Most of the respondents (63.3%) work with domestic customers and 33.3% report that they have a mix of domestic and international customers. There are predominantly developers among the respondents (66.7%), followed by team leaders (11.1%) and manager roles and others combined (22.2%). The experience of working with software development spans from 1 to 13 years, where 48.1% has 1-4 years of experience and 51.9% has 5-13 years of experience.

Six respondents did not complete major parts of the survey and were therefore excluded from the sample data. One respondent answered every question in the same way and was also excluded.

A summary of the survey data can be found in Appendix B.

5.2 Factor Analysis

The factor analysis, principal component analysis (PCA) specifically, revealed irregularities in the survey data. Section 3.4.1 explains the PCA method. A closer investigation showed that five of the survey questions (Q21, Q31, Q32, Q41, Q131) in the Chinese version of the survey had their response options inverted, as a result of human error. The response data of all five variables (questions) were reverse-coded before proceeding with further analysis. It was found that a few variables were not homogenous within their factor, hence, two variables were moved (Q53, Q14) to other factors and four variables (Q111, Q121, Q131, Q141) were omitted to
cancel out inhomogeneous aspects. See Appendix C for the result of the PCA on the original data set.

5.3 Reliability

An internal consistency test was performed to determine the consistency of the questions belonging to the same factor (aspect) and the survey responses. The Cronbach’s alpha test was utilized to assess the internal consistency. Cronbach's alpha is described in Section 3.4.2.

Table 5.2 shows the result of the internal consistency test of the multi-variable aspects. Every aspect shows a high consistency and our survey is concluded to be of good reliability.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>N of items</th>
<th>Cronbach's alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive aspect</td>
<td>4</td>
<td>.779</td>
</tr>
<tr>
<td>Communication aspect</td>
<td>2</td>
<td>.740</td>
</tr>
<tr>
<td>Social aspect</td>
<td>3</td>
<td>.702</td>
</tr>
<tr>
<td>Organizational cultural aspect</td>
<td>4</td>
<td>.803</td>
</tr>
<tr>
<td>Competence and recruitment aspect</td>
<td>3</td>
<td>.762</td>
</tr>
</tbody>
</table>

Table 5.2: Results from the reliability test using Cronbach's alpha

5.4 Hypothesis Testing and Correlation analysis

As mentioned in Section 3.2, an aspect is defined as a barrier for Agile adoption in China, if the majority of the population perceive their organization to possess a behavior, in this particular aspect, that is predominantly negative in an Agile perspective. And correspondingly, an aspect is defined as a non-barrier for Agile adoption in China if the majority of the population, in contrary, perceive their organization to possess a positive behavior.

According to the definition above, an aspect would pose as a barrier for Agile adoption if it can be concluded with high significance that the probability of the respondents choosing the response option unfavorable for Agile adoption exceeds 50%. Correspondingly, if the probability of the respondents choosing the response option favorable for Agile adoption exceeds 50% it is concluded to not be a barrier. A binomial probability distribution test was conducted to accept or reject the hypothesis accordingly.

A correlations test for each aspects was performed to identify possible relations between the aspects and Agile adoption. The Pearson product-moment correlation coefficient ($r$) was used to measure the correlation.

Section 3.4.3 describes the binomial probability distribution test in detail, and Section 3.4.4 covers the Pearson product-moment correlation coefficient.

The result of the analysis for each aspect and its hypothesis is presented and discussed in the following sections.

5.4.1 Cognitive aspect

Hypothesis H1 is tested in this section, it states that:

$H1$: The cognitive aspect of developers and personnel in Chinese software development organizations is a barrier in Agile adoption in China.
The null and alternative hypothesis is defined as:

\[ H_0: p \geq .5; H_1: p < .5 \text{ where } n = 108, Y = 73, \alpha = .05 \]

\[ P(Y \leq 73) = .999 > .05 \text{ the null hypothesis is not rejected. Consequently the main hypothesis } \]

H1 is rejected and it cannot be concluded that cognitive aspect of the Chinese software development industry is a barrier in Agile adoption. However, since \( P(Y \geq 73) = 0.000075 < .01 < .05 \) the cognitive aspect is concluded to not be a barrier for Agile adoption, at both 95% and 99% confidence. Table 5.3 show survey data of the cognitive aspect.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Q11</td>
<td>27</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Q12</td>
<td>27</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Q13</td>
<td>27</td>
<td>16</td>
<td>59%</td>
</tr>
<tr>
<td>Q14</td>
<td>27</td>
<td>21</td>
<td>78%</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>73</td>
<td>68%</td>
</tr>
</tbody>
</table>

Table 5.3

From the survey data it is clear that majority of the respondents answer all the questions in a way that is considered positive for Agile adoption. As suggested by the literature, it does not seem to be a resistance in taking on responsibility among the Chinese team members (Q11), as 67% show a high sense of responsibility. 59% answer that the employees in their organization have a progressive attitude (Q13) despite the cultural characteristics of being conservative and contented with one’s position in life [49]. The team members’ motivation is considered (Q12) ‘high’ by 67% and the team’s collaboration (Q14) is even higher with 78%. In conclusion, cognitive aspect in the Chinese software development organizations is not a barrier for Agile adoption in China. Figure 5.1 present the positive responses for Agile.

