Implementation of Agile Software Development Methodology in a company – Why? Challenges? Benefits?

Masterarbeit

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Abstract

The software development industry is enhancing day by day. The introduction of agile software development methodologies was a tremendous structural change in companies. Agile transformation provides unlimited opportunities and benefits to the existing and new developing companies. Along with benefits, agile conversion also brings many unseen challenges. New entrants have the advantage of being flexible and cope with the environmental, consumer, and cultural changes, but existing companies are bound to rigid structure.

The goal of this research is to have deep insight into agile software development methodology, agile manifesto, and principles behind the agile manifesto. The prerequisites company must know for agile software development implementation. The benefits a company can achieve by implementing agile software development. Significant challenges that a company can face during agile implementation in a company.

The research objectives of this study help to generate strong motivational research questions. These research questions cover the cultural aspects of company agility, values and principles of agile, benefits, and challenges of agile implementation. The project management triangle will show how benefits of cost, benefits of time, and benefits of quality can be achieved by implementing agile methodologies. Six significant areas have been explored, which shows different challenges a company can face during implementation agile software development methodology. In the end, after the in depth systematic literature review, conclusion is made following some open topics for future work and recommendations on the topic of implementation of agile software development methodology in a company.

Zusammenfassung

Die Softwareentwicklungsbranche entwickelt sich von Tag zu Tag weiter. Die Einführung agiler Softwareentwicklungsmethoden war ein gewaltiger Strukturwandel in Unternehmen. Agile Transformation bietet den bestehenden und neu entstehenden Unternehmen unbegrenzte Möglichkeiten und Vorteile. Neben den Vorteilen bringt die agile Umstellung auch viele unsichtbare Herausforderungen mit sich. Neue Marktteilnehmer haben den Vorteil, flexibel zu sein und den Umwelt-, Verbraucher- und Kulturveränderungen zu begegnen, aber bestehende Unternehmen sind an eine starre Struktur gebunden.

Das Ziel dieser Forschung ist es, einen tiefen Einblick in die Methodik der agilen Softwareentwicklung, das agile Manifest und die Prinzipien hinter dem agilen Manifest zu erhalten. Die Voraussetzungen, die Unternehmen für eine agile Softwareentwicklungsimplementierung kennen müssen. Die Vorteile, die ein Unternehmen durch die Implementierung agiler Softwareentwicklung erzielen kann. Erhebliche Herausforderungen, denen sich ein Unternehmen bei der agilen Implementierung in einem Unternehmen stellen kann.

Die Forschungsziele dieser Studie helfen, starke motivationale Forschungsfragen zu generieren. Diese Forschungsfragen umfassen die kulturellen Aspekte der Agilität des Unternehmens, Werte und Prinzipien der Agilität, Nutzen und Herausforderungen der agilen Implementierung. Das Projektmanagement-Dreieck wird zeigen, wie Kosten-, Zeit- und Qualitätsvorteile durch die Implementierung agiler Methoden erzielt werden können. Sechs wichtige Bereiche wurden untersucht, was zeigt, dass ein Unternehmen bei der Implementierung einer agilen Softwareentwicklungsmethodik unterschiedliche Herausforderungen bewältigen kann. Am Ende, nach der eingehenden systematischen Literaturrecherche, wird nach einigen offenen Themen für die zukünftige Arbeit und Empfehlungen zum Thema Implementierung agiler Softwareentwicklungsmethodik in einem Unternehmen Schluss gezogen.

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1. Introduction

The framework, which centered on the iterative software development technique, where requirements and solutions evolved through collaboration and teamwork is called agile software development. The rapid and flexible response to change is encouraged and evolutionary development, adaptive planning, empirical knowledge, and continual improvement is concerned and linked with agile software development. There are 12 agile principles behind it. Agile manifesto umbrellas core agile values and principles. These principles direct the right ways for working with agile framework and practice (AgileAlliance.org 2019).

The cross-functional teams make sure that your team has the right set of skills. After putting teams together, they do not require many hard efforts to have a check between team members. Obtaining the right skills set among team members is the responsibility of the managers, and for this manager space is always available in a company. To provide a successful and comfortable atmosphere, it is also the responsibility of the managers. Many times it happened, a situation comes that cannot be handled by the teams and then managers have to step in and find the most suitable solution.

At the start, a significant step taken by many organizations while start implementing agile software development framework was that they strongly focus on agile manifesto. The organizations practice requirement gathering, team collaboration, and sustainability. Sometimes organizations also neglect some vital practices such as initial training, defining business goals, and pilot project selection that result in so many unseen challenges. Without following the agile manifesto, transition to agile software development is not possible (Requirement Gathering 2019).

Agile methodology seems to be practiced by every software development organization. The work influenced by the use of agile software development methods is more efficient instead of waterfalls software development methodology. Different types of customer's needs and behaviors are supported by agile software development by illustrating different roles in a workflow according to the user perspective. Agile software development begins by including an internal owner, and who is required to be the voice of the customer. (Prominent Agile Software Development 2018)

1.1. Motivation and Problem statement

For achieving successful projects, one must follow the structure defined by the organization; this structure defined as success criteria for the project. The results, project impacts and the performances, along with quality, cost and time are taken into consideration to measure the success of the project. "Never delivering the solution" is the pure definition of failure in an agile software development system. Like other development methodologies, agile has a high level of success. In terms of applying a different approach to project development, agile faces a set of challenges and problems depending on circumstances. The three main reasons for the failure of agile projects are:

- Agile software Development Company with insufficient experience and skills.
- Little understanding of the changing project requirements.
- Company's philosophy with odd values.

Sometimes failures become so bizarre that they cannot be compensated by avoiding any bad experience or failure in software development(Gloria J. 2013).

A collaborative environment is created between the user and the developer to achieve efficiency, trust, and better output. For agile software development, there are core principles defined by agile methods on their own. The iterative and incremental software development in an agile framework is advocated by the Crystal, Extreme Programming (XP), Kanban, Dynamic Systems Development Methodology, Feature Driven Development, and SCRUM. (Madan, 2015)

The companies have identified that the implementation of agile methodology and practices as one of the critical pillars in the software industry (Jaubert et al. 2014). Therefore, with the emergence of agile software development sense in IT industry many benefits and challenges also emerged for companies. Roles and processes can be customized, as long as they stay in line with guiding values and principles of agile software development. Implementing agile software development in a company is not only using tools and following processes; it is the people and whole operational system.

The overall aim of the thesis is to develop and discuss 'why' companies are transforming to agility to make most out of it. Many companies are transforming to agile software development framework in one way or another because of the fast-changing requirements. Some get successful, and many others faced obstacles in their

attempt to change from other traditional methods to the agile methodology. In the next chapter of this thesis, the conceptual background of 'Agile software development methodologies' will be discussed and reviewed based on recent literature. This section follows prerequisites for agile implementation, cultural aspects, benefits from agile implementation, characteristics of agile in software development and challenges of agile implementation. The next chapters will elaborate the systematic literature review methodologies and the chosen methodology for this research following searching strategy, searching terms, data extraction, and analysis. The last chapter of this thesis includes the conclusion from the research and the limitations faced during research. This section also narrates the recommendations and open topics for future research.

1.2. Research Objectives

The objective of this research is to explain the implementation of agile software development methodology. It can be done by getting familiar with one of the agile software development methodologies such as Scrum. A better understanding of agile values and principles is also necessary for agile software development implementation. The research will focus all the prerequisites need to be known before for agile software development implementation is a company. The focus will also be on the cultural aspects that can impact agility in a company. The linkage between organization agility and organization culture will be tried to explain. This research will also focus on the key points to gain success in implementing agile software development in a company. Along with all this, the main focus of the research will be on benefits and challenges that can be appeared during agile software development implementation. Like all those benefits which can be achieved by implementing ideal and balanced project management in a company. In this research, we will discuss all possible areas of challenges faced during agile software development implementation in a company. Also try to find the solutions for those challenges. This thesis would be a step by step guideline for figuring out key points for implementation agile software development in a company and its benefits and implementation challenges. The research questions for this thesis are derived from the research objectives which are discussed in next section.

1.3. Research Questions

1. What are the cultural aspects of company agility?
2. What are the values and principles of agile implementation in a company?
3. What are the benefits of agile methodologies in a company?

4. What are the challenges faced while implementing an agile methodology?

1.4. Research Methodology

In this thesis, each of the research questions needs to be answered through a systematic scientific approach, to make results and the outcomes measurable, comparable, and standardized. A systematic literature review will be conducted to answer the research questions. In a systematic literature review, relevant information can be accessed using either quantitative or qualitative research approach, with the focus to find answers to research questions. In many circumstances, research question or topic can only be compatible with one, either quantitative or qualitative research method. Although results types are different depending upon the chosen research method. The quantitative research method is an empirical investigation of a restricted subject area that is inflexible and predetermined. Based on representative number of respondents and statistical and mathematical techniques, generally valid statements are required to accept or reject the hypothesis about a phenomenon.

In contrast, qualitative research method is instead seeking to explore a phenomenon with a possibility to end up with the set of follow-up questions, which are examined from different perspectives. In qualitative research method, the research focused on absorbing the big picture and study from different perspective (Golafshani 2003). In this thesis, qualitative research approach will be used.

Initially, the conceptual background of the research topic is defined in chapter 2 along with several subsections. Then two literature review methodologies are discussed in chapter 3. Following that, the comparison of these methodologies presented. In the end, one method is chosen for the literature review on the topic of agile software development implementation.

In chapter 4, the primary research design is discussed. The first step is the "planning review process". The second step is to "conduct the review process" which includes multiple steps. (i) Specifying the research questions. (ii) Searching strategy: this show the digital databases which used in searching published literature. This search is limited to paper published in English language. (iii) Searching keywords: this shows the keywords used for searching literature. (iv) Inclusion and exclusion process: predefined inclusion/exclusion criteria make the selection of the most suitable literature. (v)

Literature quality assessment: to assess the quality of the selected literature. (vi) Data extraction: this shows all the essential data extracted during literature review in a data extraction form. The final step before hopping on to results is (vii) data synthesis: this represents the key finding from the literature. The third step is "presenting the review result." The results of the reviewed literature showed step by step in their respective sections of chapter 4.

Chapter 5 concluded the whole research; this chapter provides a summary of all findings based on selected and analyzed articles in the form of a conclusion. In addition to that, the implications for future research and the limitations of this study have been discussed in this section.

1.5. Outline

This outline of this thesis is to discuss the conceptual background of agile software development. Then discussing agile methodologies used for software development. Then talk about one of the agile methodologies in detail such as SCRUM. After that in the chapter of literature review design will then reflects comprehensively on systematic literature review methodologies and elucidate the systematic literature review methodology adopted for this research.

The subsequent chapter will discuss how research papers were identified, selected and analyzed — all the steps involved in the literature review process. The overall concluding remarks will be conducted at the end, having an appropriate crux of all the efforts made in this research accomplishment.

2. Conceptual Background

2.1. Historical Overview

In the Start, many experts were sharing their opinions that companies are required to go through a major transformation, which has already started to some extent. Following their opinion the only question that arises, how do you become a leader in the digital age and separate yourself from foot-draggers? Becoming more agile is the only thing that frequently linked to organizational transformation. The word agile is a military word used by the forces on the battlefield for applying strategies. They use this to succeed, adapt and exploit the chaos of the battlefield and to do it fast and better than the enemy (Rawsthorne and Shimp 2016). Agile came into being in 2001 as a project management framework designed for the development of complex IT solutions. Agile breaks down large projects into small work-pieces to embrace flexibility and continuous improvements. Agile promotes iterative and adaptive thinking (Goulstone 2016). Finding quick solutions to the problems, fast decision-making ability, teams working side by side and regularly checking project progress are agile main parts. Teams are engaged to produce new functioning products with all valuable features in a short consecutive development cycle. The products are also instantly available for direct feedback by stakeholders and users (Gothelf 2014).

Demand for many successful software delivery practices are raising. In start, agile has to face a tremendous failure rate in software development projects. Global players like Microsoft and Google adopted agility in their organizations. In the 1990s, organizations have to face a hard time in a way that projects consistently missed their deadlines, substantially overrun budgets and dissatisfied customers by faulty deliverables. At this time, the waterfall delivery framework widely adopted by the IT department. Crucial stages in waterfall methodology delivery cycle imply that analyze, design, built, test and integrate. It also requires completing one phase before initiating the next one. A responsible manager confirms the completion of every phase to reduce the overall business risk in the delivery. However, the approach was showing a high failure rate (Cooke 2012).

The waterfall delivery method has three key pain points causing reduced success rates. Mostly IT projects start with the creation of extensive requirement documents. Ascending levels of detailed technical reports are created for different customers. This

process consumes large amount of resources, can take months and leads to a pile of documents that can create misalignments between IT and line of business (LOB). This process does not allow any changes along the process to reflect changing conditions. It can cause unclear requirements and can lead to conflicts due to misinterpretations. The second key pain point is insufficient communication and strict separation between IT and LOB. Lastly, the risk of discovering problems at the very end is also a considerable risk. At this time these problems are most evident and most costly to resolve. It is also known as "All at once" risk (Cooke 2012).

2.2. Agile Methodologies and Practice

"Intelligence is the ability to adapt the change"- By Stephen Hawking

Agile software development is all about to adopt the change. It is built on foundation principle that business drivers will change with time and development teams must be ready to adapt that change.

In Utah in 2001, a group of experts came together to improve common software development practice and to develop new standards in the form of principles and processes in the field of software development. The result was the "Agile manifesto," a guideline established as a framework of successful software deliveries. The guideline principles of agile manifesto have transformed into a set of software development and project management methodologies. However, the broad range of agile methodologies shares the same basic objective: (Masset 2015)

- Transparency:

All the stakeholders regularly review progress, issue, and reach agreements on how to progress. Each and every decision in the system must be made after the involvement, cooperation, and approval of each member. It will help to build a pleasant trusty environment in a company.

- Improving Quality:

By small incremental and iterative deliveries, agile guarantees a high level of quality. From the beginning of product release, the quality and outputs must be monitored and continue to build upon the first deliverable.

- Finite Risk

It is far easier to make small incremental releases rather than a big release. Analyze technical risk as early as possible in the process, so the change will not set back the progress.

- Focus on business value:

The business or customer is always involved and able to ensure the value they need is delivered. Business values cannot be ignored while determining the scope of the project.

- Interdisciplinary Communication:

Motivate communication between IT and Business to increase quality deliverables. Better communication will lead to better and clear outputs. Lack of communication will lead to misunderstanding, confusion, and lots of rework. In the end, this all will lead to project delay, customer un-satisfaction, and loss of resources.

- Frequent Feedback:

Utilize regular feedback cycles through continuous delivery. Gathering regular feedback can be done by constant customer involvement. It will help to monitor product progress, performance, and future needs continuously.
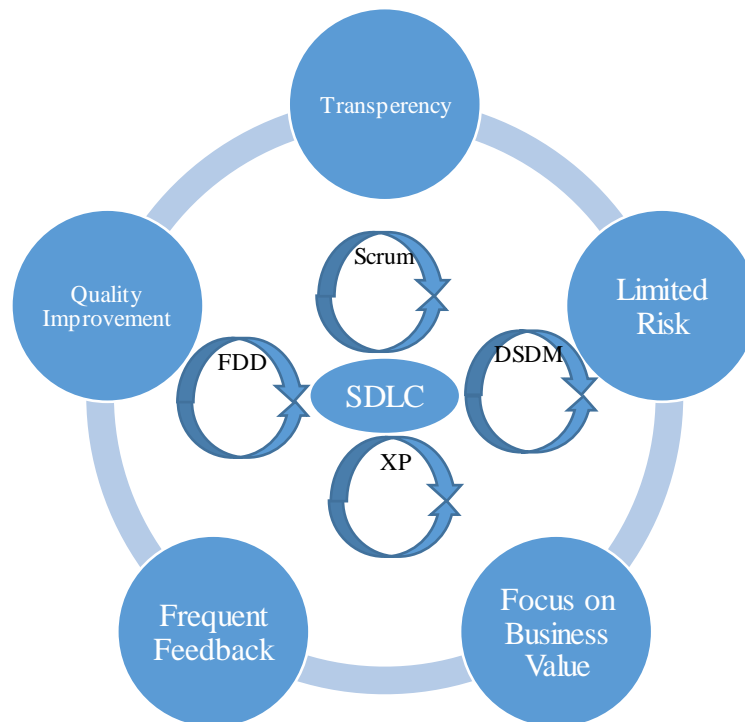
Figure 1: Agile Software Development Methodologies and Practices (Own representation)

Following the above-mentioned guidelines, many methodologies have been established over the past decades. Following is a brief overview of the agile methodologies:

Extreme Programming (XP):

Extreme Programming was developed by Kent beck at Chrysler. He developed an XP development methodology while working at a payroll project. After completing the project, beck started refining extreme programming software development methodology. XP earned recognition in 2000 and 2001. One of the best qualities of extreme programming is that it increases programming skills while decreasing time required for delivery (Livermore 2007).

The complete process in XP is transparent and accountable. Extreme programming has the ability to develop software in any unstable circumstances. The main goal of XP is to lower the cost of software changing requirements. It also increases software quality and make it adaptive to changing customer requirements. Extreme programming improves productivity and creates checkpoints due to the small delivery cycles and regular software delivery (Shivaleela and Rao 2018).

The first phase in extreme programming is requirement gathering. Basing on the collected requirements the complete development lifecycle is divided into several short cycles. The next phase is iteration process. In this phase extreme programming decides about the requirements prioritizing and also determines the amount of effort needed to implement in each cycle. The requirement prioritizing and amount of effort required is based on numbers of development cycles. XP uses pair programming techniques to develop each iteration plan. If the user requirements change during the development process then the iteration plan has to be adjusted accordingly. The next phase is testing phase. In this phase the currently developed version of software is tested for bugs. If the errors detected then it will be debugged in the next iteration. After every test phase, project tracking took place for recording instant feedbacks. This practice helps to keep notice that the amount of work has already finished (Sharma, Sarkar, and Gupta 2012).

