LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

Department of Software Engineering and Information Management

MASTER'S THESIS

A SYSTEMATIC LITERATURE REVIEW ON AGILE PROJECT MANAGEMENT

Tampere, April 2, 2013

Sumsunnahar Sheuly

Kaurasmäentie 18 A3, 33480, Ylöjärvi, Tampere

sumsunnahar.sheuly@lut.fi

ABSTRACT

In the 21st century, agile project management (APM) has emerged as a major evolutionary step in the area of software project management. APM is defined as a conceptual framework, consisting of various methods such as Scrum, quick respond to change, better customer collaboration, minimum coverage of documentation and extreme programming (XP) that facilitates to produce working software in multiple iterations with team work. Because agile project management has become more popular in the software industry in recent years, it constitutes an interesting and comprehensive research topic.

This thesis presents a systematic literature review (SLR) of published research articles concerning agile project management. Based on a predefined search strategy, 273 such articles were identified, of which 44 were included in the review. The selected 44 articles were published between years 2005 and 2012.

The thesis defines a review process by developing a review protocol and presenting the results of the review. The results are expected to provide researchers, software managers and software engineers with more information about the existing methods of APM.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

SLR   Systematic Literature Review

APM   Agile Project Management

XP   Extreme Programming

RQ   Research Questions

ASD   Agile Software Development

CMMI   Capability Maturity Model Integration

FDD   Feature Driven Development

DSDM   Dynamic Systems Development Method

OOSP   Object Oriented Software Process

BI   Business Intelligence

EVM   Earned Value Management

PO   Product Owner

SM   Scrum Master

PERT   Program Evaluation and Review Technique

1. INTRODUCTION

In recent years, researchers have become increasingly interested in agile project management (APM) in the context of software development. In that context, the agile project management is defined as a conceptual framework for undertaking software engineering projects [1]. Several approaches of Agile Methods are used to control and measure a software project. Agile Methods are considered as a family of development processes, not a single approach to software development [1]. The most popular and widely practiced APM methods include Scrum, XP (Extreme Programming) etc. and companies like IBM, Oracle, Honda, Canon and Toyota [32] [36] have been practicing Scrum. All methods share the common concept of producing working software in multiple iterations with team work, quick respond to change, better customer collaboration and minimum documentation. Managing software projects in small iteration and with continuous feedback minimizes the project management overheads and risks of failure [62].

As the interest in using agile methodologies in software projects is growing, so is the research on various aspects of agile development and project management. The emerging of different agile methods has exploded during the last year, and the number of new methods is still growing. This has resulted in a situation where researchers and practitioner are not aware of the existing approaches and their suitability for managing agile projects. Consequently, there is a need for conducting a systematic literature review in this area that summarizes the existing knowledge about APM. The results of this study can assist agile software practitioners by providing them with useful information about the existing APM methods.

The main aim of this thesis is to summarize existing research on agile project management and identify any gaps there in order to suggest areas for further research. In order to achieve this aim, several objectives have been defined, such as identifying currently known project management methodologies in APM, project management issues addressed by the existing methods, and human and social factors and their impact on APM.

This Master of Science thesis uses a systematic literature review to identify the current research. The thesis presents a systematic literature review on agile project management, and conducts a classification of the studies. It provides a comprehensive study of planning, conducting and documenting the outcome of the APM review.

The review follows the guidelines provided by Kitchenham and Charters about conducting a systematic review. The review process starts with developing a review protocol. The search strategy identified 273 articles, of which 44 articles were included in the review as primary study papers. The selected papers were published between 2005 and 2012. They were studied to find answers to the research questions. Furthermore, potential validity to threats were also identified and assessed.

The results of the review are presented in several stages. Initially, the studies are categorized and presented in four main groups: APM introduction and adoption, APM methods and approaches, team factor and comparative studies. Quantitative data presentation shows year wise distribution of published papers and the study types based on the research methods. In the next stage, several units of analysis are indentified and a summary of the included articles is presented. The answers to the research questions (RQs) are provided in the last stage.

The rest of the thesis is structured as follows: section 2 contains the background and motivation of work. In latter sections, section 3 details the systematic review, section 4 presents the results of the review, section 5 provides discussions about the answer to the research questions and section 6 details the limitations and threats to validity. Finally, the last section concludes the thesis and provides suggestions for further research.