Figure 5.1: Replies to the cognitive aspect that is positive for Agile adoption
An interesting observation is that 89% of the non-Agile practitioners perceive the collaborative attitude among their team members to be ‘high’ (Q14), whereas the corresponding percentage among Agile practitioners was only 72%. The correlation analysis shows a moderate negative relation between this question and Agile adoption ($r = -0.325$), however it is hard to draw a conclusion from this negative correlation since the percentages are very high. There is no significant correlation between communication aspect and Agile adoption ($r = -0.002$). It is noteworthy that the sense of responsibility and collaborative attitude within the teams (Q11 respectively Q14) are perceived stronger among the non-Agile practitioners. It seems that practicing an Agile methodology in China does not help to foster these attitudes, as would have been expected.

### 5.4.2 Customer Collaboration aspects

Hypothesis H2 is tested in this section, it states that:

$$H2: \text{The customer collaboration aspect in Chinese software development organizations is not a barrier in Agile adoption in China.}$$

The null and alternative hypothesis is defined as:

$$H_0: p \leq .5; H_1: p > .5 \text{ where } n = 27, Y = 13, \alpha = .05$$

Since $P(Y \geq 13) = .500 < .95$ the null hypothesis cannot be rejected. Consequently the main hypothesis **H2 is rejected** and it cannot be concluded that customer collaboration aspect of the Chinese software development industry is not a barrier in Agile adoption. Since $P(Y \leq 13) = .500 < .95$, it cannot be concluded to be a barrier either. Table 5.4 shows survey data of the customer collaboration aspect.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Q21</td>
<td>27</td>
<td>13 48%</td>
<td>14 52%</td>
</tr>
</tbody>
</table>

Table 5.4

The responses show a similar rate of 48% positive and 52% negative answers for Agile adoption. Hence, the Chinese traits of showing commitment to work and being willing to compromise do not significantly impact customer collaboration (Q21) in a positive way. A correlation analysis with Agile adoption gives $r = .113$, which indicates no or negligible relation. The responses that show positivity for Agile adoption among Agile practitioners and non-Agile practitioners, in regard to the customer collaboration aspect, is presented in Figure 5.2.
The chart shows that close customer collaboration is slightly higher in organizations that practice Agile methodologies. Personal connections (guanxi) plays an important role in Chinese organizations relations with their customers [69]. A good guanxi can be a catalyst for good customer collaboration and a bad guanxi can just as much be destructive for the same. The customer relation might be at play for this aspect and contribute to the inconclusive result.

### 5.4.3 Communication aspect

Hypothesis H3 is tested in this section, it states that:

\[ H_0: p \geq 0.5; \quad H_1: p < 0.5 \]

where \( n = 54, Y = 19, \alpha = 0.05 \)

We have \( P(Y \leq 19) = 0.020 < 0.05 \) and the null hypothesis is rejected and we can, at a 95% confidence level, accept the alternative hypothesis. Consequently the main hypothesis **H3 is accepted** and it can be concluded that communication aspect in the Chinese software development organizations is a barrier in Agile adoption. The survey data for communication aspect is presented in Table 5.5.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Q31</td>
<td>27</td>
<td>10</td>
<td>37%</td>
</tr>
<tr>
<td>Q32</td>
<td>27</td>
<td>9</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>54</td>
<td>19</td>
<td>35%</td>
</tr>
</tbody>
</table>

**Table 5.5**
In average 65% of the respondents have a negative perception of their organization in the Agile communication aspect. China's strong culture of implicit and indirect communication does significantly impact communication in Chinese software organizations in a negative way. A correlation analysis between Agile adoption and communication aspect resulted in an average coefficient of $r = .122$. This value indicates no or negligible relationship. The negative and positive responses for Agile adoption among Agile and non-Agile practitioners is presented in Figure 5.3.

![Figure 5.3: Replies positive for Agile adoption](image)

The correlation is not strong, but it is obvious that both face-to-face meetings (Q31) and especially the oral culture (Q32) are higher in organizations that practice an Agile methodology. Many Agile methods focus on practices that foster good communication, such as daily standup, iteration planning and code-review, hence the result was not surprising and indicated that communication aspect might be a barrier that is possible to overcome for Chinese software development organizations.

### 5.4.4 Knowledge sharing aspect

Hypothesis H4 is tested in this section, it states that:

$$H_4: \text{The knowledge sharing aspect among team members in Chinese software development organizations is not a barrier in Agile adoption in China.}$$

The null and alternative hypothesis is defined as:

$$H_0: p \leq .5; H_1: p > .5 \text{ where } n = 27, Y = 11, \alpha = .05$$

The binomial distribution of the knowledge sharing aspect is $P(Y \geq 11) = .221 < 0.95$, hence the null hypothesis is not rejected in favor of $H_1$. It cannot be concluded that the knowledge sharing aspect of Agile development in Chinese software development organisations is not a barrier. Furthermore, $P(Y \leq 11) = .779 < 0.95$ and it cannot be conclude that it is a barrier either. Hypothesis **H4 is rejected.** Table 5.6 presents the survey data for the knowledge sharing aspect.
The strong in-group fraternity reported in Chinese organizations [65], cannot be significantly recognized among the members of Chinese development teams, where 59% disagree that their team members are eager to learn (Q41). The correlation analysis between Agile adoption and Q41 resulted in $r = .234$, indicating a weak positive relation. The positive responses regarding agility among Agile and non-Agile practitioners is presented in Figure 5.4.