Crystal:

Alistair Cockburn developed a crystal agile software development methodology. In this people put more emphasis on software development rather than tools (Ahmed et al. 2010). Crystal is the most adaptable and lightweight software development methodology. This methodology has a uniqueness that includes a family of agile methodologies, e.g. Crystal Orange, Crystal Clear, Crystal Yellow, and others. Crystal methods are considered as the compact collection of software development

methodology elements. Large and complex software projects require more methodology elements than small noncomplex projects. Companies develop and use only those crystal methods which are required and demand by business (Shivaleela and Rao 2018).

Feature Driven Development (FDD):

Coad and Deluca developed Feature-driven development. The need for FDD was raised during a bank development project in Singapore. The bank was required such an iterative development process that is easy to use and record progress accurately (Livermore 2007).

The key advantage of this methodology is that it creates the domain of the project before starting the development. FDD is significantly different from the other methods because they put more effort into planning and designing. More effort in quality, frequent deliveries, and progress monitoring. Feature driven development use UML diagram to represent gathered user requirements and list of features. The feature list includes development tasks and functional requirements. A high-level examination of scope of the project starts the solution requirement analysis. For each modeling area, domain is assessed in detail by development team. The model of each domain is composed and represented for peer-review (Shivaleela and Rao 2018).

Feature driven development consists of five steps process. These steps do not require intensive training and learning. The first three steps are: develop the model of the desired application, develop the list of desired features, and develop an implementation plan depending on the priority features. The fourth and fifth step is iterative development. Once the prior features are implemented and released then the feature list is reprioritized. In this, the development team can keep working on the priority features (Livermore 2007).

Dynamic Systems Development Method (DSDM):

The dynamic systems development method was developed in the mid-1990s in the United Kingdom. It is an extension of the Rapid Application Development (RAD) process. The DSDM enhances the supported training and documentation of agile software development ecosystems in Europe. The major development processes of DSDM such as functional modeling, design-build, and implementation are themselves iterative. The functional model iteration phase includes functional and non-functional requirement gathering and prototyping based on list of prior requirements. The design-

build phase refines the requirement and develops the software fulfilling those requirements. Once a set of features goes through the functional model and design-build model in a specific time-box, the next set of features also goes from the same processes in second time-box. In the end, the software is deployed in user's environment in implementation phase (Highsmith 2002).

Besides, DSDM also resolves common issues between traditional and agile software development methodologies such as:

- DSDM welcomes the changing requirement during project development and implementation.
- DSDM uses prototypes rather than lengthy documentation to collect information.
- DSDM emphasizes creating and maintain a proper culture of software development. DSSM focuses on setting up a collaborative environment between company and customer (Highsmith 2002).

Test Driven Development (TDD):

In this agile software development methodology, tests are written first before the development of the software. The software is developed on the results of those tests. In TDD software development is an iterative process. The code written in of development process has mandatory to pass the iteration's test. In the end, the programmer restructures the code and implements necessary changes (Ahmed et al. 2010).

In order to get a more in-depth insight into an agile software development framework, the SCRUM methodology elaborated in the following section.

2.2.1. The Scrum Methodology

SCRUM is a famous agile software development methodology for developing and supporting complex projects since the early 1990s. Within the SCRUM structure, people can address complex problems and deliver high-value products. The Scrum is easy to understand, lightweight, and hard to master. Scrum structure implies a scrum team and roles assigned to those team members, artifacts, events, and rules. Each component plays a specific role within the Scrum framework and is essential for Scrum's success and practice. Scrum found as an empirical process and asserts that knowledge comes from experience and decisions. Transparency, inspection, and adaption are the main three pillars to implement every empirical process.

The Scrum team involves the development team, the Scrum Master, and the product owner. Scrum teams are cross-functional and self-organizing. Cross-functional teams are efficient and have all the abilities required to complete a task without the involvement of others who are not in the group. Others who are outside the team do not direct self-organizing teams. They choose themselves how best they can accomplish their goals. The ideal scrum team model has features like productivity, creativity, and flexibility. The best scrum team works in an iterative, incremental, and collaborative manner and maximize future success opportunities (Sutherland and Schwabr 2013).
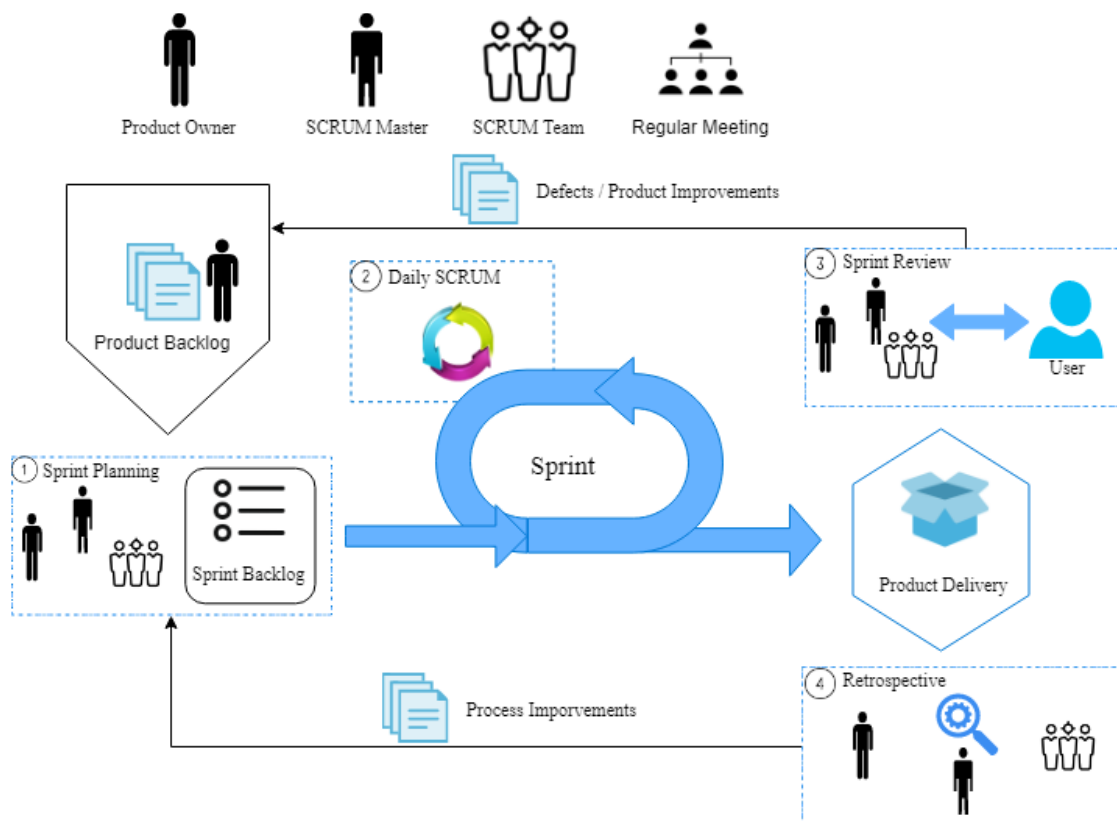
Figure 2: The SCRUM Methodology – Project Lifecycle (own representation based on (Visual Paradigm 2019))

The Product Owner is accountable for increasing product value and the work development team. The Product Owner is the only person responsible for managing the Product Backlog. Product backlog includes the following tasks: (Sutherland and Schwabr 2013)

- Solid and visible decision in the content and ordering of backlog
- To achieve best goals, arranging the items in the product backlog
- Improving the value of the work that the development team perform
- Ensure the product backlog's visibility, transparency, and clarity
- Understanding the need for product backlog to the highest level

The product owner can perform the tasks mentioned above or can assign it to the Scrum team, but the product owner remains accountable for it.

The Scrum Team consists of the professionals who work potentially and responsible for delivering the final product at the end of each sprint. Sprint is a fixed time box with the duration of usually two weeks, in with product requirements in the scope of the current sprint backlog will be designed. The Scrum team is structured by the organization to perform its work in a managed and organized way. Scrum teams have the ability to self-organizing. No one guides them on how to turn product backlog into functioning product increments. Development teams are also cross-functional, with all of the skills such as design, develop, integrate and test as a team in order to deliver functioning product increment. The development team size is usually small enough to remain agile and large enough to complete the assigned task within a Sprint. Small teams may lack skills and can be unable to deliver a releasable potential increment.

On the other hand, large teams can develop high complexity in managing practical projects. The product owner and scrum master may help in reducing the complexity if they execute sprint backlogs properly (Sutherland and Schwabr 2013).

The sprint plan meeting plans how many of the top prioritized product requirements can get delivered within the upcoming delivery cycle. Scrum master conducts this meeting, who is the primary facilitator and coach. Even though the scrum team is mainly self-organized, the scrum master is a leader without disciplinary responsibility. The scrum master is responsible to create an environment in which team can perform at best. The scrum master tries to remove hurdles and errors so that the scrum team can work continuously. The sprint planning meeting takes place between the Product Owner, Scrum team, and Scrum master. The purpose of this meeting is to discuss all possible process improvements for future iterations to complete one delivery cycle. The second sprint will start with another sprint planning meeting, and iterations proceed so on. In the end, sprint review meeting takes place. It is an informal meeting including development team, scrum master, product owner, and user. The purpose of this meeting is to show users and stakeholders which work has been done in a sprint. And compare the final product and check if it matches the commitments made at the start of sprint. There is also a scrum incremental review meeting that determines the status of the implemented work if there is any defect in the product than it again sends back to product log for the implementation of missing features.

Lastly, there is a retrospective meeting that takes place between the scrum team, the scrum master, and the product owner. This meeting takes place after the scrum review and before the next sprint planning. This meeting mostly takes place once in a single sprint and maximum three hours long. The purpose of this meeting is to find out the procedure to identify flaws, previous mistakes, and pitfalls. In this meeting scrum master, product owner and scrum team also develop the new strategies to overcome and avoid these pitfalls. In other words, sprint retrospective is to check which things and tasks development team is doing good and which are not. This is done to decide which activities will include or exclude from the next sprint (Sutherland and Schwabr 2013).

2.2.2. The Agility within Agile

Agile software development is a very famous methodology in the software industry. The main reason for this popularity is the delivery of quality products in time and gaining high market success and high customer trust. In this research, we have chosen SCRUM as an agile software development methodology. But all other software development methodologies, e.g. Extreme programming (XP), Test-driven development (TDD), Continuous integration, etc. are also essential. All these methodologies are popular due to their unique abilities in software development. Seeing so many different agile methods and practices it is difficult to find one which fits best for all solutions.

In modern companies, hybrid agile methodologies are also trending. Hybrid techniques help in high-quality product manufacturing, adopting rapid change, higher customer satisfaction, and sustainability. Agility is the ability to respond to change, so Scrum/XP hybrid is a perfect example of agility in agile. Organizations can combine practices related to different mythologies to build a framework that suits best with their organizational needs. The increasing application of customized agile solutions is the best indicator that many companies have already adopted flexibility. The Scrum / XP hybrid is the second most used agile methodology measured by the number of project implementation in the software industry (Francois 2013).

The idea behind the proposal of Scrum/XP hybrid was that the Scrum itself is a very efficient project development and agile management methodology. If it enriches with the XP's project engineering ability, then the outcome will be more beneficial. In other words, if the practices of Extreme programming (XP) used together with scrum practices then software development will become more powerful and worthy.
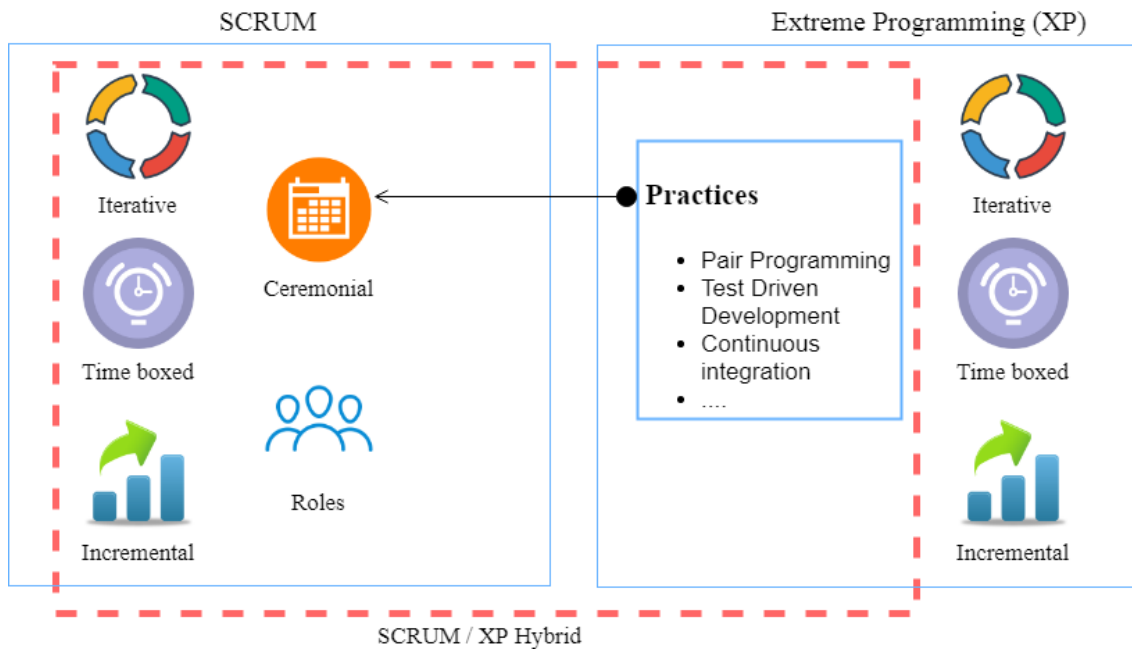
Figure 3: The SCRUM Methodology – Project Lifecycle (own representation based on (Cooke 2012))

Figure 3 demonstrates that many characteristics of XP are present in Scrum methodology as well. A Scrum/XP hybrid shows that the feature of pair programming in XP can be applied within the Scrum framework. Several benefits of Scrum/XP hybrid explored such as faster outcomes, better collaboration, and in-time delivery. But they have some limitations too (Mushtaq and Qureshi 2012).

- Scrum demands highly qualified and professionals to develop the Scrum team.
- The main focus of Scrum is on project management and remained silent about engineering software.
- XP lack in project management practices.
- XP depends entirely upon the customer that may become a failure risk.
- XP is not suitable for medium and large scale projects.

2.2.3. Prerequisite for Agile Implementation

In this section, the essential and fundamental preconditions before implementing agile software development are discussed (Gandomani and Nafchi 2016).
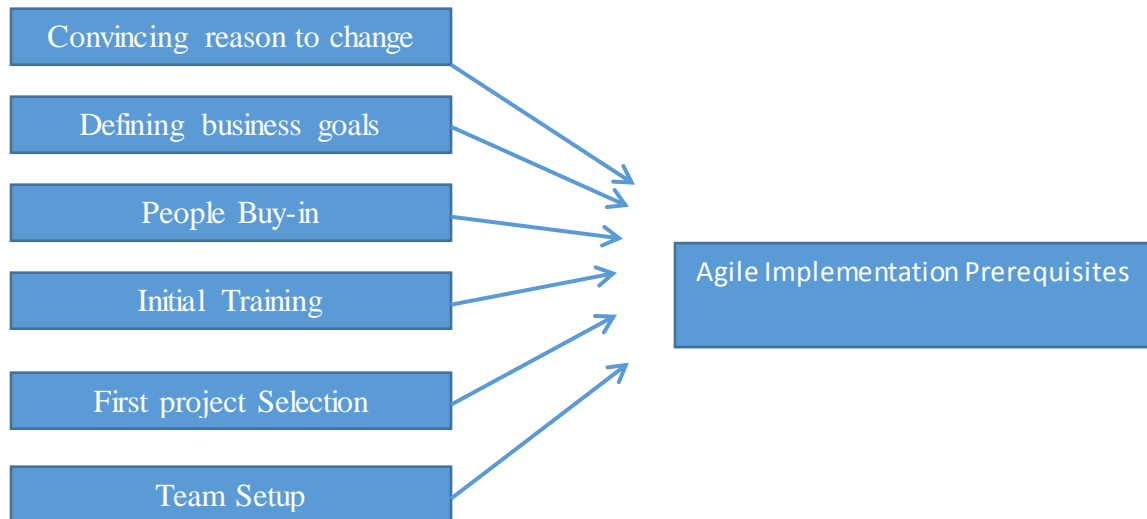
Figure 4: Agile Implementation Prerequisites (own representation based on (Gandomani and Nafchi 2016))

- Convincing reason to switch:

 For a change, organizations should have a convincing and compelling reasons to switch to agile software development method. Understanding and feeling the real reasons for the agile transition is necessary before starting the change process. Lack of knowledge about business goals can make agile implementation more difficult as expected. Start implementing an agile framework without having convincing reasons for change is a complete wastage of time, money, and resources. Organizational agility can only be avail when one is strong enough to follow their goals.

- Defining business goals:

Another prerequisite of agile implementation is setting up business goals. Business goals directly affect the requirement gathering activities and change the development process. Agile adoption is a way to improve business values rather than processes. The scope of the project cannot be determined without defining the business goals.

- People Buy-in:

Getting management buy-in before going to agile transformation is necessary. Starting with the team lead, the manager, the directors, and the people who used to maintain the day-to-day activities of their staff will need to exchange control in favor of trust and employee empowerment. Lack of management commitment can cause many hurdles for the agile implementation process. Interested and enthusiastic people not only participate in implementation efficiently but can also persuade others.

- Initial Training:

Agile approach offers different values from traditional methods; people should focus on new achievements and learn new activities. Initial training is so essential for getting familiar and adopting new roles and activities. It could help the organization to handle challenges during transformation. Less initial training can lead to lack of understanding of agile values, lack of effective collaboration and difficulty to change.   Initial training is mostly ignored and time-consuming during agile transformation. Initial training should not be limited to specific people and departments; it should be conducted at every stage of transition, if necessary.

- First project Selection:

Selecting an initial project is also one of the crucial prerequisites of agile transformation. In an organization, the initial project is also known as pilot project. This pilot project can be a training project or a real project. It helps organization to train people, remove errors and figure out defies and problems. If pilot project is the company's real project, this can lead to many unseen challenges and complexities. As in the start, the project cannot be an entirely error-free project, so it is good practice to start with a pilot project and do experiments on it. Releasing project with limited functionalities and errors in it, cannot add business value and customer satisfaction. Pilot project selection is considered as a critical task before transformation.