2. BACKGROUND AND MOTIVATION

Concepts which are required to understand the thesis have been defined and explained in the section.

2.1 Project Management

Project management is the application of knowledge, skills, tools, and techniques to project activities in order to achieve the target goal of a project [11]. According to PMBOK, the project is time-framed endeavor undertaken to complete the end goal, as a product, service, program, building or another non-trivial target of human achievement. In 1969, the Project Management Institute (PMI) was founded to serve project management. Then in 1981, PMI initiated PMBoK (Project Management Body of Knowledge), a guide to project management, containing standards and guidelines of the best known practices in the profession. It discusses how the project is managed, covering topics such as project phases and life cycle, project stakeholders, organization influences, general management skills needed by the project manager etc. Project Management consists of two principal phases [12]: planning and scheduling phase, as well as controlling phase of the on-going project.

The objective of the planning phase is the construction of a schedule stating start and finish times. Project creation involves defining the goal and tasks for the project followed by estimating durations and assigning resources: people, equipment and facilities to each tasks. Once the project has started, there is a need for monitoring and controlling the progress of each task [12]. Managing phases typically includes identification of requirements, addressing the various needs, concerns and expectations of the stakeholders, as well as balancing the competing project constraints such as scope, quality, schedule, budget, resources and risks [11].

Software project planning has three general approaches: past experience, standard guidelines, and support tools. Experienced project managers rely upon their past experience in order to create plans and often use documents and guidelines from past finished projects [67].

Standard guidelines provide a model for plan definitions and formal document format. The IEEE [68] issued the standard of the "STD 1058-1-1994 Software Planning Documents" to accomplish the software project planning. Other standard guidelines are the 15 activities for the Project Planning Key Process Area which has been issued by CMM of SEI and Software Project Management by SEI Curriculum Module SEI-CM-21.1.0 [69].

Project plan provides the basis for controlling and the standard against which performance is to be measured. Project managers use various support tools for making a software project plan. These tools are mainly for creating Gantt charts, milestone documents, and PERT (Program Evaluation and Review Technique) charts. A project plan can be presented in a form of a chart showing the start and finish times, and the relationship between activities. The main tools used in project management are the Gantt chart: a form of horizontal bar chart with defining the tasks, estimated time and allocated resources, and PERT. With PERT, a project is represented by a network of interconnected nodes, and statistical probabilities are used to calculate the expected duration of each activity. It presents the scheduled time for each task and its dependence on other tasks. Network analysis techniques are used to describe the critical path which requires the longest overall time to complete [70]

Managing a project begins with the starting of the project and it lasts until the project is completed. As part of on-going project management, upon a completion of tasks, details of its actual start and finish times and costs are entered, and relevant charts are updated. These activities enable the project manager to provide project status, and therefore to adjust the resource allocation accordingly [70].