![Figure 5.4: Replies positive for Agile](image)

The correlation together with the notable difference in responses among Agile and non-Agile practitioners signals that Agile practices such as retrospective meeting and pair-programming can help teams to stimulate their members’ willingness to learn in a positive way.

### 5.4.5 Social Aspect within the Team

Hypothesis H5 is tested in this section, it states that:

\[ H_5: \text{The social aspects within teams in Chinese software development organizations is not a barrier in Agile adoption in China.} \]

The null and alternative hypothesis is defined as:

\[ H_0: p \leq .5; H_1: p > .5 \quad \text{where} \quad n = 81, Y = 50, \alpha = .05 \]

The binomial distribution of the social aspect is $P(Y \geq 50) = .987 > .95$, hence the null hypothesis is rejected. Social aspect within the team is, with 95% confidence, not a barrier for Agile adoption in China. Hypothesis **H5 is accepted**. Table 5.7 presents the survey data obtained for this aspect.
The Chinese way of being trustworthy, sincere, able to compromise and group oriented within the development team [49], which also comply with the author's own experience, has a positive effect on the social aspect of Agile such as high interpersonal trust (Q51), honesty (Q52) and mentoring environment (Q53). The social aspect shows no relation with Agile adoption ($r = .057$). However, high trust among team members (Q51) shows a moderate to strong positive relation with respondents’ years of experience in the software development industry ($r = .388$). This supports the idea of having fewer but more experienced team members in an Agile team, since it also enforces trust within the team. The positive responses regarding agility is presented in Figure 5.5.

According to the survey data, honesty (Q52) and having mentors (Q53) are perceived markedly higher in Agile software development teams, suggesting that these attributes can be improved by a transition to Agile methodologies.

### 5.4.6 Organizational Culture Aspect

Hypothesis H6 is tested in this section, it states that:

*H6: The cultural aspect of Chinese software development organizations is a barrier in Agile adoption in China.*
The null and alternative hypothesis is defined as:

\[ H_0: p \geq 0.5; H_1: p < 0.5 \]

where \( n = 100, Y = 68, \alpha = 0.05 \)

The binomial distribution of the organizational culture aspect is \( P(Y \leq 68) = 0.997 > 0.05 \) and the null hypothesis is hence not rejected, and consequently the hypothesis \( \text{H0 is rejected.} \)

However, \( P(Y \geq 68) = 0.002 < 0.05 \) and with 95% confidence it can be concluded that organizational culture aspect is significantly identified as a non-barrier for Agile adoption. Table 5.8 shows the survey statistics of the organizational culture aspect.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Q61</td>
<td>27</td>
<td>16</td>
<td>59%</td>
</tr>
<tr>
<td>Q62</td>
<td>27</td>
<td>17</td>
<td>63%</td>
</tr>
<tr>
<td>Q63</td>
<td>27</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Q64</td>
<td>27</td>
<td>17</td>
<td>63%</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>68</td>
<td>63%</td>
</tr>
</tbody>
</table>

Table 5.8

The low outside trust and the high power distance surprisingly do not influence the Chinese software development organizations to the expected extent. In fact, both high level of honesty towards management (Q62) and having empowered teams (Q63) are very common with 63% and 67% of the respondents agreeing respectively. The correlation with Agile adoption is low in average (\( r = 0.112 \)), but having an empowered team (Q63) does show a somewhat moderate positive relation (\( \text{Pearson}\text{'s} \ r = 0.278 \)). In total 57% more Agile than non-Agile practitioners agree that the development teams in their company are empowered. Empowered teams might be more common in an Agile organizations because of the different organizational structure and the new roles Agile methodologies advocates. The positive responses regarding agility among Agile and non-Agile practitioners is presented in Figure 5.6.
The chart shows a generally high response of positive nature for Agile development, with an average of 63%.

### 5.4.7 Competence and Recruitment Aspect

Hypothesis H7 is tested in this section, it states that:

\[
H_7: \text{The competence and recruitment aspect of Chinese software development organizations is a barrier in Agile adoption in China.}
\]

The null and alternative hypothesis is defined as:

\[
H_0: p \geq .5; \ H_1: p < .5 \text{ where } n = 81, Y = 49, \alpha = .05
\]

The binomial distribution for the competence and recruitment aspects is \( P(Y \leq 49) = .977 > .05 \) and the null hypothesis cannot be rejected. Hypothesis **H7 is rejected** accordingly. \( P(Y \geq 49) = .002 < .05 \), thus with 95% confidence it can be concluded that organisational culture aspect is significantly identified as a non-barrier for Agile adoption. *Table 5.9* shows survey data of the competence and recruitment aspect.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Q71</td>
<td>27</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Q72</td>
<td>27</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Q73</td>
<td>27</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>81</strong></td>
<td><strong>49</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>

*Table 5.9*
The common recruiting strategy of quantity over quality, as a result of China’s great workforce, and the reported lack of on-the-job training in high-tech organizations [67], are not noticeable among the respondents of the survey. Both sufficient technical training of the team (Q71), and aiming for fewer but senior team members (Q73) have 59% positive responses. Neither the fact that it is common for people to receive their positions through relations impact the Chinese software development teams in a negative way. Over 56% among Agile and non-Agile practitioners report that their team, in general, consist of technically competent and experienced people (Q72). A reason can be that acquiring positions through relations is more common for managerial positions.