- Team setup:

Another critical prerequisite is setting up a team. Hiring appropriate people for a team in a project is a fundamental activity. Each member of a team must match perfectly to their roles and responsibilities. Roles like project manager, scrum master, coaches, developer, tester and mentors, product owner, etc. are critical and must be assigned to the deserving skilled person. The decision that either a team is a cross-functional or self-organizing is all depended on the team members. The way team members behave, learn, perform, and execute during the project development decides the success or failure of a company.

2.3. Cultural Aspects of Company Agility

2.3.1.What is Culture?

To understand the basics of organizational cultural agility, one must understand the meaning of culture. Many researchers came up with different definitions of culture. Some say cultural as a collective set of beliefs, and some believe culture includes explicit, such as artifacts and norms. According to (Schein 2004), for a better understanding of culture one must understand the levels of culture. There are three levels of culture describing the more observable artifacts and less observable artifacts.

According to the author, the first level of culture is 'underlying assumptions.' It involves a belief that one can have towards human behavior, relationship, reality, and truth. It is the core level among all three levels of culture levels. The underlying assumptions provide people a cognitive structure that helps them to perceive the situation and make sense of the current activities, events, and human relationships. These underlying assumptions are formed over time as when new approaches or methods develop to cope with the ongoing problems. (Leidner and Kayworth 2006)

The next level of culture proposed in (Schein 2004) is 'espouse justification.' The espouse belief identifies the 'values' which are essential for the cultural group. These values represent the strategies, goals, and philosophies that how and why people behave in different situations. However, (Schein 2004) makes it well clear that values and basic cultural assumptions are solely reflections of each other. By having a high level of understanding of values then these values are more debatable and visible.

The next level of culture is explained through 'artifacts' which includes visible organizational structure and processes — artifacts like art, information technology, myths, heroes, language, rituals, and ceremonies. Cultural artifacts of an organization are hard to decipher and most observable of all three levels of culture. (Schein 2004) claims that the invisible 'values' of culture can be easily studied and examined than underlying assumptions of culture. On the other hand, cultural artifacts (information technology, art, myths) that are visible but cannot be studied easily (Leidner and Kayworth 2006). I concluded from it that culture is an important plus difficult variable to demonstrate the interaction of the social groups with information technology (IT).

2.3.2.Organizational Cultural and Agility

Organization cultural agility is very well explained by the well-known and among the most widely recognized framework called 'The competing value framework' (Cameron and Quinn 2006). This model framework involves vertical and horizontal dimensions. One side of the vertical dimension, which exhibits flexibility, adaptability and dynamics opposes the other side of the vertical dimension with exhibit stability, order, and control. Similarly, one side in the horizontal dimension, i.e. internal orientation which exhibits integration, collaboration, and unity confronts the other side in horizontal dimension, i.e. external orientation which exhibits differentiation, competition, and rivalry. These dimensions join with each other and bring us the four different culture types, i.e. Clan culture, Adhocracy culture, Hierarchy culture, Market culture. A brief conceptual view of four culture types is explained below:

Flexibility and Discretion

Clan Culture	Adhocracy Culture
Hierarchy Culture	Market Culture

Internal Focus | External Focus

Stability and Control
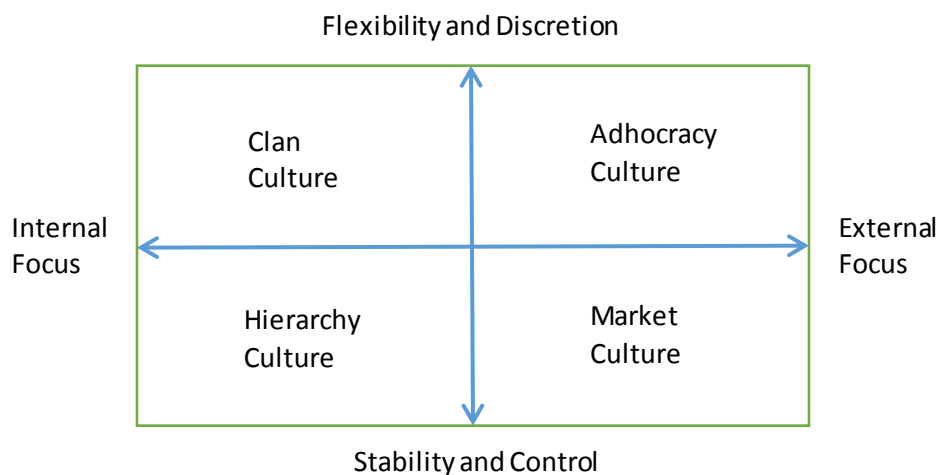
Figure 5: The competing Value Framework (own representation based on ((Cameron and Quinn 2006); (Felipe, Roldan, and Leal-Rodriguez 2017)))

The **Clan culture** involves attributes like family-oriented, trustworthiness, closeness, empowerment and community (Cameron and Quinn 2006). This culture type emphasis less concern on structure/control and has an excellent focus on flexibility. In this culture type, company members are focused on vision, goals, and outcomes. Strict company rules and procedures do not help in driving the members of the company.

The **Market culture** type is recognized due to the high focus on goals. Therefore, the cultural values inherent to this culture type are productivity, effectiveness competitiveness and results optimization. The internal and external exchanges of values

are viewed in market terms. The values flow with minimum cost and time delay between stakeholders and different members (Felipe, Roldan, and Leal-Rodriguez 2017).

The **Adhocracy culture** is known as original, dynamic, entrepreneurial, innovative, risk-taking, prepared for change, aggressive, and flexible (Leal-rodríguez et al. 2016). A company following this culture type often gets success by focusing on decision making (in product, services, and development) processes. That is why this is also known as innovation-oriented or development culture. Its main target is adaptability, flexibility and decision making (Demeester 1999).

The last culture type is the **Hierarchy culture**, which is highly bureaucratic, rule-driven. This culture type decreases the levels of ambiguity and increases the sense of security, certainty, predictability, effectiveness, stability, formalization, and standardization. Hierarchy culture mainly focuses on efficiency and internal control, i.e. very accurate range of norms, rules, instructions, and procedures (Felipe, Roldan, and Leal-Rodriguez 2017).

Notion of organization agility as proposed by (Sherehiy, Karwowski, and Layer 2007), is embedded in interrelated concepts, i.e., organizational adaptability, organizational flexibility, reactive and proactive facet. Organizational agility encompasses abilities to sense the environmental change and respond to them readily, by refiguring out their set of available means, business processes, and strategies (Overby, Bharadwaj, and Sambamurthy 2006). There are following interrelated dimensions which shape organizational agility:

- Customer Agility, which considers gaining customer's feedbacks or opinions to earn increased market intelligence.
- Affiliating Agility, which involves leveraging knowledge from distinct business partners to increase the company's response to market requests.
- Operational Agility, which involves an ability to fast process reshaping to cope with dynamic environmental and market situations (Felipe, Roldan, and Leal-Rodriguez 2017).

As very well said by (Cameron and Quinn 2006) in their seminal work 'Diagnosing and changing organizational culture based on competing values framework' that: *"No organization in the twenty-first century would boast about its constancy, sameness or*

status quo compared to ten years ago. [...] The frightening uncertainty that traditionally accompanied major organizational change has been superseded by the frightening uncertainty now associated with staying the same. Most companies are regularly failing to adopt the change because of their inability to implement cultural change accurately. To overcome this failure, the competing value framework should be applied in a company (Cameron and Quinn 2006).

Hence the competing value framework could be a reliable tool to analyze organization culture and organizational agility (Felipe, Roldan, and Leal-Rodriguez 2017); (Cameron and Quinn 2006).

2.4. Values and Principles

With the birth of "Agile manifesto" four core agile values also came into existence. These core agile values are:

- Individuals and interaction over processes and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following plan.

Following these four primary agile values, 12 agile principles were made. These principles help to make agile implementation easy and guide agile development teams to check whether they are following agile culture or not. Each agile principle emphasizes something which shows its significance. Table 1 contains an in-depth investigation of agile principles (Laanti, Similä, and Abrahamsson 2013).

No.	Emphasizes	Principles
1.	Agile has the highest priority to satisfy the customer. It can be done by delivering early and continuous valuable software.	Customer Satisfaction, Continuous and early delivery
2.	Companies and developers need to work together in an entire project.	Collaboration, Decision making
3.	Organizations must welcome varying requirements, even late in the development process.	Adaptability, Competitiveness

4.	Another vital principle of agile is the delivering developing software often with the preference of shorter timescale.	Frequent Delivery
5.	In agile, frequent delivery of developing software also help to measure the project progress.	Measure progress via deliverables
6.	Agile organizations build projects around motivated individuals. Agile provides them supportive and trusty environment.	Motivated individuals, Supportive and trusty environment
7.	In agile, face-to-face communication within a development team enhance effectiveness and efficiency.	Transparency, Efficiency
8.	In agile organization, sponsors, developers and customers must maintain constant pace to promote sustainable development.	Sustainability
9.	It is essential to increase the work which is not done yet but the team.	Work optimizing
10.	Agile framework can only achieve its best architecture, requirement gathering, and designs when there is best self-organizing team.	Self-Organization
11.	Excellent design and constant attention to technical excellence increase agility.	Focus on technical excellence and design
12.	Teams conduct regular meetings to find how to become more productive and adjust themselves accordingly.	Plan for improvement of efficiency and behavior

Table 1: Agile Principles (own representation based on ((Laanti, Similä, and Abrahamsson 2013))

2.5. Benefits of Agile Implementation

In general, agile software development methodologies are the incremental and iterative method of project management. In the following, we will find out how benefits of cost, benefits of time and benefits of quality can be achieved by maintaining the project management triangle while implementing agile software development.

2.5.1. The Iron Triangle

The agile framework delivers more benefits than the traditional waterfall approach. Although the question arises: how to achieve these benefits? The most commonly used matrix to measure project benefits is the agile iron triangle also known as the project management triangle. One of the biggest problems of the project manager is to harmonize project cost, time and scope. It is difficult to harmonize it because the change in one may affect the other two. The project manager in a company tries to keep balance among time, cost and scope but there may make trade-offs among these three during the project implementation. There are many examples of such projects that are delivered on time within the decided budget but not meeting the expectations of the customers. The successful project depends on how well the balance has been maintained among these project constraints, i.e. time, cost, and scope. The Agile triangle directs companies on how to balance and evaluate competing demands of cost, time and scope within their project (Milatic et al. 2014).
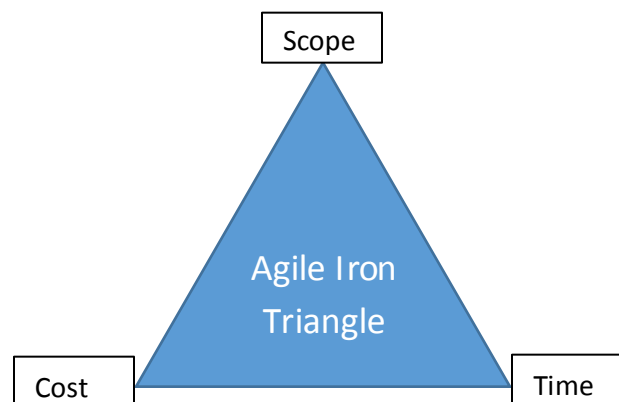
Figure 6: The Agile iron triangle (own representation based (Milatic et al. 2014))

The triangle was named an agile iron triangle because although the side can shorten or lengthen, they are unbreakable. But the three sides are joined in such a way that one side must be adjusted as the other sides do (Milatic et al. 2014). One report indicating

the success criteria as well as the success rate based on project size and methodology is shown below in table 2:

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

Table 2: Comparison of agile methodologies based on project success rate (own representation based on ((The Standish Group 2015))

Here we can see that agile (Scrum) is showing a higher chance for success as compared to waterfall. Agile emphasizes on joint working of company and customer. The real benefit of the project or company is gaining high customer satisfaction. Implementing the iron triangle in an agile software development framework opens many opportunities for a company to gain maximum benefits. Improved customer satisfaction, improved outcome and continuity, and less time-to-market are few out of many agile software development benefits. Actual benefits are always witnessed during agile implementation. In the following sub-sections of chapter 2, the benefits attached to agile methodologies implementation by maintaining an iron triangle are further explained.

2.5.2. Time (Time-to-market)

This constraint of the iron triangle implies the timetable planning of the projects, and this timetable has to be followed during the project lifecycle to achieve customer satisfaction. The activities involved in timetable planning are finding and gathering requirements, implementing features, and documentation. These activities are divided

down into smaller chunks. This practice makes the timetabling easy because the activities can be easily checked, executed, planned, and controlled. During the project development lifecycle, it may need to change the timetable because of unforeseen circumstances. The project manager monitors the changes and status of the project on the run time and updates the project development team about the changes as they occur. Regular updates about the timetable change may help the project team to remain alert and maintain the speed of deliverables (Magnusson and Smith 2015).

Regularly providing small iterative delivery phases helps better results in an agile company. If the delivery phases are too long, then the company's project can quickly turn from great opportunity into great risk. If the company is unable to provide a valuable solution to its customers in time, there could be a massive risk of losing those valuable customers.   Because other companies might be faster in offering the same project with the same needs in less time (Atkinson 1999). This risk can be avoided if the customer is fully informed about the project in advance.

A fully functional, thoroughly tested and ready product can be released to the customer in advance at the end of the project lifecycle. These short iterative delivery cycles can make things clear to the customers and help the customers to identify if there is any unforeseen issue.   Agile is not directly enhancing the ability of the staff to implement a predefined scope in less time. To reduce the time-to-market factor, the agile software development structure allows the organization to focus on the customer's highest priority features first, and released short incremental deliverables to the customers (Magnusson and Smith 2015).

    With the transformation from traditional to agile approaches, unwanted steps in the development process are eliminated, and it is one of the major benefits of agile software development methodology. The quick regular release of the small incremental deliveries helps to maintain the pace, can have instant reviews from the consumer. One project that has been heading in the wrong direction for so long without can be handled using agile incremental testing. The time saved by agile implementation will be significant. A right agile organization has a bounce-back ability. Agile organizations can react quickly, instantly, and adjust according to the current circumstance (Pollack, Helm, and Adler 2018).

2.5.3. Costs (Budget & ROI)

The total cost estimated for the project completion is called the budget. It is a time-phased cost of all the work that needs to be done in a project lifecycle (Magnusson and Smith 2015). The project life costing is the period that starts with the product's first development cycle until it is taken out for service (Milatic et al. 2014). To estimate the cost of the project company needs to look into the business needs, existing limitations for the project, requirements, and justification carried out about the project. The company has to define the activities required to implement the requested changes, e.g. the resources, the time, and the estimated cost required for those activities. Changes of this kind constitute important input to the project's overall budget (AlHarbi n.d.).

New concepts and clusters provided by agile methodologies and practices allow organizations to meet budgetary limitations while being open to new requirements. An estimate of the project cost is replaced by a budget to create values in the business sector (Pollack, Helm, and Adler 2018). Opposite to the traditional software development approach, in the agile approach budget and time are fixed constraints, while scope is a somewhat flexible constraint. In agile, a product is developed containing a set of necessary features and customer's top priority requirements. Even after giving the best cost control of the project, it is still not fully sure that all targeted features are implemented. There could be the circumstances in which the company needs to allocate extra resources to get a product ready for delivery. (Magnusson and Smith 2015)

Agile methodologies can be considered more beneficial than the traditional approach, in terms of budget and return on investment. In the waterfall approach a product that delivered in less time, less cost and high scope does not guarantee success and profit. Until the product is tested and customer feedback is collected.

On the other hand, in an agile software development approach, it is difficult to release a product that does not fulfill any customer's needs. Because in agile software development framework product is delivered incrementally and tested rapidly. In this way failures and pitfalls can be detected instantly. Therefore it will be not the wrong decision to move priorities from traditional to agile software development (Milatic et al. 2014).

In the traditional software development framework, product features are only released once the project is finished. While in the agile software development model, the most valuable features are released to the customer much earlier than final delivery. In that case, the first product features generate return in advance to the final project completion and increase the ROI while it cuts the payback period (Olteanu 2018).

2.5.4. Scope (Result and stability)

The scope constraint of the project management triangle involves the final result and quality of the finished product (Ika 2009). The scope of the project is based on the stakeholder's needs, priorities, and expectations. The scope of product quality and stability depends on the complexity of the project. A critical project is more likely to have a formal and time-intensive scope than a routine project (Magnusson and Smith 2015). A problem that appears when it comes to the scope is that whether implementing a specific feature in the product will generate value or not. Many managers tend to apply more functions in a single attempt to achieve higher performance at the expense of more time and high cost. Managers trying to deliver many features by spending extra resources tend to exploit business values. (Atkinson 1999).

The client comes first according to agile software development principle guidelines. The unique and different mindset is a significant aspect of the agile software development approach. Therefore, companies need to shift away from product-centric view: "What are the top products?" to a customer-centric view "What is the top solution for our clients"? (Ika 2009). Business values cannot be ignored while defining the scope of the project. It is better to determine the success of the project by the result of the project and feedbacks, rather than by showing the number of features implemented or by the number of the projects finished in a short period of time. Agile organizations ensure and follow such a methodology to measure success. When each and every progress activity during the product development is monitored, then it is easy to handle the project in case of project off-track (Milatic et al. 2014).

2.6. Characteristics of Agile in Software Development

In the above sections, we have discussed a lot about agile software development, its methodologies, its values and principles, and its implementation benefits. As the agile methods are not only the project development tool but it is a strategic approach for the

whole company. Improved customer satisfaction, improved outcome and continuity, and less time-to-market are few out of many agile software development benefits. Real gained benefits can always be witnessed during agile implementation. Agile software development methodology implementation in a company is not an easy and smooth task. Many changes in all business departments need to make when there are unexpected circumstances during the implementation (Olteanu 2018). In this section of chapter 2, the key characteristics of agile in software development are discussed.

2.6.1.Agile Always Starts On Top

Leaders always need to adopt a Catalyst Leadership style. These leaders inspire others in an organization without losing the unity and consistency in the entire system. Leaders develop such cohesion that they know very well they can trust every individual member of the organization. The author of the Swiss agile study named these leaders as Agile Champion. Agile champions know by their own experience that agile implementation takes place at the same time in several domains (Meier and Kropp 2015).

One European institute that transformed its entire company into agile framework described the priorities for its leaders (Lovich et al. 2018).

- **Trust.** Stay calm that not everything is planned. Let give trials, and encountered errors will show the right dimension.
- **Collaboration.** Go for the good of the company, not for that which is not good for the particular unit.
- **Openness.** Stay open to opinions on your behavior, activities, and performance.
- **No Ego.** Stay as a unit. Let everyone speak with one voice and listen to what they speak.
- **Transparency.** Maintain transparency in an organization in all activities and plans.
- **Accountability.** Everyone in a company is accountable for its task. They have to tell you about the project's progress and their role in that.

Leaders consider themselves as the role model of behavioral change. It is always hard to make commitments to new behavior than just talking about what needs to change. The most effective leader performs daily workouts in full view of their colleagues and team members that involve individuals and the leadership team action plans. These plans

reflect how well an agile leader model new behavior, how and what they communicate and how they engage the entire organization.

Command and Control, risk-averse are one of the most difficult agile behaviors. These are important for empowerment, but it does not come easy. In agile it is well said that "the hardest thing to learn is to let go." Agile leaders also reinforce transparency and accountability. As leaders empower the team more, they ask for transparency in each activity of team. Agile leaders follow a venture capital-style model of accountability to give the team more empowerment and autonomy.   For this, the leader returns to the team after every decided time period to see results, progress, and provide feedback (Lovich et al. 2018).

Agile Methodologies add the voice of the customer in the product development cycle, to enable ongoing product iteration based on continuous customer feedback. For this purpose a standardized methodology knows as DevOps, promoting purposeful communication between development and operational team to improve quality and speed of application delivery at a moderate cost. Today when every business is a software business, DevOps as a whole bring benefits to the company and contributes a lot in business performance (CA Technologies 2016).

2.6.2. Agile Challenges Company Velocity

Agile Champion cannot change the whole company at once. There could be a possibility that during the transition, one needs to face so many unexpected challenges that might affect the company's velocity.

Common challenges affecting the company's velocity include lack of experience, bad team-work, corrupt leadership, and inappropriate organizational culture. There can be several managerial challenges at the start of agile software development methodology implementation; for example the choice made by the one managerial group can conflict with the other project manager's decision. Therefore, building trust among team members is vital. Teams must trust and have confidence in their manager's decisions and should work with them with same goal in mind (Stein et al. 2017).

Besides lack of trust between teams few other things also impacts on overall company's velocity, e.g. development team pace, the pace of implementing new features, prioritizing the important activities and deprioritizing the less important activities, and the pace at which organization integrates new values (Almeida 2017). The

organization's velocity always remains a significant challenge because if the development team develops a product in two weeks, but it takes ten to twelve weeks approximately for testing and integration. One reason impacting company velocity is shifting product and features from development to operational team, in this company encounters many issues. The operational team is accountable for stability, testing and avoiding outages. Also operations team is required for adjustment of new features of the product which are taking a lot of time to in development (Cho 2008).

2.6.3. Agile Is Not Just a Process

To explain agile software development is more than a process; it is important to get familiar with the disciplines, techniques, and practices of agile craftsmanship. Craftsmanship is far more than a technique: It is an attitude. Craftsmanship involves how to reach successful agile transformation with honor, self –respect and pride. In craftsmanship an agile leader needs to work well and clean, faithful communication, the power to face difficult decisions, and honesty and clarity(Meier and Kropp 2015).

Leader had to rid of the fear of taking risks and bold decision. It might impact their professional careers. Instead, they will learn to take actions and responsibilities and to add values to the company. Agile leaders had to work flexible, for example by coming with such a good idea that prioritizes more valuable activities (Cooke 2012). Agility requires a skill set that combines flexibility and curiosity for continuous improvement. Agile team maker has to be able to identify the multi-skilled candidate, who can be the profitable, accountable and responsible(Gothelf 2014). Another broad success criterion for an organization is to give necessary training, even to highly skilled staff to immune the experience of agile culture shock.

2.7. Challenges of Agile Implementation

Agile is becoming a dominant software developing method in today's world. Many old and new companies started migrating from traditional to agile software development methodology. Many of them got succeeded, and many of them got failed in achieving agility. With the expansion of the agile software development framework, many unseen problems and challenges keep showing up in various ways. Agile involves many software development methodologies such as SCRUM, XP, TDD, etc. and all these methodologies are specialists in different software engineering practices. But it can

never say that adopting any specific methods will reduce the probability of challenges. As a result of reviewing various literatures for this research, six different major areas have emerged and each area covers several challenges. These areas are named as a development area, people conflicts area, business area, communication area, management area, and cultural area. The following table shows the challenges the company faces while implementing agile methodologies. Also, with the solution proposed to overcome those challenges.

Areas	Challenges	Solutions	References
Development area	Requirement changing throughout the project	Proper planning, conducting and reviewing meetings	(Pikkarainen et al. 2008)
	Lack of documentation	Agile promotes documentation as code. The developer adds comments while coding. It is trending in many software development companies.	(Cho 2008)
	Distinction in system and teams	Make synchronization between teams	(Boehm and Turner 2005)
	Merging industrial process with agile software development methodology	Choose and begin with the pilot project and complete it using agile software methodology before implementing entire industrial procedures.	(Boehm and Turner 2005)
	Abnormal project life cycle	Adjustment of traditional long life	(Boehm and Turner 2005)

		cycles with agile's methodology.	
	Inconsistency in the development process as per planning and final result		(Pikkarainen et al. 2008)
People conflicts area	Attitude difference between management, staff, and customer	Scrum master should be able to play a role in finding and removing any attitude difference among administration, staff, and customers.	(Boehm and Turner 2005)
	Large and geographically distributed teams	Regular Retrospective meetings meet co-located staff and regular staff interacting using JIRA or Bitbucket, etc.	(Almeida 2017)
	Slow development process due to lack of pair programming	Managers should understand the psyche of staff and figure out where and why process slowdown occurred.	(Stein et al. 2017)
	Lack of sources for pair programming	In a proper agile software development company, a system is required to monitor such as pair programming status, progress charts, and provide communication and information sharing medium.	(Boehm and Turner 2005); (Stein et al. 2017)

	Cubicles and private working space	Agile provides an open working space and face-to-face communication opportunity.	(Cho 2008)
Business area	Human traditional way of thinking.	Empowering staff to adopt a non-traditional approach.	(Boehm and Turner 2005)
	Unclear business and customer requirements	Scrum master must figure out ambiguous statements and take essential information out of the statements.	(Cho 2008)
	Misunderstanding of new agile practices		(Stein et al. 2017)
Management area	Typical plan-driven process such as creating non-code artifacts, strict work processes	Scrum master or manager must encourage greater participation of all staff.	(Almeida 2017)
	Teams unable to agree on single a consensus		(Stein et al. 2017)
	Hardships in managing long distances collocated teams	The scrum master should arrange regular scrum meetings and maintain regular interaction in the company.	(Cho 2008)
	Risk management	Ensure identification, prioritizing and control	(Almeida 2017)

	Unavailability of resources during project development		(Pikkarainen et al. 2008)
	Delay in implementation of decision due to less team agreement	The decision should be made under the supervision of all staff.	(Boehm and Turner 2005)
	Process standard rating		(Boehm and Turner 2005)
	Mistrust between customer and staff	Regular meetups with the customer to judge their satisfaction level from their feedbacks.	(Boehm and Turner 2005)
Communication area	In-sufficient Communication	Define importance of communication and provide means of communication	(Cho 2008)
	Large and geographically distributed teams	Regular Retrospective meetings meet co-located staff and regular staff interacting using JIRA or Bitbucket, etc.	(Almeida 2017)
	Less customer involvement	Keep clients the part f the project development process by mean of efficient communication.	(Cho 2008)
	Risk of tacit and false knowledge distribution		(Pikkarainen et al. 2008)
Culture area	Convincing staff to agile that has long working experience with traditional		(Almeida 2017)

	development		
	Introducing of cross-cultural knowledge		(Stein et al. 2017)
	Organization behavior	Start with regular and new changes in the old approach to adopt agile	(Almeida 2017)

Table 3: Agile implementation challenges and solutions (own representation)

3. Primary Literature Review

In every academic activity, reviewing the small or big chunk of academic literature is an essential task. For review purpose selection of actual relevant literature is a non-trivial task. In many literature reviews, it is unclear why and how they achieved their specific samples of literature. Well-explained and well-structured literature review has a higher chance of getting published. The value of review increased when nice legitimization is made for every choice during the review process(Webster and Watson 2002). Literature review is often considered as a task that can be easily done or as something which is evident but in real-life practice, it considerably opposite as what is believed. Research literature reviews are done for various purposes. These reviews involve providing a theoretical background for research, answering the particular research questions by understanding and learning the breadth of research on a specific topic of interest (Okoli and Schabram 2010).

It is not realistic to expect readers to be familiar with all of the relevant background and pre-existing knowledge about the chosen topic. The literature review builds a good trusty relationship between the author and the reader. The reader comprehends why and how the author has chosen a specific book or article. The issues targeted by the systematic literature review are literature finding, properly evaluating and integrating all the quality literature that is directing to various research questions. To find out what a high standard literature review includes, it is very well summed up by these authors in their work. (Baumeister and Leary 1997); (Okoli and Schabram 2010); (Webster and Watson 2002).

An excellent systematic literature review must fulfill the following:

- Find gaps, conflicts, inconsistency, and relation in the studies and find out reasons for it.
- Figure out to what extent the existing studies are addressing and clarifying a specific issue.
- Establish general statements instead of summarizing those theories what else have made.
- Assess, expand, comment, or establish a hypothesis.
- While implementing these things, offer suggestions for future work.

- Also, offer direction for future work if necessary.

Therefore systematic literature review is a piece of research in which more broaden research questions can be addressed. According to (Siddaway 2014), systematic literature review lies at the top of the hierarchy of literature review as it can provide most real-world inference.

Authors (Okoli and Schabram 2010) in one of their working paper represents the guidelines for conducting a systematic literature review. Those guidelines represent the features and values of systematic review. The following figure will give a short overview of the steps involved in the general systematic literature review:
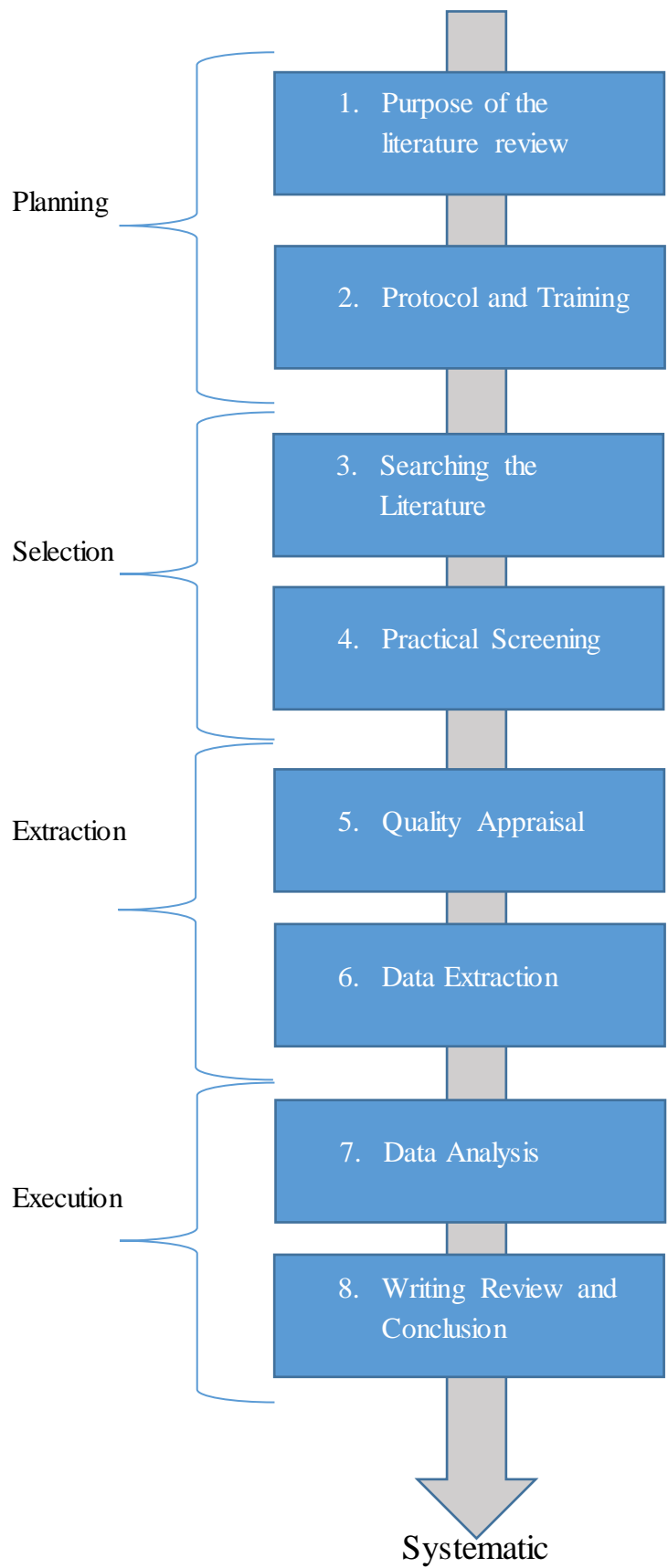
Figure 7: Steps of systematic Literature Review (own representation based on ((Okoli and Schabram 2010))

3.1. Overview of Some Literature Review Methodologies

In this chapter, an overview of some literature review methodologies is discussed. After explaining and analyzing these literature review methodologies, in the next section comparison of these methodologies is mentioned. In the end, one methodology is selected for a systematic literature review on the topic of Agile Software development implementation.

3.1.1. Composite Research: A guide to write a systematic literature review (Piper 2013)

Author Rory J. Piper, as a researcher at the University of Edinburg, described a guide for medical students, how to write a systematic literature review. University of Edinburg was the college of Medicine and Veterinary Medicine. (Piper 2013) Described that active systematic reviewing is a very important skill in a scientific study when encountered with any research question. It helps the researcher in identifying the relevant literature, its gaps, quality, and limitations. The poorly done systematic literature review can be misleading and proper planning and execution of the research design can minimize this risk.

Generating a Hypothesis

A hypothesis is defined by the author as an anticipated explanation for an observation, one that can be examined (scientific hypothesis) or can be extended (working hypothesis). (Piper 2013)

Review of the literature of already existing and relevant studies to test the hypothesis is the same as any experimental investigation. A hypothesis is formed by synthesizing the research process. A blur question is more likely to take to an unclear answer. Author advised to limit review question and aims in synchronized systematic research as discussed below (Piper 2013):

Search the Literature

The first question while starting your search arises "*What to search*." To maintain a balance in specific and board searching is difficult sometimes. An appropriate "search string" with well suitable and well-selected keywords can help in searching relevant

topics. It is essential to list down your keywords as they can be required later to state in the manuscript.

Besides "what to search," the other question which mostly arises "*Where to search.*" There are a lot of powerful literature search engines available. There are differences in these sources and therefore need to be careful while searching, that data should be relevant. That is why the use of multiple search engines is suggested in systematic literature research.

Managing your findings

The inclusion and exclusion process of the searched literature during the research must be performed strictly. The selection of the literature should be performed according to the research questions or aim of the research.   Even in exclusion process, the rejected literature must be recorded. Both inclusion and exclusion criteria contain the rules for selecting and not selecting the literature.

After this process, the discussion process is conducted. This process aims to integrate the findings from various literatures. Literature is then properly evaluated, analyzed, highlight the conflict and suggest future work.

Interpreting your findings

In this last step, meta-analysis is conducted, if enough qualitative or quantitative data is found. This meta-analysis is performing using different statistical methods to assess and present information gathered by studies.

3.1.2. Rigorous Systematic Literature Review (Kitchenham 2004)

Author Barbara Kitchenham from Keela university, Newcastle UK worked on a joint report with Empirical Software Engineering National ICT Australia Ltd, Eversleigh Australia. The objective of this report was to recommend a detailed systematic literature review appropriate for the researcher from software engineering. The author in this report defined the importance of a systematic literature review. The report says searching strategy must be predefined to conduct a systematic literature review. Researchers must put effort into identifying and reporting the literatures that are directly relevant to the research questions (Kitchenham 2004).

Following are the key phases to perform the systematic literature review process (Kitchenham 2004):

1. Planning review process
   - Identification of the need for the review
   - Development of the review protocol
2. Conducting review process
   - Identification of the literature
     i. Specifying the research questions
     ii. Searching Strategy
     iii. Searching keywords
   - Selection of the literature
     i. Literature selection criteria
     ii. Literature quality assessment
     iii. Literature selection process
   - Data extraction
   - Data analysis
3. Presenting review process
   - Showing the review results

This methodology aimed to enable more systematic and transparent review, especially in complex and dynamic fields. Author Kitchenham also worked on another paper with some other authors from the department of computer science, Durham University UK. In this paper author (Kitchenham et al. 2009) conducted a complete systematic literature review and also he implemented all the steps of systematic literature review mentioned in (Kitchenham 2004) joint report.

3.2. Comparison of Methodologies

In the above-defined systematic literature review methodologies, one is more detailed than the other. As a researcher, what I understand from these two above methodologies is that the literature review methodology from Piper is based on hypothesis testing. Hypothesis is a supposition that is based on limited evidence. Hypothesis testing made in Piper methodology was limited systematic research. This methodology was undertaken without any predefined search strategy. This methodology is appropriate for

small and limited types of research. The literature managing process was somehow competitive, as Piper methodology also mentioned the importance of literature selection criteria. But interpreting the final findings is not very well defined. Overall, steps are not very much tricky and it is nevertheless very complex if someone follows Piper methodology.