The correlation analysis between competence and recruitment aspect and Agile adoption shows no relation \( r = .046 \). The positive responses regarding agility is displayed in Figure 5.7.

![Figure 5.7: Replies positive for Agile](image)

The positive responses are high for this aspect, for each question at least 44%, in both the Agile and non-Agile group, perceive their organization to exhibit a behavior beneficial for Agile adoption.

### 5.4.8 Managerial Aspect

Hypothesis H8 is tested in this section, it states that:

**H8: The managerial aspect in Chinese software development organizations is a barrier in Agile adoption in China.**

The null and alternative hypothesis is defined as:

\[
H_0: p \geq .5; H_1: p < .5 \text{ where } n = 27, Y = 23, \alpha = .05
\]

The binomial distribution of the managerial aspect is \( P(Y \leq 23) = .999 > .05 \), thus the null hypothesis is not rejected. Hence, the hypothesis **H8 is rejected**. However, \( P(Y \geq 23) = .000005 < .01 < .05 \) so with 95% (and 99%) confidence, it can be concluded that managerial aspect is not a barrier for Agile adoption in Chinese software development organizations. **Table 5.10** displays survey data of the managerial aspect.
The question of having managers with light-touch or adaptive management style (Q81), preferred in an Agile organization [39], has a high frequency with 85% of the respondents agreeing to the statement. The conservative mindset of Chinese management is unexpectedly not influencing the software industry. A reason can be that the industry is relatively young and of innovative character, where a conservative mindset would be abrupt and devastating. Managerial aspect has a weak positive relation with Agile adoption ($r = .243$). The positive responses regarding agility is displayed in Figure 5.8.

![Figure 5.8: Replies positive for Agile](image)

### 5.4.9 Other Aspects

In this section the data from non-hypothesized aspects will be presented and analyzed. First the software project process aspect is analyzed, followed by the technical aspect. In general both aspects have a high amount of positive answers from an Agile perspective, hence the author conducted tests to determine if they are non-barriers in Agile adoption.

The null and alternative hypothesis for the software project process aspect is defined as

$$H_0: p \leq .5; H_1: p > .5$$

where $n = 81, Y = 52, \alpha = .05$

The binomial distribution for software project process aspect is $P(Y \leq 52) = .996 > .95$, and the null hypothesis can be rejected in favor of $H_1$. The software project process aspect is not to be considered a barrier for Agile adoption in Chinese software development organizations. Table 5.11 displays the survey data of the software project process aspect.

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Q81</td>
<td>27</td>
<td>23</td>
<td>85%</td>
</tr>
</tbody>
</table>

*Table 5.10*
### Table 5.11

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Q91</td>
<td>27</td>
<td>17</td>
<td>63%</td>
</tr>
<tr>
<td>Q92</td>
<td>27</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Q93</td>
<td>27</td>
<td>17</td>
<td>63%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>81</td>
<td><strong>52</strong></td>
<td><strong>64%</strong></td>
</tr>
</tbody>
</table>

Incremental planning and architecture (Q91), deliver feature by importance (Q92) and frequent delivery of working software (Q93) all have a high frequency of replies aligned with Agile software development. The correlation analysis shows no relation with Agile adoption \( r = 0.061 \). Deliver feature by importance (Q92) shows a weak positive relation with Agile adoption \( r = 0.216 \), and might be due to the common use of the Agile practices: iteration planning and prioritized backlog. The positive responses regarding agility for the software project process aspect are presented in Figure 5.9.

It is surprising that frequent delivery of working software (Q93) is remarkably higher among non-Agile practitioners (78% versus 56%) since Agile development is primarily iterative and advocates delivery of working software frequently, preferably after each iteration [13].

The null and alternative hypothesis for the technical aspect is defined as

\[
H_0: p \leq 0.5; \quad H_1: p > 0.5 \quad \text{where} \quad n = 81, Y = 61, \alpha = 0.05
\]

The binomial distribution of the technical aspect is \( P(Y \leq 61) = 0.999 > 0.99 > 0.95 \), and the null hypothesis can be rejected, with a confidence of 95% and 99%. The technical aspect is not to be considered a barrier for Agile adoption either. Table 5.12 displays the survey data of the technical aspect.
Pursue simple design (Q101), having just enough documentation (Q102) and using tools for automation of deployment (Q103) have an average of 75% of the respondents answering in a favorable way of working Agile. Deploy automation is a very common practice in both Agile and non-Agile organizations with a response rate of 89%. This aspect does not show any relation with Agile adoption when conducting a correlation analysis ($r = .044$). The positive responses regarding agility for the technical aspect is presented in Figure 5.10.

![Figure 5.10: Replies positive for Agile](image)

**Table 5.12**

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Positive for Agile</th>
<th>Negative for Agile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Q101</td>
<td>27</td>
<td>19</td>
<td>70%</td>
</tr>
<tr>
<td>Q102</td>
<td>27</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Q103</td>
<td>27</td>
<td>24</td>
<td>89%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>81</td>
<td>61</td>
<td><strong>75%</strong></td>
</tr>
</tbody>
</table>
6 Conclusions and Discussion

In this chapter the conclusion of the study in this master’s thesis will be summarized and a recommendation for organizations considering adopting Agile methodologies will be proposed. The limitation of the study is also discussed and future research is suggested.

The purpose of this master’s thesis is to create a better understanding of how and to what extent Agile methodologies suit Chinese software development organizations. Agile is based on people and is therefore highly interlaced with culture. The strong Chinese culture is hence expected to have an impact on the adaptation and practices of Agile methodologies.

In this master’s thesis a comprehensive review of research pertaining to Agile software development and Chinese culture has been conducted. The findings from the research analysis together with author intuitions were used to form a hypothetical framework. Based on the hypothetical framework a survey questionnaire was designed, and on the data obtained a statistical analysis was performed and the results were examined. These steps have resulted in answers to the three research questions (Section 1.3) that have been the focus of this thesis:

- **Question 1:** What are the underlying principles and values of Agile methodologies?

This question was answered in Section 2.1, where a thorough literature review was presented and manifested that Agile methodologies are based on the need to respond to constant change. To fulfill this need, each Agile methodology is built on the common Agile values, its principles and a set of specific Agile practices.

- **Question 2:** What factors are important for an organization to succeed in adopting Agile methodologies?

The second research question was answered through a comprehensive study of research in the area of Agile adoption as well as Agile and its cultural impact. The analysis resulted in a list of ten main aspects in which each covers several specific factors that are important to possess for an organization to enable an easier transition to Agile methodologies. The identified aspects were: cognitive aspect, customer collaboration aspect, communication aspect, knowledge sharing aspect, social aspect, cultural aspect, competence and recruitment aspect, managerial aspect, software project process aspect and technical aspect.

- **Question 3:** What are the critical barriers that impact the success of Agile and Agile adoption in Chinese software development organizations?

The answer to the third question was obtained with help of the hypothetical framework described in Chapter 4 and the survey result presented in Chapter 5. In Table 6.1 the outcome of the result and analysis is summarized.
### Conclusions and Discussion

<table>
<thead>
<tr>
<th>Label</th>
<th>Hypothesis</th>
<th>Result</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>The cognitive aspect of developers and personnel in Chinese software development organizations is a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Non-barrier</td>
</tr>
<tr>
<td>H2</td>
<td>The customer collaboration aspect in Chinese software development organizations is not a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>H3</td>
<td>The communication aspect within Chinese software development organizations is a barrier in Agile adoption in China.</td>
<td>Accepted</td>
<td>Barrier</td>
</tr>
<tr>
<td>H4</td>
<td>The knowledge sharing aspect among team members in Chinese software development organizations is not a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>H5</td>
<td>The social aspects within teams in Chinese software development organizations is not a barrier in Agile adoption in China.</td>
<td>Accepted</td>
<td>Non-barrier</td>
</tr>
<tr>
<td>H6</td>
<td>The cultural aspect of Chinese software development organizations is a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Non-barrier</td>
</tr>
<tr>
<td>H7</td>
<td>The competence and recruitment aspect of Chinese software development organizations is a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Non-barrier</td>
</tr>
<tr>
<td>H8</td>
<td>The managerial aspect in Chinese software development organizations is a barrier in Agile adoption in China.</td>
<td>Rejected</td>
<td>Non-barrier</td>
</tr>
</tbody>
</table>

#### Table 6.1: Summary of the analysis results

Two of the eight hypothesis in the hypothetical framework were accepted and the rest were consequently rejected.

Hypothesis H3, pertaining to the communication aspect, was accepted and concluded as a barrier for Agile adoption in Chinese software development organizations. The strong culture of implicit and indirect communication in China significantly impacts the important communication aspect in negative way. The data reveals a positive trend of improving the communication aspect as a result of an Agile transition. However, I suggest that software development organizations in China should pay extra attention to this aspect and invest more efforts to improve and foster good communication for easier Agile adoption and in order to get better throughput from their Agile way of working.

Hypothesis H5, addressing the social aspect within teams, was also accepted, despite being concluded not to be a barrier for Agile adoption in China. The social aspects required in Agile software development are reached by the Chinese way of being trustworthy, sincere, able to compromise and group oriented [49].

Hypothesis H2, regarding the customer collaboration aspect, and hypothesis H4, regarding the knowledge sharing aspect, were both rejected in the hypothesis tests. They are inconclusive and cannot be determined as neither a barrier nor a non-barrier for Agile adoption in China. It was discussed that personal connections (guanxi) could contribute to the inconclusive result of hypothesis H2. Knowledge sharing was discussed and considered as a non-barrier, since the aspect showed a positive correlation with a transition to Agile and is reported significantly higher in Chinese organizations that practice Agile methodologies.
Hypotheses H1, H6, H7 and H8 were all hypothesized as barriers but rejected. All of them were concluded not to be barriers for Agile adoption in Chinese software development organizations. Out of the 12 questions in these 4 hypothesis, only one question was answered more positively by non-Agile practitioners. This is a strong trend indicating that a transition to Agile methodologies affects the agility of Chinese software development organizations in a positive way, hence an adoption to Agile methodologies should be favorable among Chinese software development organizations.

The two non-hypothesized aspects, namely software project process aspect and technical aspect, were also concluded not to be barriers for Agile adoption in China.

In conclusion, the survey results contradict many of the perceived traits of Chinese software development organizations which were assumed to pose as barriers for Agile adoption. With communication aspect being the only concluded barrier, the overall result indicates that Agile methodologies are suitable, and should be favorable for software development organizations in China. Although Agile adoption in China is concluded to not hold many barriers, I recommend to not neglect any of the aspects, since Agile adoption is not a binary process but rather a scale where true agility means to constantly improve in all the areas. The results presented must be considered in the view of the very limited survey samples, hence this might not be a completely accurate conclusion for the entire software development industry in China.