On the other hand, a rigorous systematic literature review by Kitchenham is more detailed and dynamic. The complete review process comprises of three major phases. The good thing is that the review starts by defining the review protocols that demonstrate the need for review and methods that will be conducted during the literature review. In this methodology, predefined protocols help to specify the research question, searching strategy including searching terms, literature selection criteria, data extraction and synthesis. Kitchenham review methodology is also very discrete, unbiased and fulfilling all necessary steps of the rigorous systematic literature review.

3.3. Chosen Methodology

Rigorous literature review by (Kitchenham 2004) is the best appropriate methodology for this thesis as this methodology is accustomed to dynamic and variable topics like the sector of software engineering. Because of the iterative nature, it is transparent and traceable for the reader and the reviewer himself. Rigorous review is such a well-defined and clear systematic literature review that there is less probability that results of literature are biased. However, the author (Kitchenham 2004) himself mentioned that a systematic literature review requires more effort than a traditional literature review.

4. Systematic Literature Review

"Rigorous literature review" will be applied in this chapter for the topic of implementation of Agile Software Development methodology. The systematic literature review methodology undertaken for this study is based on the guidelines of (Kitchenham 2004). All the steps of the literature review are documented and mentioned in the following subchapters.

4.1. Planning Review Process

Talking about the phases of the Kitchenham literature review, the first phases is about "planning the review process," which includes identifying the need for review and development of review protocols.

- **Identifying the need for review**:

This phase is performed to check either there is a need for systematic review or not. The need for the review arises when researchers want to summarize all existing information about the topic in a well-organized, balanced, thorough and fair manner (Kitchenham 2004). In this thesis each of the research questions needs to be answered through a systematic scientific approach, to make results and the outcomes measurable, comparable and standardized. To achieve this goal thorough and unbiased literature review is mandatory.

- **Development of review protocol:**

According to the joint report of (Kitchenham 2004), developing a review protocol specifies the procedure or method that will be adopted during the systematic literature review. This phenomenon of pre-defined review protocol helps to reduce the chances of biased research. In this research, the elements of review protocol are the following:

- o Specifying research questions
- o Searching Strategy
- o Searching keywords
- o Literature inclusion/exclusion criteria
- o Literature selection process
- o Data Extraction
- o Data Analysis

4.2. Conducting Review Process

4.2.1. Specify the Research Questions:

The research questions formulated for this study are:

- What are the cultural aspects of company agility?
- What are the values and principles of agile implementation in a company?
- What are the benefits of agile methodologies in a company?
- What are the challenges faced while implementing an agile methodology?

4.2.2. Searching Strategy

Initially, the trial research was conducted with a wide scope. The scope was set to get a clear idea about the topic of "agile software development implementation in a company." As agile software development is a very widely expended topic in different disciplines. It was very important to properly understand the basics of the research topic and what is precisely asked to research. Initially, the necessary trial research to create a core understanding of the research topic was made using keywords such as "agile implementation," "agile software development".

Basing on the initial trial research, search results, and keywords, the research questions have been specified, as mentioned in section 4.2.1. Once the final research questions are determined, the next step was to re-identify the search keywords and formulate new search strings. These strings are then used to conduct the new search for searching literature relevant to answer the research questions. The list of digital databases was also increased to search for relevant literature. The following databases are used to search published literature:

- Google Scholar
- Research Gate
- Science Direct
- Jstor
- Academia

Multiple digital databases, as mention above have been used for searching relevant literature, but mainly used are "Google Scholar" and "Research Gate." It has been done

to avoid duplication because the same articles available on these two databases are also available on other digital databases. Other databases as mentioned above were not excluded from searching because those articles which were available in paid version on one database were available for free on different databases. On the other hand, virtual network protocol (VPN) from the University of Koblenz-Landau plays an essential role in finding journal articles.   The research done in this thesis was also limited to the literature published in the English language and available in databases mentioned above. The search was also limited to the article's title, abstract, and keywords to decrease the irrelevant hits. Further limitations you can find in section 4.2.4.
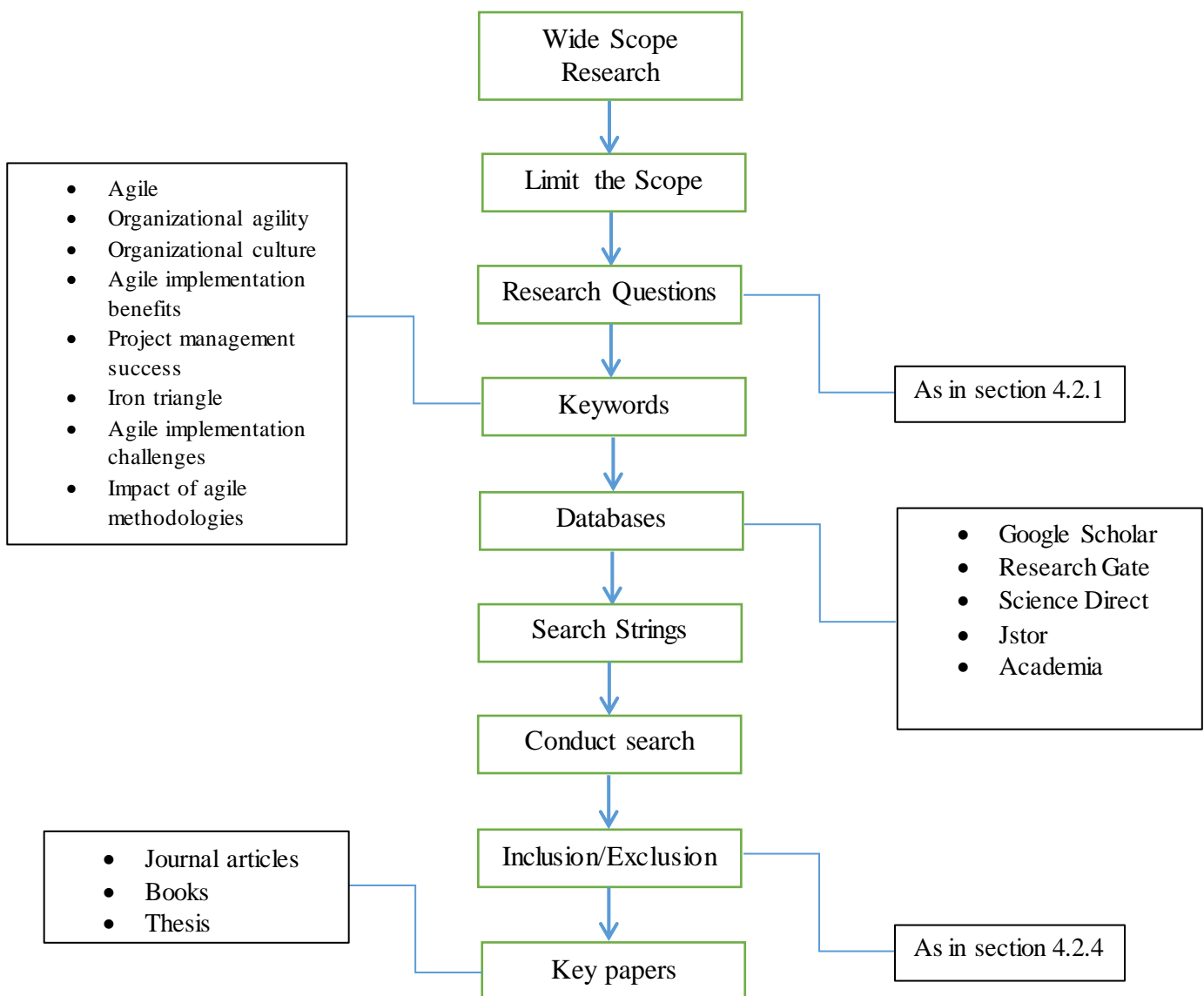
Figure 8: Searching strategy (own representation)

The next sub-section of this chapter will help you understand the search strategy more clearly along with the results.

4.2.3.Searching Keywords

According to the (Kitchenham 2004) joint report defining the search terms or keywords used for searching is also a crucial part of conducting the review process. Keywords used for searching should lead to a perfect formulation of the search strings and should create a foundation for the entire scope of chosen research.

The following keywords used for the search in this thesis:

- Agile
- Organizational agility
- Organizational culture
- Agile implementation benefits
- Project management success
- Iron triangle
- Agile implementation challenges
- Impact of agile methodologies

The keywords as mentioned above were combined using Boolean AND's or OR's to formulate the search strings. The main objective of doing this was to guarantee the scope of clear systematic review. Therefore, all alternatives synonyms of the keywords were considered during the search, i.e., success factors, implementation failure, cultural aspects, etc.

4.2.4.Literature Inclusion/Exclusion Criteria:

As mentioned by (Kitchenham 2004), literature selection criteria are aimed to identify the literature that directly refers to the research questions. The study selection is multistage process. The inclusion/exclusion criteria defined for this research is as follow:

Initial inclusion was based on the articles abstract because the full-text version was not available for many of the literature and it was difficult to pay for the paid articles. Those pieces of literature have been included which directly talk about the agile manifesto and agile software development implementation, agile transformation, agile implementation challenges and benefits. Only those literatures have been included that provide direct evidence about the research question. Apart from journal articles and conference

proceedings, few books and thesis are also included which are directly relevant to our research questions.

Literatures have been excluded that deal with the agile in general but do not provide direct evidence about the research questions. Exclusion of the literatures is also done by reading the articles abstract. Those literatures were also excluded that were not available for free. Literatures with incomplete results or in-progress research were also excluded.

4.2.5.Literature Selection Process

The literature selection was a multistage process. As mentioned above, initial inclusion and exclusion of the literature were done by reading the title and abstract. Once after reading the abstract thoroughly, those literatures which provide direct evidence about the research questions were downloaded in full text. In the first literature selection round, the downloaded numbers of literatures were 192.

The second round of selecting relevant literatures was performed by following inclusion and exclusion criteria, 72 literatures were then chosen including journal articles, conference proceedings, books, reports, and thesis. The full text of all 72 chosen literatures was again thoroughly examined. During the full-text literature reviewing, the inclusion and exclusion process again took place. After performing this some good results were found.

Following is the list of found journals, conference proceedings for this research:

Journals and Conference Proceeding	No's of articles selected
European Journal of Information Systems	1
Int. J. Innovation and Learning	1
Sustainability	1
Economy Informatics	1
Communications in Computer and Information Science	1
World Journal of Computer Application and Technology	1

IEEE SOFTWARE	1
Empirical Software Engineering	1
Issues in Information Systems	1
MIS Quarterly	1
International Journal of Industrial Ergonomics	1
International Journal of Medical Informatics	1
International Journal of Project Management	1
Project Management Journal	2
International Journal of Managing Projects in Business	1
8th International Quality Conference	1
Proceedings of 50th Hawaii International Conference on System Sciences	1
European Journal of Marketing	1

Table 4: Found journals and conference proceedings (own representation)

It was observed during research that a very wide time period is covering researches on the topic of agile software development. The topic of agile software development is widely expended. Also, different digital databases include hundreds of journal articles, conferences proceedings and books on topic of agile software development implementation each year. Due to this, in this research it was hard to declare the total numbers of articles found in each database. Following table shows the numbers of chosen articles from respective databases:

Databases	First Selection	Second Selection	Final Selection
Google Scholar	64	21	7
Research Gate	56	28	9
Science Direct	23	5	2
Jstor	28	11	2
Academia	21	7	3
Total	192	72	23

Table 5: Total first and final selection of literature (own representation)

By applying the forward and backward citation and snowballing techniques, the following 23 literatures were finally selected, fitting to the research topic.

Literature	Title	Author	Year	ID
Journals				
MIS Quarterly	Review: A Review of Culture in Information Systems. Research: Toward a Theory of Information Technology Culture Conflict	Leidner, DorothyE & Kayworth, Timothy	2006	S1
Int. J. Innovation and Learning	Assessing the links between organizational cultures and unlearning capability: evidence from the Spanish automotive components industry	Leal-rodríguez, Antonio Luis & Morales-fernández, EmilioJ & Ariza-Montes, José Antonio & Eldridge, Stephen	2016	S2
Economy Informatics	IT Agile Transformation	Olteanu, Cristian Gabriel	2018	S3
IEEE Software	Management challenges to implementing agile processes in traditional development organizations	Boehm, Barry & Turner, Richard	2005	S4
International Journal of	What is the Iron Triangle, and how has it changed?	Pollack, Julien & Helm, Jane &	2018	S5

Managing Projects in Business		Adler, Daniel		
International Journal of Medical Informatics	Cultural aspects of information technology implementation	Demeester, Michel	1999	S6
International Journal of Industrial Ergonomics	A review of enterprise agility: Concepts, frameworks, and attributes	Sherehiy, Bohdana & Karwowski, Waldemar & Layer, John K.	2007	S7
European Journal of Information Systems	Enterprise agility and the enabling role of information technology	Overby, Eric & Bharadwaj, Anandhi & Sambamurthy, V.	2006	S8
Sustainability	Impact of Organizational Culture Values on Organizational Agility	Felipe, Carmen M. & Roldan, Jose L.& Leal-Rodriguez, AntonioL.	2017	S9
International Journal of Project Management	Project management : cost , time and quality , two best guesses and a phenomenon , it's time to accept other success criteria	Atkinson, Roger	1999	S10
Issues in Information Systems	Issues and challenges of the Agile Software Development with Scrum	Cho, Juyun	2008	S11
World Journal of Computer Application and Technology	Challenges in the Migration from Waterfall to Agile Environments	Almeida, Fernando	2017	S12
Project Management Journal	Project Success as a Topic in Project Management Journals	Ika, Lavagnon A	2009	S13
Empirical	The impact of agile practices	Pikkarainen, M. &	2008	S14

Software Engineering	on communication in software development	Haikara, J. & Salo, O. & Abrahamsson, P. & Still, J.		
Project Management Journal	New possibilities for project management theory: A critical engagement	Cicmil, Svetlana & Hodgson, Damian	2006	S15
European Journal of Marketing	Relation between organizational culture, identity and image	Schultz, Majken & Hatch, Mary Jo	1997	S16
Conference Proceedings				
8th International Quality Conference	Project management : cost , time and quality	Milatic, Slavia & Stajcic, Dejan & Stojcetovic, Bojan & Lazarevic, Dragan & Prlincevic, Bojan	2014	S17
Proceedings of the 50th Hawaii International Conference on System Sciences		Challenges in Transitioning to an Agile Way of Working	Stein, Mari-klara & Rossi, Matti & Hekkala, Riittia & Smolander, Kari	2017	S18
Communications in Computer and Information Science	Definition of Agile Software Development and Agility	Laanti, Maarit & Similä, Jouni & Abrahamsson, Pekka	2013	S19
Thesis				
	The Project Management Triangle: a hidden framework? A qualitative study of ERP implementations in Sweden	Magnusson, Frida & Smith, Jonathan	2015	S20
	The Balancing between Scope, Time, and Cost	AlHarbi, AbdulAziz Hameed		S21
Books				

Organizational Culture and Leadership	Schein, Edgar H.	2004	S22
Diagnosing and Changing Organizational Culture Based on the competing value framework	Cameron, Kim S. & Quinn, Roberte.	2006	S23

Table 6: Selected literature (own representation)

4.2.6. Literature Quality Assessment

According to (Kitchenham 2004) in addition to inclusion/exclusion criteria, is it also consider essential to assess the quality of the selected literature for the research. This process is done to improve the inclusion criteria. Following quality assessment questions were made to evaluate the selected literature quality:

- QA1: Were the study's main objective/hypothesis described?
- QA2: Were the study's research methodology described?
- QA3: Were the study covers topics relevant to the research?

Score scale for each question is Yes (1), No (0) and partly (0.5) and in the end, summed up the score depending on the numbers of quality assessment questions answered in a paper. Partly mean that if any of the questions mentioned above is implicitly mentioned in the study. The result of the literature quality assessment is shown in table below:

Title	QA1	QA2	QA3	Total Score
Review: A Review of Culture in Information Systems. Research: Toward a Theory of Information Technology Culture Conflict	1	1	1	3
Assessing the links between organizational cultures and unlearning capability: evidence from the Spanish automotive components industry	1	1	1	3

Cultural aspects of information technology implementation	1	0	1	2
Enterprise agility and the enabling role of information technology	1	0	1	2
Impact of Organizational Culture Values on Organizational Agility	1	1	1	3
A review of enterprise agility: Concepts, frameworks, and attributes	1	0	1	2
Project management : cost , time and quality , two best guesses and a phenomenon, it's time to accept other success criteria	1	0	1	2
Project Success as a Topic in Project Management Journals	1	1	1	3
What is the Iron Triangle, and how has it changed?	1	1	1	3
New possibilities for project management theory: A critical engagement	1	0	0	1
IT Agile Transformation	1	1	1	3
Challenges in the Migration from Waterfall to Agile Environments	1	1	1	3
Management challenges to implementing agile processes in traditional development organizations	1	0	1	2
The impact of agile practices on communication in software development	1	1	1	3
Issues and challenges of the	1	0	1	2

Agile Software Development with Scrum				
Project management : cost , time and quality	1	0	1	2
Relation between organizational culture, identity and image	1	0	0	1
Challenges in Transitioning to an Agile Way of Working	1	1	1	3
Definition of Agile Software Development and Agility	1	0	1	2
The Project Management Triangle: a hidden framework? A qualitative study of ERP implementations in Sweden	1	0.5	1	2.5
The Balancing between Scope, Time, and Cost	1	0	1	2

Table 7: Literature quality assessment (own representation)

After performing the quality assessment, I found that there are two literatures with quality score equal to 1. Due to low scoring and less relevance to the research topic, these literatures were excluded from the research. This quality assessment test in this research was only performed for literature, i.e., journal articles, conference proceedings, and thesis.

4.2.7. Data Extraction

According to (Kitchenham 2004), the objective of this part is to come up with a data extraction form that accurately records the information the researcher obtains from literature. This form must contain all the necessary information required to address the research questions. Following is the data extraction form for this research. Source IDs in the following table reflect the values assigned in table 6, i.e., title, journal, author, and year. Due to the page restriction source IDs have been used.