An organization should have a genuine reason and commitment before pursuing an Agile adoption. Adopting Agile methodologies in a Chinese software development organization should therefore be preceded by a throughout recall of the Agile concept and a true reflection and understanding of the values Agile development promotes, together with the potential impacts it would have on the organization.

### 6.1 Limitations of the study

As mentioned earlier, one of the main limitations of the study, and a common problem of projects of this size, is to collect enough sample data to be able to draw general conclusions of the bigger population. It was proven hard and time consuming to find people that were willing to answer the survey questionnaire.

It has come to my attention that respondents were suspicious about the intention and the anonymity of the survey. Several people commented on the forum post and asked questions related to this. Anonymity and authenticity are common problems to overcome in China, however more effort could have been put into assuring the respondents of this.

Another potential problem is that the respondents of the survey might be bias towards Agile. The forum posts asking people to participate, as well as the survey introduction, both mentioned that the aim of the survey - to better understand Agile practices in China. This could have impacted the survey data in a way that would not correlate with an unprejudiced group of respondents.

The amount of questions in the questionnaire can also be seen as a limitation, since more questions will give more answers and more data to analyze. A long questionnaire risks to eliminate respondents that are not willing to put in the time and effort to answer such a survey [56]. The relatively small size of the questionnaire was an estimated decision that was aimed to obtain more respondents.
6.2 Future Research

The world is changing, and the world of the IT industry seems to be changing even faster. To be on top of the competition software organizations need to be able to cope with this constantly changing environment. Agile methodologies is one answer, to cope with constant change, and when this way is chosen it is important to understand the consequences and the impact it will pose on the organization at hand.

In the survey, culture has been viewed as a static independent variable in relating the Chinese cultural characteristics and adoption to Agile. The results hint, and are pointing at the direction of other research, that culture is a highly dependent variable and can be influenced and even changed by adopting Agile methodologies. Extending the survey questionnaire with an organizational cultural section would possibly have given a deeper insight in the specific part of the culture that impact specific part of Agile and Agile adoption. Such extension would also create an interesting opportunity to compare Agile adoption between countries and cultures.

With the current globalization future research on the impact of Agile adoption in multicultural teams and global development organizations would be highly interesting and potentially give guidance around the subject with yet another dimension.
7 References


Appendix A

Software Development

Please choose a language. / 请选择一项语言。

- 中文
- English

Agile Adoption Survey

This survey aims to gather data from software development organizations to better understand the prerequisites for Agile adoption.

The survey is divided into two parts. The first part has 6 questions and covers general background information, the second part has 29 questions and covers Agile adoption factors. The respondent does not require any prior experience or knowledge of Agile.

The survey will only take around 5-10 minutes to complete.

I’m very grateful that you are helping me with my research by participating in this survey.

Thank you!
Joakim Eriksson

Agile Adoption Survey

Part 1

What country do you come from? *

- China
- Other

Which type of city is your organization located in? *

- 1st tier city
- 2nd tier city
- 3rd tier city
- Other

What type of organization do you work in? *

- Private owned
- State owned
- Joint venture
- Non-profit organization
- Other (please specify)

My role in the organization is *

- Functional Manager
- Project Manager
- Team Leader
- Developer/Tester
- Other (please specify)
Appendix A

The customers of our software products are mostly *

- Domestic
- International
- Mix

How long have you been working with software development? *

[ ] years.

Do you have any prior experience in working with agile methods? *

- yes
- no

Does your team(s) work according to any agile method? *

- yes
- no

Part 2

Your replies should reflect the option you agree to the most, from your knowledge and experience, about the software development organization you currently work in; where (0) = No! (Disagree, Low, Slow, etc.), (1) = Yes! (Agree, High, Fast, etc.) or (2) = Don't know.

Cognitive Aspects *

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, the members' sense of responsibility is generally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[0 = not so high, 1 = high]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, the members' motivation is generally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[0 = not so high, 1 = high]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our organization, the employees have a progressive attitude. (e.g. are</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>interested in change and favor progress) [0 = I disagree, 1 = I agree]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Collaborative Aspects *

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our projects, customers collaborate closely with the development team.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[0 = no, 1 = yes]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our projects, customer commitment and presence is best described as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(being committed means motivated, active, and consider themselves to be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>responsible elements of the project) [0 = not so strong, 1 = strong]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, the collaborative attitude among the members is generally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[0 = not so high, 1 = high]</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
## Appendix A

### Communication Aspects

<table>
<thead>
<tr>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, we have daily face-to-face meetings.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = no, 1 = yes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our organization, we have a strong oral culture which places high value on face-to-face communication.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our software development projects, communication between teams, management and other departments is generally best described as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = slow &amp; ineffective, 1 = fast and effective)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Knowledge Sharing Aspects

<table>
<thead>
<tr>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, the members’ are eager to constantly learn from one another.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, having mentors and training members through mentoring is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = uncommon, 1 = common)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Team Social Aspects

<table>
<thead>
<tr>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, the trust among team members is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = not so high, 1 = high)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Corporate Cultural Aspects

<table>
<thead>
<tr>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our organization, we have the culture of trusting people.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>In our team, the members’ honesty towards management, and vice versa, is</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = not so high, 1 = high)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our company, our development teams are empowered. (i.e., trusted to take technical decisions, alter the work process, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our company, the organizational culture is, in general, best described as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = flat and cooperative, 1 = hierarchical and bureaucratic)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our organization, we reflect upon ourselves and implement changes we</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>find necessary.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HR and Recruitment Aspects

<table>
<thead>
<tr>
<th>Description</th>
<th>0</th>
<th>1</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, we are given technical training that is sufficient and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>appropriate.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our team consists of technically competent and experienced people in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>general.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = I disagree, 1 = I agree)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our organization, the recruitment strategy in hiring developers is best described as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0 = many but junior, 1 = fewer but senior)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Managerial Aspects

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our organization, managers generally have a light-touch or adaptive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>management style.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = I disagree, 1 = I agree ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, we have a regular working schedule with little overtime.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = I disagree, 1 = I agree ]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Software Project Management Aspects

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>In our team, planning and architecture is usually done</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = all upfront, 1 = incrementally ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, the order in which features is delivered by is based on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>importance (i.e. not on risk, effort or time).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = I disagree, 1 = I agree ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, the delivery frequency of working software is often</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = less than bi-monthly, 1 = more than bi-monthly ]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Technical Aspects

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>During development, our team always try to pursue simple design.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = I disagree, 1 = I agree ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, we have just enough documentation. (Not too much, nor too</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>time)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = I disagree, 1 = I agree ]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In our team, we use tools for automation of deployment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 0 = no, 1 = yes ]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You have completed the survey. Thank you very much for your participation.

You can now close the window.
Appendix B

Software Development

1. What country do you come from? *
   Number of participants: 26
   26 (100.0%): China
   - (0.0%): Other

2. Which type of city is your organization located in? *
   Number of participants: 8
   3 (37.5%): 1st tier city
   3 (37.5%): 2nd tier city
   2 (25.0%): 3rd tier city
   - (0.0%): Other

3. What type of organization do you work in? *
   Number of participants: 27
   19 (70.4%): Private owned
   - (0.0%): State owned
   6 (22.2%): Joint venture
   1 (3.7%): Non-profit organization
   1 (3.7%): Other
   Answer(s) from the additional field:
   - 外企中国合资公司
4. My role in the organization is *
   Number of participants: 27
   2 (7.41%): Functional Manager
   1 (3.70%): Project Manager
   3 (11.11%): Team Leader
   18 (66.70%): Developer/Tester
   3 (11.11%): Other
   Answer(s) from the additional field:
   - QA
   - 测试工程师
   - 软件测试工程师

5. The customers of our software products are mostly *
   Number of participants: 27
   17 (63.00%): Domestic
   1 (3.70%): International
   9 (33.33%): Mix
6. How long have you been working with software development? *

   Number of participants: 27

   - 9
   - 10
   - 4
   - 8
   - 5
   - 10
   - 13
   - 6
   - 5
   - 8
   - 1
   - 1
   - 9
   - 10
   - 8
   - 5
   - 2
   - 2
   - 3
   - 1
   - 3
   - 1
   - 1
   - 7

7. Do you have any prior experience in working with agile methods? *

   Number of participants: 27

   17 (63.0%): yes
   10 (37.0%): no

8. Does your team(s) work according to any agile method? *

   Number of participants: 27

   18 (66.7%): yes
   9 (33.3%): no
9. Cognitive Aspects

<table>
<thead>
<tr>
<th></th>
<th>0 (1)</th>
<th>1 (2)</th>
<th>Don't know (0)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Σ %</td>
<td>Σ %</td>
<td>Σ %</td>
</tr>
<tr>
<td>In our team, the members’ sense of respect [0 = not so high, 1 = high]</td>
<td>8x 29.63</td>
<td>18x 66.67</td>
<td>1x 1.69 ± 0.47</td>
</tr>
<tr>
<td>In our team, the members’ motivation... [0 = not so high, 1 = high]</td>
<td>7x 26.92</td>
<td>18x 69.23</td>
<td>1x 1.72 ± 0.46</td>
</tr>
<tr>
<td>In our organization, the employees have... [0 = I disagree, 1 = I agree]</td>
<td>10x 37.04</td>
<td>16x 59.26</td>
<td>1x 1.62 ± 0.50</td>
</tr>
</tbody>
</table>

10. Collaborative Aspects

<table>
<thead>
<tr>
<th></th>
<th>0 (1)</th>
<th>1 (2)</th>
<th>Don't know (0)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Σ %</td>
<td>Σ %</td>
<td>Σ %</td>
</tr>
<tr>
<td>In our projects, customers collaborate closely [0 = no, 1 = yes]</td>
<td>13x 50.00</td>
<td>12x 46.15</td>
<td>1x 1.48 ± 0.51</td>
</tr>
<tr>
<td>In our projects, customer commitment... [0 = not so strong, 1 = strong]</td>
<td>15x 55.56</td>
<td>10x 37.04</td>
<td>2x 1.40 ± 0.50</td>
</tr>
<tr>
<td>In our team, the collaborative attitude... [0 = not so high, 1 = high]</td>
<td>5x 18.52</td>
<td>21x 77.78</td>
<td>1x 1.81 ± 0.40</td>
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</table>