ID	Author	Research Type	Topic Area	Excerpts	Quality score
S1	(Leidner and Kayworth 2006)	Systematic literature review	Culture in IS Research (national and organization level)	IT's influence on research; IT Culture; Culture and IT systems development; Culture IT adoption and diffusion; Culture, IT use and outcomes; IT culture	3
S2	(Leal-rodríguez et al. 2016)	Meta-Analysis	Organizational cultures and unclearing capability	Organizational culture affects organizational unclearing; Adhocracy culture; Clan culture; Market culture; Hierarchy culture; partial least square model & Structural equation model for hypotheses testing	3
S3	(Olteanu 2018)	Conventional Literature review (Case study based)	Agile adoption as project management approach	Important pre-requisites for agile implementation; organization culture as biggest challenge in agile transformation; Efficient knowledge management in important;	3
S4	(Boehm and Turner 2005)	Empirical research	Project management challenges to implement agile processes	Agile process; development conflicts; people conflicts; business process conflicts	2
S5	(Pollack, Helm, and Adler 2018)	Systematic Literature review	Concepts of Iron triangle	Limitation of Iron triangle; Disputed third vertex of iron triangle; common core of iron triangle;	3
S6	(Demeester 1999)	Empirical research	Detecting and	Culture operational view; Cultural influence on project life	2

			resolving culture-based conflict in IT	cycle; Change Governance Framework; Culture sets values and norms in the decision-making process, Adhoc culture	
S7	(Sherehiy, Karwowski, and Layer 2007)	Empirical research	Agile manufacturing	Adaptive and flexible organization; agile attributes and practices; workforce agility; workforce adaptability; measuring of agility	2
S8	(Overby, Bharadwaj, and Sambamurthy 2006)	Empirical research	Enterprise Agility	Distinction from enterprise agility; similar concepts; Enterprise agility sensing and responding capabilities; Strategy to measure enterprise agility	2
S9	(Felipe, Roldan, and Leal-Rodriguez 2017)	Meta-Analysis	Linking organization culture and organizational agility	Impact of organizational culture to organizational agility; Four types of cultures; Models for hypotheses testing;	3
S10	(Atkinson 1999)	Empirical research	iron triangle, measuring project management success	Project management; Criteria of success; The Square root framework; asserted cost and time are only guesses and quality as phenomenon	2
S11	(Cho 2008)	Empirical research	Issue and challenges with Scrum	Characteristics of traditional agile software development; comparison between them; Artifacts of scrum; Five issues and challenges must be resolved	2

				before launching agile project	
S12	(Almeida 2017)	Systematic Literature review	Key challenges in-migration from traditional to agile methodolog ies	Four dimensions of challenges; Dimension includes organization and management, process, people, tools	3
S13	(Ika 2009)	Conventional Literature review	Project managemen t success factors	Project success criteria; Project success factors; links between success criteria and success factors	3
S14	(Pikkarain en et al. 2008)	Conventional Literature review	Agile practices affect communicat ion in a focal company	increase understanding of communication in agile software development; pros and cons of increasing communication process; Impacts on internal and external communication; communication hurdle between developer and stakeholder	3
S17	(Milatic et al. 2014)	Empirical research	Cost, time and Scope to measure project success	Iron triangle; Benefits of cost, time and scope; inter-relation of iron triangle	2
S18	(Stein et al. 2017)	Conventional literature review	Challenges of transitionin g software developmen t team to agile	Principles of agile; organizational challenges; management challenges	3

S19	(Laanti, Similä, and Abrahamsson 2013)	Empirical research	Agile manifesto and agile principle	Emphasis on agile principles; Agile manifesto; declaration of interdependence; definitions of agile and what it emphasis	2
S20	(Magnusson and Smith 2015)	Systematic Literature review	Relevancy of project management triangle and ERP system implementation	Success factors of ERP system implementation; Issue of ERP system implementation; project management triangle	2.5
S21	(AlHarbi n.d.)	Empirical research	Balance between time, cost and scope	Triple constraints triangle; project balance; Interacting between major project dimensions	2
S22	(Schein 2004)	Text Book	Structure of organizational culture and the role of leadership	Define organizational dimensions of the culture; Leadership role in creation and management of culture; culture divided into three levels	
S23	(Cameron and Quinn 2006)	Text Book	Diagnose and initiate change in culture	Valid instrument for diagnosing cultural and management competency; framework of understanding organizational culture; systematic strategy for changing organizational culture and personal behavior; divided seven chapters	

Table 8: Data Extraction (own representation)

4.2.8. Data Synthesis

In this part, I tried to summarize, combine, or synthesize the pertinent data acquired from the selected publications for this research and also analyze the relevancy of the literatures with the particular research question. The literatures which were searched and collected from multiple digital databases are used to present the findings. The data extracted from the journal articles, conference proceedings, thesis, and books using reading all text, excerpts and topic areas are synthesized by the data synthesis approach. The following table also shows literature intervention to answer specific research question. Source IDs in the table below directly relate to all the values assigned in table 6 & 7. Literature's data is used in splits (using IDs) to avoid data overflow and redundancy.

RQs	ID, Author	Findings	Extent (in this research)
	S1, (Leidner and Kayworth 2006)	Culture has a direct or indirect influence on IT. Understanding of culture is vital to study IT at national and organizational cultural levels. The authors in this paper reviewed the literature to understand the linkage between IT and culture. Authors encountered two streams of research, i.e., national-level (cross-cultural studies) and organizational level. From analysis, the author develops the theory of IT, values and conflict.	Fully
Cultural aspects of organizational agility	S2 (Leal-rodríguez et al. 2016)	In this paper, the authors shed light on the current relationship between different culture typologies and organizational unlearning. Organizational unlearning is a way of removing old working trends and make way for new ones. The author implements famous framework 'competing value framework' from "Cameron and Quinn" to assess the influence of company's cultural on organizational routines. Authors used two techniques partial least square path modeling and variance-based structural equation modeling to determine this relationship. The authors concluded that adopting organizational culture and unlearning might be the first step in learning. Continuous	Fully

		and dynamic learning and unlearning approach lead company to sustain long term advantages.	
	S6 (Demeeste r 1999)	Culture sets our values and norms that guide us to the decision making process. The author in this article has reduced the culture to seven dimensions framework. The structure and dynamics of decision making process are described as Change Governance Framework. The purpose of this framework is to control aspects of decision making that are sensitive to cultural preference. Decision-making culture refers to 'Adhoc' type to culture.	Fully
	S7 (Sherehiy, Karwowsk i, and Layer 2007)	In this paper, existing knowledge of agile manufacturing and agile workforce has been reviewed. This paper contains comprehensive characteristics of agility that can be applied to an enterprise e.g. organizational adaptability, organizational flexibility, reactiveness and culture of change.	Fully
	S8 (Overby, Bharadwaj , and Sambamur thy 2006)	The ability of an organization to sense environmental change is the prominent aspect of company success. Authors in this paper define enterprise agility, outline enterprise agility from similar concepts, explore the capabilities of enterprise agility and explain the enabling role of information technology. The authors also propose a methodology to measure enterprise agility.	Fully
	S9 (Felipe, Roldan, and Leal-Rodriguez 2017)	It is essential to develop capabilities to adapt and offer a quick response to culture change, to remain competitive. This paper presents analysis of two relevant research gaps: (i) the relationship that determines the impact by each four organizational culture typologies, i.e. Clan, Adhocracy, Hierarchy, and market, comprised in competing value framework on organizational agility. (ii) The unseen effects of environmental factors. To test the research model and hypothesis authors used two modeling techniques, i.e. partial least square path, and variance-based structural equation.	Fully
	S22 (Schein 2004)	The author, in his book attempts to show the structuring and functioning of organizational culture and the role played by the leadership in creating and managing culture. Author added	Fully

		materials based on more recent clinical research to make the concept more vivid by identifying more of organizations with whom author has worked over years. This edition is organized into three parts: First part focus on organizational and occupational function. How to think about them, how to analyze them and leadership issues are highlighted. The second part consists of the content of culture. In a sense, culture cover all of the give group's life; therefore content is in principle, endless and vast. The author in this part develops some set of dimensions that are useful in making sense of cultural landscape as applied to organizations. In the third part, author shifted his focus to leader as founder, manager. Also leader is considering a victim of culture if he does not understand how to manage culture. The issues that leader faces at each of these different organizational growths are because the role culture plays at each stage is totally different. The author concluded that culture humility could not be achieved unless we see cultural assumptions with ourselves. In the end, cultural understanding and cultural learning start with self-insight.	
	S23 (Cameron and Quinn 2006)	In this book, authors represent their own observation that organizations often fail during changing and improvement efforts because of the inability to understand culture change. Authors also present their conviction that the competing value framework can be applied to several aspects of organizational and personal performance. Authors have written this book also to share tools and procedures own empirical research, and consulting experience has found. This book offers three contributions: (1) validated instruments for diagnosing organizational culture and management competency. (2) Theoretical framework to understand organizational culture. (3) Systematic strategy to change organization culture and personal behavior. This book is also an information source for explaining a robust framework of culture types. This book consists of seven chapters and five appendixes.	Fully

	S19 (Laanti, Similä, and Abrahams son 2013)	Authors suggested that the agile manifesto and agile principles are referred to as the definition of agile and agility. The authors researched many definitions in this article and examined where each definition emphasizes and which emphasis we found in agile principles. The author concluded that people do mean many things when they talk about agile software development and agility. It is better to understand other person's perceptions about agile before creating too many misunderstandings.	Fully
Agile implementation Values and Principles	S11 (Cho 2008)	The agile practice has been developed and evolved since the early 1990s. In this paper, the author explains the difference between agile and traditional software development practices. The author introduced the characteristics of Scrum methodology and also explored the issues and challenges appeared in a company that has implemented Scrum. This paper presented five challenges and issues related to communication, documentation, user involvement, working environment.	Partly
	S18 (Stein et al. 2017)	The authors in this research examined how the project development team, management and supplier understood the agile way of working and how this understanding changed over time. Obvious challenges for agile transition include lack of experience with agile development, no common view on agility, its key principle and practices. Authors suggest that large complex agile projects need to have very high-level clear objectives, architecture and management control derived from them.	Partly
Benefits of agile implementation	S3 (Olteanu 2018)	This paper includes a discussion about Knowledge management for IT agile adoption based on organizational change. Knowing knowledge management challenges and favorable circumstances are the pre-requisite of IT agile adoption. The author concluded whole organization is impacted by agile adoption at the project management approach. The author also found organizational culture as the biggest challenge for agile transformation.	Partly
	S5	Authors explore which concepts are the parts of	Fully

	(Pollack, Helm, and Adler 2018)	the iron triangle and which have changed over time. The iron triangle is also known as triple constraint, is a central concept of project management practice. Authors found that cost and time are constant parts of the iron triangle, but scope is contested. Authors concluded that they found significant links between time, cost and scope which verify these concepts as vertices of the iron triangle. Authors created the network for time, price, and scope and found that these concepts are highly interconnected. Scope, performance, requirements, and quality could all be interchangeable as third vertex of iron triangle, but presence is mandatory.	
	S10 (Atkinson 1999)	The project management triangle has been used to measure the success of the project for many years. The author in this paper defines project management, the criteria for success and why project management is so reluctant to adopt an iron triangle instead of other criteria. In this paper, authors propose a new framework 'The square root' to consider success criteria.	Fully
	S13 (Ika 2009)	The author is this research analyzes concepts like project management success, project success, success criteria, and success factors.	Fully
	S17 (Milatic et al. 2014)	The authors in this research illustrate the importance of project management: cost, time, and quality. According to them just completing the project is not sufficient, because the project must be of acceptable quality. The authors presented the elements of project management triangle and connection between them.	Fully
	S20 (Magnusson and Smith 2015)	The project management triangle is a framework that is generally used to control the three main factors that affect project success. This thesis aims to investigate the relevance of this triangle framework when it comes to the ERP-implementation. To find this author has conducted interviews and a more casual form of dialog with employees and customers in IT company which is specialized in ERP-implementation. And the authors concluded that information regarding this was not always matching and it is not still applicable to ERP	Fully

		systems since they show deviation in different aspects. ERP implementation is dynamic so interdependencies tend to vary every time. To achieve better project results, one must keep in mind that they should facilitate communication more often.	
	S21 (AlHarbi n.d.)	This paper addresses the dynamic interaction that takes place between characteristics of a product, development cost, development time and quality in a system environment. The author mentioned different scenarios resulting that all three concepts of project management triangle are interrelated in a way that if quality decreases and time decreases then cost might increases. Good agile software development practice is to maintain balance between project management.	Fully
Challenges of Agile implementation	S3 (Olteanu 2018)	This paper includes a discussion about Knowledge management for IT agile adoption based on organizational change. Knowing knowledge management challenges and favorable circumstances is the pre-requisite of IT agile adoption. The author concluded whole organization is impacted by Agile adoption at project management approach. The author also found organizational culture as the biggest challenge for agile transformation.	Fully
	S4 (Boehm and Turner 2005)	Authors in this article figure out some challenges that are targeting agile and traditional software development practices. Authors came up with a collection of change-related challenges and almost 40 perceived barriers to agile implementation.	Fully
	S6 (Demeeste r 1999)	Culture sets our values and norms that guide us to decision making process. The author has reduced the culture to seven dimension framework. The structure and dynamics of decision making process are described as Change Governance Framework. The purpose of this framework is to control aspects of decision making that are sensitive to cultural preference. Decision-making culture refers to 'Adhoc' type to culture.	Partly
	S11 (Cho	The agile practice has been developed and evolved since the early 1990s. In this paper	Fully

	2008)	author explains the difference between agile and traditional software development practice. The author introduced the characteristics of Scrum methodology and also explored the issues and challenges appeared in a company that has implemented Scrum. This paper presented five challenges and issues related to communication, documentation, user involvement, working environment.	
	S12 (Almeida 2017)	Technical and organizational level challenges faced by migration from traditional (waterfall) to an agile environment. The author has addressed four dimensions and a total of 49 sub-dimensions of problems. These dimensions include people, organizational and managerial, tools and process. Also, author came up with the discussion to mitigate these challenges.	Fully
	S14 (Pikkarain en et al. 2008)	The research focuses on exploring the impact of XP and Scrum related to communication in a focal company. The research was carried out in F-secure where two software development projects were compared from the communication perspective. To enhance the communication between developer, project leader, and stakeholder is the primary goal. This study indicated that agile software development in the projects has a positive effect on internal and external communication. However, hurdles are still present in communication between developers and stakeholders.	Fully
	S18 (Stein et al. 2017)	The authors in this research examined how the project team, management and supplier understood the agile way of working and how this understanding changed over time. Obvious challenges for agile transition include lack of experience with agile development, no common view on agility, its key principle, and practices. Authors suggest that large complex agile projects need to have very high-level clear objectives, architecture and management control derived from them.	Fully

Table 9: Data Synthesis (own representation)

Following table 10 shows which literatures are thoroughly discussing the respective research question and which are partly. Following table is just a simple representation of table 9, showing the relevancy of literatures to research questions:

Title	Cultural aspects of organization agility	Values and Principles	Benefits of agile implementation	Challenges of Agile implementation
Review: A Review of Culture in Information Systems. Research: Toward a Theory of Information Technology Culture Conflict	X			
Assessing the links between organizational cultures and unlearning capability: evidence from the Spanish automotive components industry	X			
IT Agile Transformation			X*	X
Management challenges to implementing agile processes in traditional development organizations				X
What is the Iron Triangle, and how has it changed?			X	
Cultural aspects of information technology implementation	X			X*
A review of enterprise agility: Concepts, frameworks, and attributes	X			
Enterprise agility and the enabling role of information technology	X			
Impact of Organizational Culture Values on Organizational Agility				
Project management : cost , time and			X	

quality , two best guesses and a phenomenon , it's time to accept other success criteria			
Issues and challenges of the Agile Software Development with Scrum	X*		X
Challenges in the Migration from Waterfall to Agile Environments			X
Project Success as a Topic in Project Management Journals		X	
The impact of agile practices on communication in software development			X
Project management : cost , time and quality		X	
Challenges in Transitioning to an Agile Way of Working	X*		X
Definition of Agile Software Development and Agility	X		
The Project Management Triangle: a hidden framework? A qualitative study of ERP implementations in Sweden		X	
The Balancing between Scope, Time, and Cost		X	
Organizational Culture and Leadership	X			
Diagnosing and Changing Organizational Culture Based on the competing value framework	X			

Table 10: Relevancy of selected literature and research questions (own representation)

4.3. Presenting the Review

According to (Kitchenham 2004) systematic literature review the final step of the review process involves, showing all the outcomes that have been achieved by performing the systematic literature review. The results represented in this section are based on the analysis of data collected from the papers selected for this research. These results can be shown in a single tabular form or can be shown in different graphs or charts. In this research, most of the results from literature review such as specifying research questions, searching strategy, searching keywords, literature inclusion/exclusion criteria, literature selection process, data extraction, data analysis have been shown in their respective sections, which can be found in section 4.2.