11. Communication Aspects

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<tr>
<td></td>
<td>Σ %</td>
<td>Σ %</td>
<td>Σ %</td>
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<tr>
<td>In our team, we have daily face-to-face... [0 = no, 1 = yes]</td>
<td>10x 37.04</td>
<td>17x 62.96</td>
<td>- 1.63 ± 0.49</td>
</tr>
<tr>
<td>In our organization, we have a strong... [0 = I disagree, 1 = I agree]</td>
<td>9x 34.62</td>
<td>17x 65.38</td>
<td>- 1.65 ± 0.49</td>
</tr>
<tr>
<td>In our software development projects,... [0 = slow &amp; ineffective, 1 = fast &amp; effective]</td>
<td>8x 29.63</td>
<td>19x 70.37</td>
<td>- 1.70 ± 0.47</td>
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12. Knowledge Sharing Aspects

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<tr>
<td></td>
<td>Σ %</td>
<td>Σ %</td>
<td>Σ %</td>
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<tr>
<td>In our team, the members are eager to... [0 = disagree, 1 = agree]</td>
<td>11x 40.74</td>
<td>15x 55.56</td>
<td>1x 1.58 ± 0.50</td>
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<tr>
<td>In our team, having mentors and train... [0 = uncommon, 1 = common]</td>
<td>12x 46.15</td>
<td>14x 53.85</td>
<td>- 1.54 ± 0.51</td>
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13. Team Social Aspects

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<td>%</td>
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<tr>
<td>In our team, the trust among team members</td>
<td>6x 22.22</td>
<td>20x 74.07</td>
<td>1x 1.77, 0.43</td>
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<tr>
<td>In our team, the members' honesty to...</td>
<td>9x 34.62</td>
<td>16x 61.54</td>
<td>1x 1.64, 0.49</td>
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</tbody>
</table>

14. Corporate Cultural Aspects

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<td>%</td>
<td>%</td>
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<tr>
<td>In our organization, we have the culture</td>
<td>9c 33.33</td>
<td>16x 59.26</td>
<td>2x 1.64, 0.49</td>
</tr>
<tr>
<td>In our team, the members' honesty to...</td>
<td>7x 28.00</td>
<td>17x 68.00</td>
<td>1x 1.71, 0.46</td>
</tr>
<tr>
<td>In our company, our development team...</td>
<td>8c 29.63</td>
<td>18x 66.67</td>
<td>1x 1.69, 0.47</td>
</tr>
<tr>
<td>In our company, the organizational cu...</td>
<td>9c 34.62</td>
<td>16x 61.54</td>
<td>1x 1.64, 0.49</td>
</tr>
<tr>
<td>In our organization, we reflect upon o...</td>
<td>8c 29.63</td>
<td>17x 62.96</td>
<td>2x 1.68, 0.48</td>
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</tbody>
</table>

15. HR and Recruitment Aspects

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<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>In our team, we are given technical train</td>
<td>10x 37.04</td>
<td>16x 59.26</td>
<td>1x 1.62, 0.50</td>
</tr>
<tr>
<td>Our team consists of technically comp...</td>
<td>7x 26.92</td>
<td>17x 65.38</td>
<td>2x 1.71, 0.46</td>
</tr>
<tr>
<td>In our organization, the recruitment st...</td>
<td>10x 37.04</td>
<td>16x 59.26</td>
<td>1x 1.62, 0.50</td>
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</tbody>
</table>

16. Managerial Aspects

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<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>In our organization, managers generally h</td>
<td>3x 11.54</td>
<td>23x 88.46</td>
<td>- 1.88, 0.33</td>
</tr>
<tr>
<td>In our team, we have a regular work...</td>
<td>9c 33.33</td>
<td>18x 66.67</td>
<td>- 1.67, 0.48</td>
</tr>
</tbody>
</table>
17. Software Project Management Aspects

Number of participants: 27

<table>
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<tr>
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</tr>
<tr>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(x)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

In our team, planning and architecture is
[0 = all upfront, 1 = incrementally]
\(x\): 10 - 37.04, 17 - 62.96
\(\bar{x}\): 1.63, \(\sigma\): 0.49

In our team, the order in which feature...
[0 = I disagree, 1 = I agree]
\(x\): 8x - 30.77, 18x - 69.23
\(\bar{x}\): 1.69, \(\sigma\): 0.47

In our team, the delivery frequency of...
[0 = less than bi-monthly, 1 = more th...]
\(x\): 9x - 33.33, 17x - 62.96
\(\bar{x}\): 1.65, \(\sigma\): 0.49

18. Technical Aspects

Number of participants: 27

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<th>Don’t know (0)</th>
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<tr>
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<td></td>
</tr>
<tr>
<td>(x)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

During development, our team always try
[0 = I disagree, 1 = I agree]
\(x\): 7x - 25.93, 19x - 70.37
\(\bar{x}\): 1.73, \(\sigma\): 0.45

In our team, we have just enough doc...
[0 = I disagree, 1 = I agree]
\(x\): 8x - 30.77, 18x - 69.23
\(\bar{x}\): 1.69, \(\sigma\): 0.47

In our team, we use tools for automati...
[0 = no, 1 = yes]
\(x\): 3x - 11.11, 24x - 88.89
\(\bar{x}\): 1.89, \(\sigma\): 0.32
### Appendix C

#### Component Matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<td>-.200</td>
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<td>-.203</td>
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<td>-.033</td>
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Extraction Method: Principal Component Analysis.

a. 9 components extracted.