4.3.1. Showing the review results

Research methodology used in the selected literatures

In the selected papers for this research, different research methodologies have been witnessed. The research methodologies used in selected papers are named as follow:

- Literature review
- Empirical search
- Meta-analysis
- Others

By literature review methodology means both systematic and conventional literature reviews. Empirical research means the research done is those papers are based on direct or indirect observation. Meta-analysis research includes the research made basing on case studies, surveys, and interviews. Other includes those literatures that are books. As there is no research methodology implies in chosen books, so these are included in the "others" search methodology. From the analysis of the data extracted from the literature, it is synthesized that 38% of the selected literatures follow literature review research methodology. 42% of the chosen literatures follow empirical research methods. And 10% of the selected literatures follow Meta-analysis approach. The following figure will represent the methodologies applied in selected literatures.
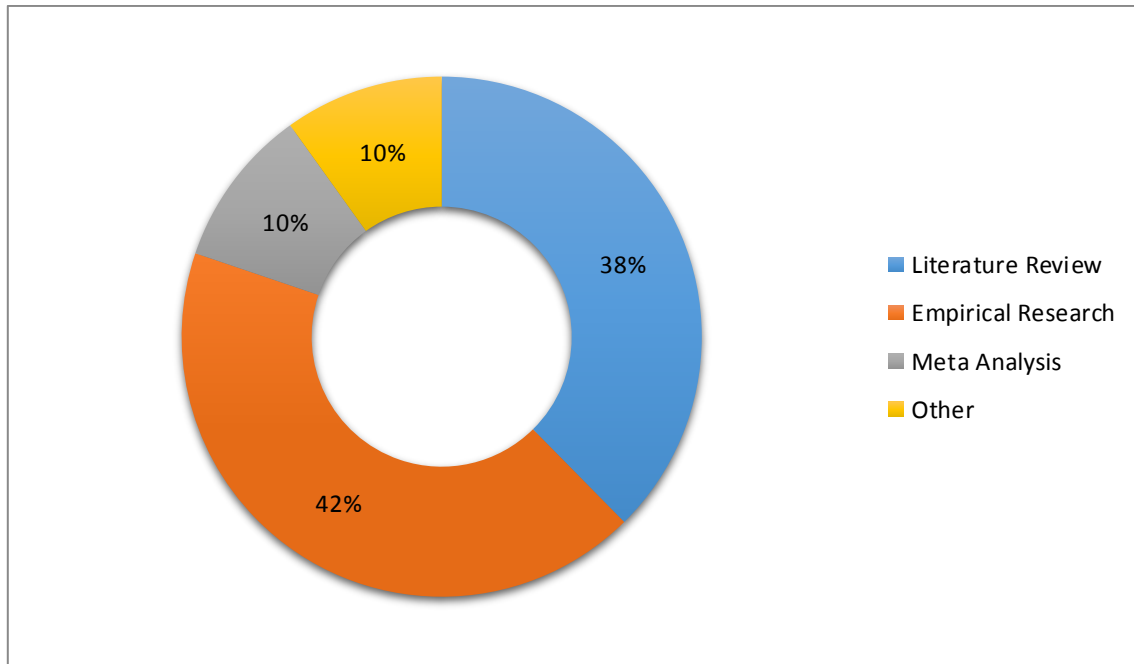
Figure 9: Methodology applied in selected literatures (own representation)

Assessment quality scores of selected literatures

In this research, a literature quality assessment was performed to synthesize the quality of the selected literatures. In literature quality assessment, each literature gains a quality score on a condition if it successfully answers the quality assessment question. In this research, three quality assessment questions were considered as mentioned in section 4.2.6. Score scale for each question is Yes (1), No (0) and partly (0.5) and in the end, summed up the score. Partly means that if any of the questions is implicitly mentioned in the paper. The following figure represents the numbers of articles with their quality assessment scores.
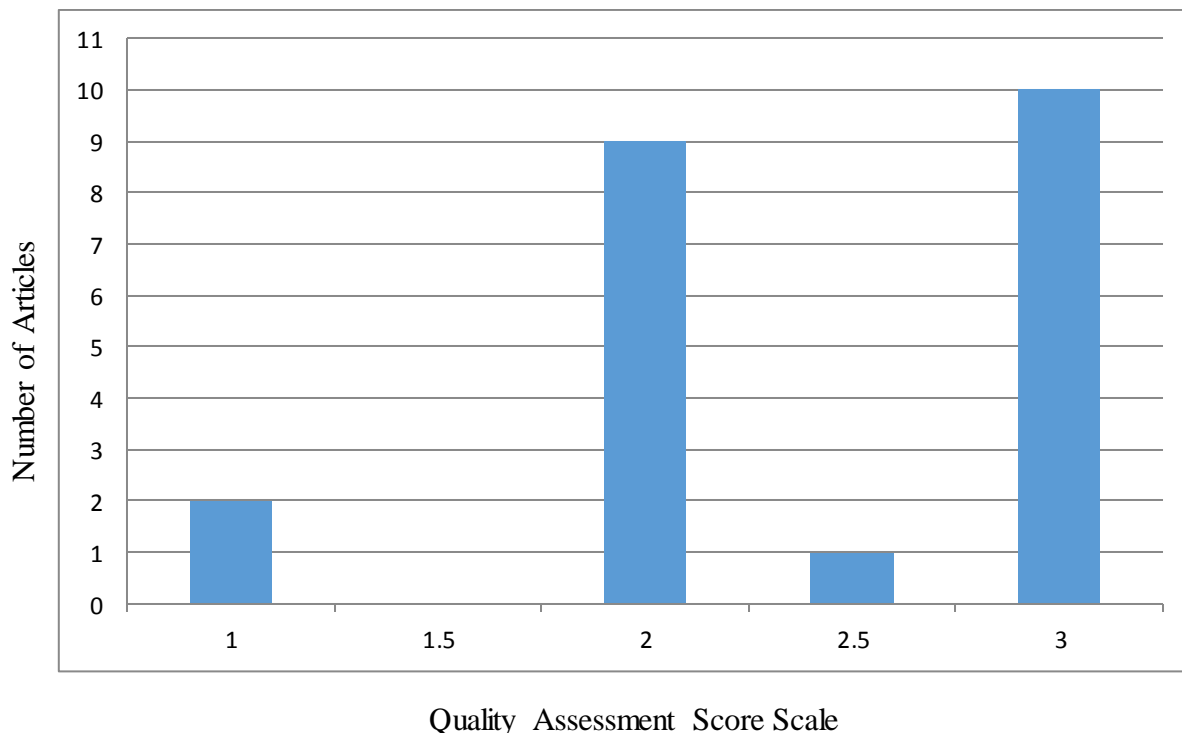
Figure 10: Numbers of articles and quality assessment score (own representation)

As mentioned earlier, this quality assessment was performed only on journal articles, conference proceedings, and thesis. Two literatures that score only 1 were excluded from the research due to low-quality assessment scores and irrelevancy.

Type of searched literature

	Journal Articles	**Conference Proceedings**	**Thesis**	**Books**
Total numbers	16	3	2	2
Percentage	69%	13%	9%	9%

Table 11: Selected literature types (own representation)

For this research, a total of 23 literatures were finally selected during the literature search and selection process. These selected literatures are of different types such as journal articles, conference proceedings, thesis, and books. The table shown above represents the numbers of types of literatures.

5. Conclusion, Limitation and Recommendation

This section provides a summary of all findings based on selected and analyzed articles in the form of a conclusion. The findings of the literature review are summed up by answering the research questions, stated in chapter 1. In addition to that, the implications for future research and the limitations of this study have been discussed in this section.

5.1. Conclusion

Each scientific elaboration for the sake of transparency, traceability, efficiency, and reproducibility, needs to describe its approach. The essential purpose of any systematic review is to evaluate the evidence provided by the literature critically. In this research, for conducting and evaluating the literature review the method used is the systematic literature review by (Kitchenham 2004). Following are the findings by conducting the systematic literature review approach:

- RQ1: What are the cultural aspects of company agility?

The answer to this research question has been discussed in section 2.3 of chapter 2. The focus of this question is to understand what is culture and the linkage between organizational culture and agility. During the research, it was found that different authors discussing organizational culture and its aspects or features. But in this research, the answer is derived from the most valuable articles available in best-ranked journals and conference proceedings. These articles are authored by (Schein 2004), (Leidner and Kayworth 2006), (Cameron and Quinn 2006), (Felipe, Roldan, and Leal-Rodriguez 2017), (Leal-rodríguez et al. 2016), (Overby, Bharadwaj, and Sambamurthy 2006), (Sherehiy, Karwowski, and Layer 2007).

In Conclusion to the findings to these articles, to understand the basics of organizational cultural agility one must understand the meaning of culture. Many authors came up with the definitions of culture, and some say culture as a collective set of beliefs, and some believe culture includes explicit artifacts and norms. After understanding the three levels of culture described by author Schein, it is summarized that culture is a difficult

variable to demonstrate the interacting of social groups within information technology (IT).

The linkage between organizational culture and agility is very well explained by the well-known and among the most widely recognized framework called 'The competing value framework' by author Cameron and Quinn. A brief conceptual overview of four major types of cultures, i.e. Clan culture, Adhocracy culture, Hierarchy culture, Market culture has been addressed in this framework with their aspects and emphasizes. Each culture has its essential aspects of attaining agility in a company. It is concluded that having abilities to foresee environmental and cultural change can increase the chances of company agility.

Authors Felipe and his colleagues have also proposed interrelated concepts to understand organizational agility. These concepts are customer agility, affiliation agility, and operational agility. In conclusion to all this, To remain successful is very difficult as many non-peaceful and unwanted challenges keep on slowing the company's pace to maintain agility. I suggest those managers who want to enhance the level of agility in their organizations must actively study, understand the definition of culture, its types and implement the competing value framework.

- RQ2: What are the values and principles of agile implementation in a company?

The answer to this research question has been discussed in section 2.4 of chapter 2. In this question, agile four core values and the 12 agile principles have been discussed.

Agile core four values are:

- "Individuals and interaction over processes and tools".
    - o Develop a medium of interaction and communication among the team members. It is better than just remain dependent on the process to guide.
- "Working software over comprehensive documentation".
    - o Develop properly working software to measure customer expectations and satisfaction. It is better to deliver working software to the customer than the bundle of documents narrating about the software.
- "Customer collaboration over contract negotiation".

- o Develop room collaboration and communication even after the contract negotiation is over. Allow customer involvement over the complete life cycle. This will give two-way benefits; to development team to re-correct the implementation (if required) and to customers to revise their vision and requirements.
- "Responding to change over following plan".
  - o Welcome change and embrace it instead of running from it. Changes are inevitable and good practice is to accommodate requirement change anytime during the development process.

The first agile principle emphasizes customer satisfaction and continuity — continuous product delivery help to retain instant feedbacks from the customers. The second principle emphasizes collaboration and decision making. The third principle emphasizes adaptability and competitiveness. Same as this fourth principle emphasizes quick and frequent delivery. The fifth principle focuses on measure progress via deliverables. The sixth principle puts focus the values, i.e. provide a trusty and supportive environment and motivated individuals. The seventh principle emphasizes transparency and efficiency. The eighth principle emphasizes sustainability. Ninth focuses on optimizing and simplicity. The tenth principle put focus on the value, i.e. self-organization. The eleventh principle emphasizes technical excellence and design. And the final twelfth principle put emphasizes efficiency and behavior improvement. These 12 principles of agile are born with the agile manifesto. Each principle is a profound concept on which loads of time and research has been invested. Each principle plays very vital role in building agile software development infrastructure (Laanti, Similä, and Abrahamsson 2013).
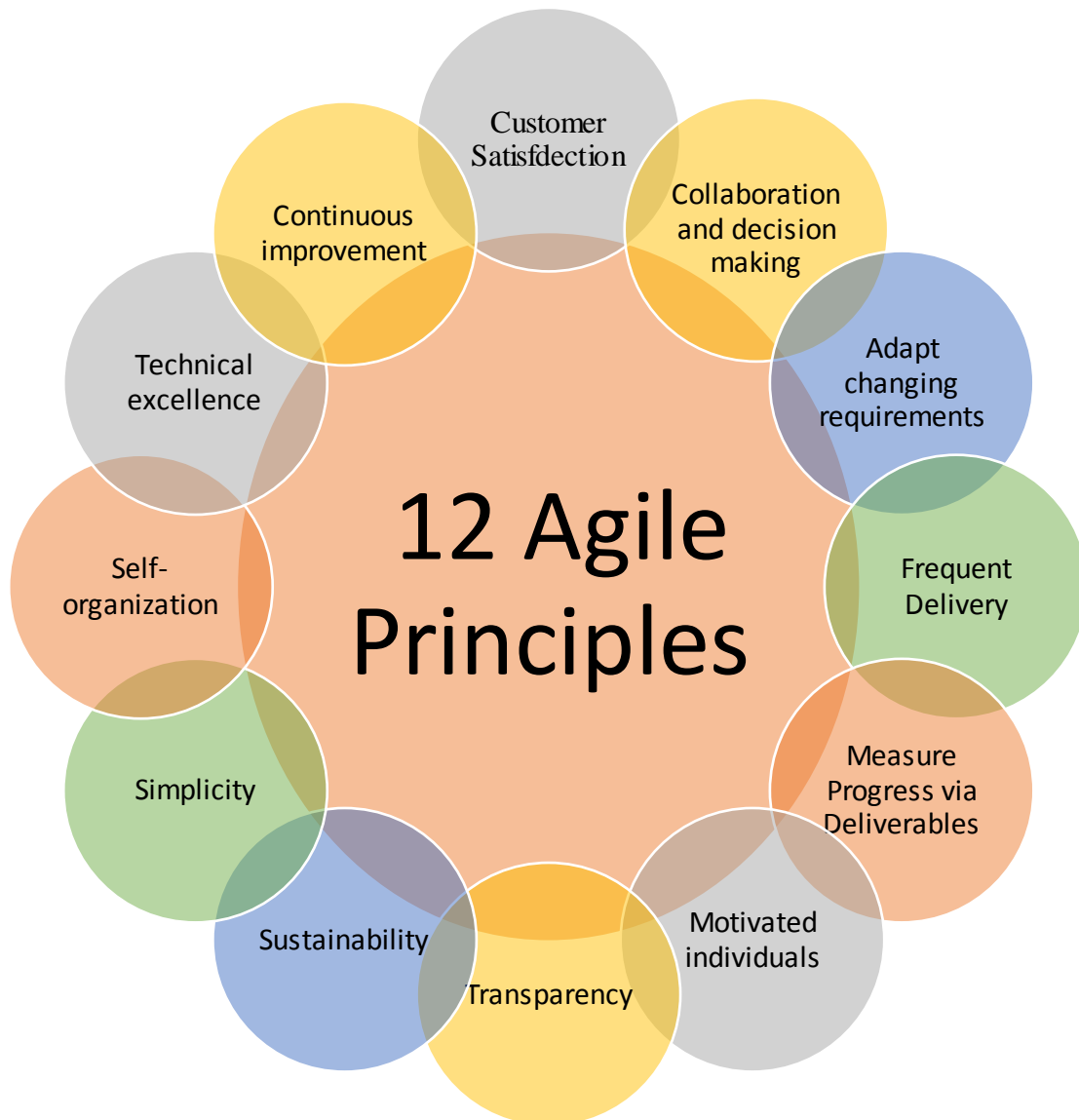
Figure 11: Agile principles (own representation)

- RQ3: What are the benefits of agile methodologies in a company?

The answer to this research question has been discussed in section 2.5 of chapter 2. As mentioned earlier in introduction for achieving successful projects, one must follow the structure defined by the organization; this structure is called success criteria for the project. The results, project impacts and the performance, along with quality, cost and time are taken into consideration in order to measure the success of the project. During the research dozen of literatures were found discussing the agile implementation benefits. Each paper was somehow surrounded by same benefits or success factors of

agile implementation. But in this research, the answer is obtained from the most valuable articles available in best ranked journals. These articles are authored by (Magnusson and Smith 2015); (Pollack, Helm, and Adler 2018); (Atkinson 1999); (Milatic et al. 2014); (AlHarbi n.d.); (Olteanu 2018);(Ika 2009). In this research, discussions have been made on how to measure benefits of agile software development implementation. Agile project management triangle famously known as agile iron triangle came as most commonly used matrix to measure this. Project managers face different challenges and problems in harmonizing iron triangle. As in this research, it is found that all three constraints i.e. cost, time and scope are interrelated and interdepend able. But these constraints are not fixed constraints e.g. cost, time and scope of the project can be changed according to circumstance. Many examples can be found in which projects fulfilling the cost and time constraints but lacking in quality constraint (Milatic et al. 2014). In section 2.5.1, one report from Standish Group is shown in Table 2. This report also gives a deep insight into the success rate of agile methodologies based on project size and methodology (The Standish Group 2015).

TIME constraint of agile iron triangle involves benefits like customer satisfaction, in-time frequent delivery, and efficiency. Once a time plan is made then the project has to be finished in time to attain customer satisfaction. Agile implementation practice does not simply increase the developers' capability to cut the time but organization should also aware their staff about their highest priorities. By defining priorities and deleting unwanted steps in development process will enhance and maintain the pace. Frequent deliveries help to have instant feedback from the client.

COST constraint of agile iron triangle implies benefits i.e. return on investment, sustainability and overview of the company's progress. In this research, it is found that in agile approach time and cost are fixed and interrelated. Like in agile software development, client's all top priority features and requirements are tried to implement. This requires both cost and time. Even the company tries its best to cost control but still it is not guaranteed that all requirements are implemented. If not, it requires more time to implement and cost of the product fluctuates.

SCOPE constraint of an agile iron triangle involves benefits like quality maintenance, technical excellence & design and product value. As mentioned above time and cost of iron triangle are fixed constraints but scope is rather flexible. Like the extent to scope

changes with the complexity of project. Just delivering unlimited functions and features by the expense of huge time and cost is insufficient if value of the product is forgotten.

To summarize them all, a company can have all the benefits on agile if they are successful in properly implementing agile iron triangle.

- RQ4: What are the challenges faced while implementing an agile methodology?

The answer to this research question has been discussed in section 2.7 of chapter 2. As a result of reviewing various literatures six different major areas have emerged and each area includes several challenges. These areas are named as development area, people conflicts area, business area, communication area, management area and cultural area. These areas are considered major categories that might involve agile implementation challenges. Along with each challenge, I have also tried to find solutions. All these challenges along with solutions can be seen in table 3.

The first area in this table is the development area which categorizes the challenges that might be faced during development process of agile implementation. The second area in table categorizes the issues among people in a company during agile implementation. Either they have trouble in staff behavior or in communication. All challenges found during research that might be faced in agile implementation are mentioned. The third area in this table is business area. Business challenges that might arise during agile implementation like pursuing staff to adopt agile way of thinking rather than traditional, Unclear business and customer requirements and misunderstanding agile core definition and practice. This area figures out the issues between agile and traditional methods during daily business routines. The fourth area categorizes those challenges that might show up in management process while implementing agile methodologies. Major challenges like risk management, unavailability of resources during project management, delay in implementation of decisions etc. The fifth area in this table is communication area which categorizes the challenges that might be shown up during communication process in agile implementation. Many literatures have discussed communication problem appeared as major challenge while implementing agile. Sometimes distance and large geographically distributed teams appeared as challenge because it is difficult to manage and overlook. Sometimes tacit and false knowledge transfer became a challenge. Regular retrospective meetings, regularly meeting co-located staff and regular staff interacting using JIRA or Bitbucket etc. are proposed as

solution for this challenge. The sixth and final area of challenge is cultural area which involves challenges that might be faced during agile implementation. In conclusion, I must say that during implementation of agile software development there is less probability of challenges that might be faced as compared to traditional software development and agile methodology also provides the best solutions.

The conclusion from the studied literature is that the agile software development methodology is a key for today's business which is providing new and high potentials to firms. Cultural adoption is necessary for agile software development implementation. It is found that during the implementation of agile software development, there is less probability of challenges that might be faced as compared to traditional software development. Agile software development methodology also provides the best solutions to different issues. Thus, agile software development is recommended as the best methodology so far for companies who want to quit the traditional way of software development framework.

5.2. Limitations

Like other researches, this research also suffered from limitation that might affect the accuracy of results. The first limitation of this research is that many of the literatures are paid or are available on text-request. Even our university VPN helps a lot in accessing these literatures for free but this is not possible on all Databases. The second limitation this research faced is that all the literatures included are in English language. There could be some other good and nice literatures in other languages but due to language restrictions they can be used. The third limitation was that not all the databases provide filtering option for searching research topic. Filters like subject, date, article type, year, author etc. Also there was limitation regarding research methodology used in this research that in joint technical report of author (Kitchenham 2004) does not explain non-quantitative data analysis. The author has explained quantitative data analysis and report in detail. According to his report non-quantitative is mostly descriptive but what it must involve was somehow missing.

In addition to the above mentioned limitation, there were also some difficulties faced in this research, and there are few reasons for these difficulties. One of the difficulties is that agile is a very wide topic and implemented in different fields not only in software engineering field. Due to which agile definitions vary according to the field it implemented.

Another difficulty was found is that agile implementation challenges were different from one company to another as agile method focus an environment where humans are the major actors. Due to this, many literatures studied in this research were discussing same kind of challenge area but context was different which makes it difficult and confusing. Many agile software development implementation challenges were falling in more than one area such as in management and people. It was hard to distinguish in which exact category they fall.

5.3. Recommendations and Open Topics

It has been construe from the results of the studied literatures that agile software development methodology is a key for today's business which is providing new and high potentials to businesses. In this research, I have studied in-depth about agile software development methodology, agile manifesto and principles behind the agile manifesto, benefits and challenges of agile implementation. This research also pointed out cultural adoption is necessary for agile transformation. This research has concluded agile as best software development methodology so far for companies who want to transform from traditional to any other software development framework. Yet, the transformation is not large scale transformation; it will start slow with small scale and has the potential to grow.

As a recommendation, first step before implementing agile software methodology should be selection of a suitable project. It is mostly crucial to decide which project is most suited to pilot agile practices. Common question that arises while making agile strategic decision are; should the pilot project be large and important project? Who will manage this project? Is the company is capable of bearing the failure? These are the conditions which lead to unclear requirement, unclear goal and customer dissatisfaction. So, selection of a suitable pilot project will increase the confidence level and leads to organizational agility.

Additionally, what I understand from the studies that while implementation agile does not imply that all departments should follow agile methods such as SCRUM. It should be done department by department. As it is mentioned above, transformation is a small scale process that enhances slowly and steadily. It is concluded in this research that

agile is useful to almost all extent but what are the limitations of agile? Which areas in which agile practices are incompatible? These questions are still unanswered.

However, agile software development remains the most biggest and challenging practice in the software industry. Working on the above-mentioned research gaps can give a significant push to this research. Based on pure review of the selected literature, without any statistical result or meta-analysis, this research shows that there is positive progress in a company with agile software development implementation.

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Schein, Edgar H. 2004. *Organizational Culture and Leadership*. 3rd ed. Jossey-bass.

Sharma, Sheetal, Darothi Sarkar, and Divya Gupta. 2012. "Agile Processes and Methodologies: A Conceptual Study." *International Journal on Computer Science and Engineering* 4(5): 892–98.

Sherehiy, Bohdana, Waldemar Karwowski, and John K. Layer. 2007. "A Review of Enterprise Agility: Concepts, Frameworks, and Attributes." *International Journal of Industrial Ergonomics* 37(5): 445–60.

Shivaleela, S, and L Manjunatha Rao. 2018. "Current State of Agile Methodologies and Its Extended Practices in Software Development - A Review." *International Journal of Advanced Research in Computer and Communication Engineering* 7(7): 90–95.

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Stein, Mari-klara, Matti Rossi, Riittia Hekkala, and Kari Smolander. 2017. "Challenges in Transitioning to an Agile Way of Working." In *Proceedings of the 50th Hawaii International Conference on System Sciences |*, , 5869–78.

Sutherland, Jeff, and Ken Schwabr. 2013. *The Scrum Guide* ^TM.

The Standish Group. 2015. "CHAOS Resolution by Agile vs Waterfall."

Webster, Jane, and Richard T Watson. 2002. "Analyzing the Past To Prepare for the Future : Writing a Literature Review." *MIS Quartely* 26(2): 13–23. www.jstor.org/stable/4132319.

Appendix

Annotated Bibliography

Leidner, Dorothy E, and Timothy Kayworth. 2006. "Review : A Review of Culture in

   Information Systems Research: Toward a Theory of Information Technology

   Culture Conflict." *MIS Quarterly* 30(2): 357–99.

   This article includes a review of culture in information systems. Culture has direct

   or indirect influence on Information technology. Authors in this article show the

   linkage between IT and culture. From analysis authors develop six themes and

   based on these themes authors develop a theory of IT, values and cultural conflict.

Leal-rodríguez, Antonio Luis, Emilio J Morales-fernández, José Antonio Ariza-Montes,

   and Stephen Eldridge. 2016. "Assessing the Links between Organisational Cultures

   and Unlearning Capability : Evidence from the Spanish Automotive Components

   Industry." *Int. J. Innovation and Learning* 20(xxxx).

   Authors of this article shed light upon current relationship between different

   culture typologies and organizational unlearning. The author implements famous

   framework 'competing value framework' to assess the influence of company's

   cultural on organizational routines. Authors used two techniques partial least

   square path modelling and variance-based structural equation modelling to assess

   this relationship.

Olteanu, Cristian Gabriel. 2018. "IT Agile Transformation." *Economy Informatics*

   18(1): 23–31.

   This article includes discussion about Knowledge management for IT agile

   adoption based on organizational change. Author concluded whole organization is

impacted by agile adoption at project management approach and organizational culture as the biggest challenge for agile transformation.

Boehm, Barry, and Richard Turner. 2005. "Management Challenges to Implementing Agile Processes in Traditional Development Organizations." *IEEE Software* 22(5): 30–39.

Authors in this article figure out some challenges that are targeting agile and traditional software development practice. Authors came up with a collection of change related challenges and almost 40 perceived barriers to agile implementation.

Pollack, Julien, Jane Helm, and Daniel Adler. 2018. "What Is the Iron Triangle, and How Has It Changed?" *International Journal of Managing Projects in Business* 11(2): 527-547.

This article narrates about iron triangle and some features of iron triangles which have changes over time. Authors found that cost and time are constant part of the iron triangle but scope is contested. This article concluded that there is significant links between time, cost and scope which verify these concepts as vertices of iron triangle. Authors created the network for time, cost, and scope and found that these concepts are highly interconnected.

Demeester, Michel. 1999. "Cultural Aspects of Information Technology Implementation." *International Journal of Medical Informatics* 56(1–3): 25-41.

Culture sets our values and norms that guide us to decision making process. Author has reduced the culture to seven dimension framework. The structure and dynamics of decision making process are described as Change Governance Framework. The purpose of this framework is to control aspects of decision making that are

sensitive to culture preference.

Sherehiy, Bohdana, Waldemar Karwowski, and John K. Layer. 2007. "A Review of Enterprise Agility: Concepts, Frameworks, and Attributes." *International Journal of Industrial Ergonomics* 37(5): 445-460.

This paper contains comprehensive characteristics of agility that can be applied to all aspects of enterprise e.g. organizational adaptability, organizational flexibility, reactiveness and culture of change. In this paper, existing knowledge of agile manufacturing and agile workforce has been studied.

Overby, Eric, Anandhi Bharadwaj, and V. Sambamurthy. 2006. "Enterprise Agility and the Enabling Role of Information Technology." *European Journal of Information Systems* 15(2): 120–131.

This article defines enterprise agility, outline enterprise agility from similar concepts, explore the capabilities of enterprise agility and explain enabling role of information technology. The ability of organization to sense environmental change is the prominent aspect of company success.

Felipe, Carmen M., Jose L. Roldan, and Antonio L. Leal-Rodriguez. 2017. "Impact of Organizational Culture Values on Organizational Agility." *Sustainability* 9(December).

This paper present analysis of two relevant research gaps: (i) the relationship that determine the impact by the each four organizational culture typologies i.e. Clan, Adhocracy, Hierarchy and market, comprised in competing value framework on organizational agility. (ii) The unseen effects by environmental factor. Modelling techniques used: partial least square path and variance based structural equation.

Atkinson, Roger. 1999. "Project Management: Cost , Time and Quality , Two Best

Guesses and a Phenomenon , Its Time to Accept Other Success Criteria."

International Journal of Project Management 17(6): 337-342.

This article defines about project management, the criteria's for success and why

project management is so reluctant to adopt iron triangle instead of other criteria.

In this paper, authors propose a new framework 'The square root' to consider

success criteria.

Cho, Juyun. 2008. "ISSUES AND CHALLENGES OF AGILE SOFTWARE

DEVELOPMENT WITH SCRUM." *Issues in Information Systems* IX(2): 188–

195.

In this article, Author introduced the characteristics of Scrum methodology and

also explores the issues and challenges appeared in a company which has

implemented Scrum. Author explains the difference between agile and traditional

software development practice. This paper presented five challenges and issues

related to communication, documentation, user involvement, working

environment.

Almeida, Fernando. 2017. "Challenges in the Migration from Waterfall to Agile

Environments." *World Journal of Computer Application and Technology* 22(5):

39-49.

Technical and organizational level challenges faced by migration from traditional

(waterfall) to agile environment. Author has addressed four dimensions and a total

of 49 sub-dimensions of challenges. These dimensions includes: people,

organizational and managerial, tools and process. Also author came up with the

discussion to mitigate these challenges.

Ika, Lavagnon A. 2009. "Project Success as a Topic in Project Management Journals."

Project Management Journal 40(December): 6–19.

Author is this article analyzes the concepts like project management success, project success, success criteria and success factors.

Pikkarainen, M. et al. 2008. "The Impact of Agile Practices on Communication in Software Development." *Empirical Software Engineering* 13(3): 303-337.

Concentration of this article is to explore the impacts of XP and Scrum related to communication in a focal company. The goal was to increase the understanding of communication between developer, project leader and stakeholder. This study indicated that the agile software development in the projects has positive effect on internal and external communication. However, hurdles are still present in communication between developer and stakeholder.

Milatic, Slavia et al. 2014. "Project Managament : Cost , Time and Quality." In *8th International Quality Conference*, , 345–50.

According to authors, just finishing the project is not enough, because project must be of satisfactory quality. This article explains the significance of project management: cost, time and quality. Authors presented the elements of project management triangle and connection between them.

Stein, Mari-klara, Matti Rossi, Riittia Hekkala, and Kari Smolander. 2017. "Challenges in Transitioning to an Agile Way of Working." In *Proceedings of the 50th Hawaii International Conference on System Sciences /*, , 5869–78.

How agile way of working was understood by project team, management and supplier and how this understanding changed over time has been discussed in this article. Noticeable challenges for agile conversion include, lack of experience with agile development, no common view on agility, its key principle and practices.

Authors suggested that large complex agile projects need to have very high-level clear objectives, architecture and management controls derived from them.

Laanti, Maarit, Jouni Similä, and Pekka Abrahamsson. 2013. "Defination of Agile Software Development and Agility." *Communications in Computer and Information Science* 364 CCIS(June): 247–58.

In this article, agile manifesto and agile principles are referred to as the definition of agile and agility. Authors researched many definitions in this paper and examine where each definition emphasizes and which emphasizes we found in agile principles. Author concluded that people do mean many things when they talk about agile software development and agility. It is better to understand other person's perceptions about agility before creating too many misunderstandings.

Magnusson, Frida, and Jonathan Smith. 2015. "The Project Management Triangle : A Hidden Framework ? A Qualitative Study of ERP Implementations in Sweden." University of Gorhenburg.

The purpose of this thesis is to examine the relevance of the project management triangle framework when it comes to the ERP-implementation. The authors concluded that information regarding this was not always matching and it is not always applicable on ERP systems since they show deviation in different aspects. As ERP implementation is dynamic in nature so interdependencies tend to vary every time. In order to achieve better project results, one must keep in mind that they should facilitate communication more often.

AlHarbi, AbdulAziz Hameed. "The Balancing between Scope , Time , and Cost." University Cyberjaya, Malaysia.

This paper addresses the dynamic interaction that take place between

characteristics of product, development cost, development time and quality in a system environment. Author mentioned different scenarios resulting that all three concepts of project management triangle are interrelated in a way that if quality decreases and time decrease then cost might increases. Good agile software development practice is to maintain balance between project management

Schein, Edgar H. 2004. *Organizational Culture and Leadership*. 3rd ed. Jossey-bass.

This book shows the structuring and functioning of organizational culture and the role played by the leadership in creating and managing culture. This edition is organized into three parts: First part focus on organizational and occupational function. How to thing about them, how to analyze them and leadership issues are highlighted. Second part consists of content of culture. In a sense, culture cover all of the give group's life; therefore content is in principle, endless and vast. Author in this part develop some set of dimensions that are useful in making sense of cultural landscape as applied to organizations. In the third part, author shifted his focus to leader as founder, manager. Also leader is considered as a victim of culture if he does not understand how to manage a culture. The issues that leader faces at each of these different organizational growths are because the role culture plays at each stage are totally different. Author concluded that culture humility cannot be achieved unless we see cultural assumptions with ourselves. In the end, culture understanding and culture learning start with self-insight.

Cameron, Kim S., and Roberte. Quinn. 2006. *Diagnosing and Changing Organizational Culture Based on the Competing Value Framework*. Revised Ed. USA: Jossey-bass.

In this book authors represent their own observation that organizations often fail during changing and improvement efforts because of the inability to understand

culture change. Authors also present their conviction that competing value framework can be applied to several aspects of organizational and personal performance. Authors have written this book to also share tools and procedures own empirical research and consulting experience have found. This book offers three contributions: (1) validated instruments for diagnosing organizational culture and management competency. (2) Theoretical framework to understand organizational culture. (3) Systematic strategy to change organization culture and personal behavior. This book is also an information source for explaining a robust framework of culture types.
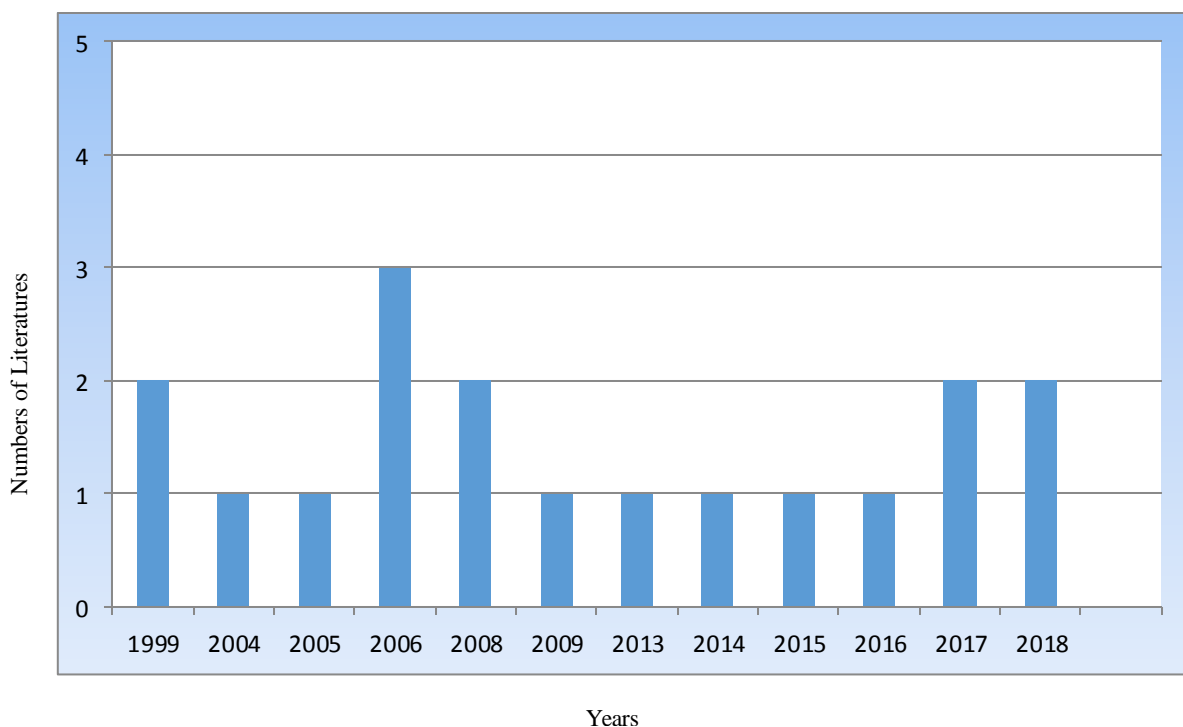
Selected Literature year wise:

Figure 12: Year-wise selected data (own representation)

At the start, the research was made with the restriction that resources were (journal articles, books, conference proceedings, and thesis) not older than year "2001".

The reason for this was that as 2001 was the starting year of agile manifesto and later on many types of research were made on agile software development methodology implementation. Due to this, most of our resources are those which are published after the year "2001" till year "2018". But in this research, for one question, i.e., "cultural aspects of company agility," it was a little hard to find latest articles, and most of articles or books found were older than the year 2001. As research on organizational culture topic has been carrying out for many years, even before the birth of the agile manifesto. According to my research, (Pettigrew 1979) used the term "organizational culture" for the first time in the journal of *Administrative Science Quarterly*. Therefore, few resources are from before the year "2001".