2.2 Agile Project Management

Agile software development is an iterative way of planning and guiding a project. Figure 1 shows the agile life cycle which begin with stakeholders determining what features are possible candidates for inclusion in the product. Product owner leverage stakeholder input to write epics which are large user stories that require to be broken down into smaller pieces of work. Once an epic is broken down into stories, the stories are prioritized and maintained in a backlog. Agile Software Development (ASD) includes the notion of iterative cycles, where all of the phases are interconnected, each phase being a feedback mechanism for the others [13].
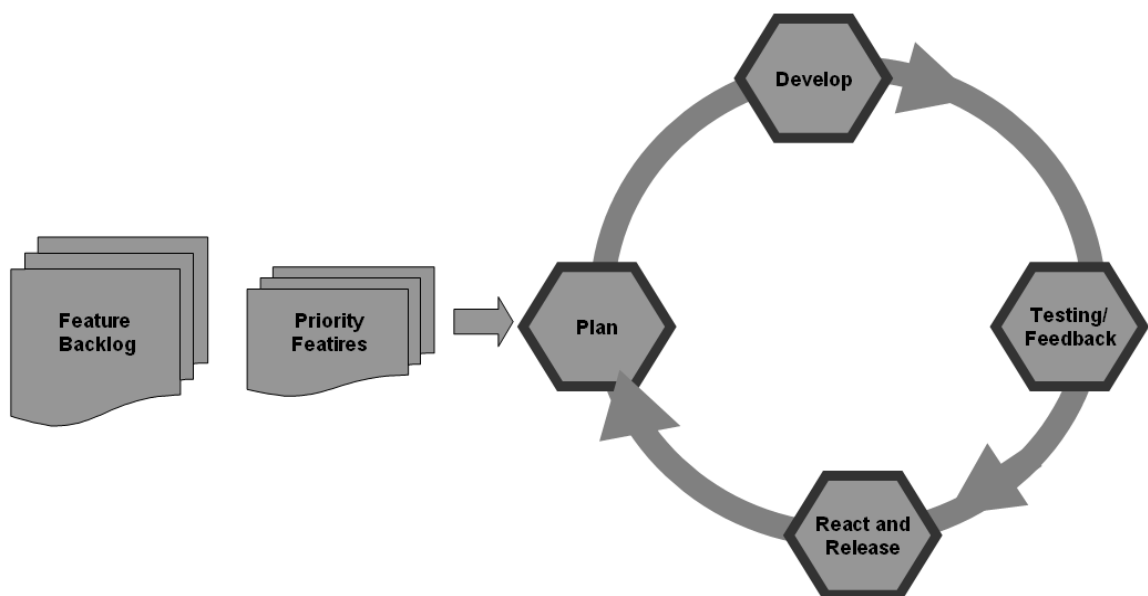
Figure 1: Agile Lifecycle [13]

This section presents the key concepts and methods of agile software development process which will guide readers to understand the agile concepts.

2.2.1 What Is Agile Method

Agile methodologies are developed as a reaction to plan-driven methodology's bureaucracy: there is so much stuff to do to follow the methodology that it slows down the whole pace of software development. Therefore, agile methods have emerged as group of software development methodologies which are adaptive rather than predictive and are people-oriented rather than process-oriented [2].

Agile software development method is characterized by following attributes: incremental, cooperative, straightforward and adaptive Incremental refers to small software releases with rapid development cycles. Cooperative refers to a close interaction between team and customer. Straightforward implies that the method is easy to learn and to modify and that it is sufficiently documented. Finally adaptive refers to the ability to make and respond to last moment changes [72].

Agile methods break software features into small increments which require minimum of planning and do not directly involve long-term planning. Iterations are short time frames which typically last from one to four weeks. Each iteration involves a cross functional team working in all software development cycles stages, such as planning, requirement analysis, design, coding, unit testing, and accepting testing. At the end of the each iteration a working product is presented to the stakeholders. Managing software projects in this way minimizes the risks of failure and allows the project to adapt to changes quickly. An iteration does not essentially add enough functionality to a market release, but the aim is to have an available release at the end of each iteration. Several iterations might be needed to release a product or new feature [73].

Agile software development methods focus on keeping the code simple, testing often and encouraging the stakeholders to collaborate actively. On the contrary, traditional development methods are sometimes called heavy and often use the concept of waterfall development model. The waterfall model is based on linear and sequential phases where each phase has a defined goal. Once one phase has been completed, the next phase starts without having the option to go back [25].

Agile methods emphasizes on quality and project agility. In order to improve quality and project agility, specific tools and techniques such as continues integration, automated text, pair programming, test-driven development, design patterns, code refactoring and other techniques are often applied while developing of software.

2.2.2 Agile Manifesto

In 2001, a group of seventeen independent-minded software consultants and practitioners gathered together and signed the Agile Software Development Manifesto. The manifesto relies on four main values supplementing the twelve principles. According to the Agile Alliance, the main four values are [6]:

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

The manifesto summarizes the core values of agile software development.
The goal of ASD (Agile Software Development) is to create working software, not to fulfill the predefined development process. Agile principles are intended to facilitate the process of creating working software. According to Kent Beck the Agile Manifesto is based on twelve principles which are listed below [6]:

- Highest priority is to satisfy customers through early and continuous delivery of valuable software.

- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

- Deliver working software frequently, with a preference to the shorter timescale.

- Business people and developers must work together daily throughout the project.

- Build projects around motivated individuals. Providing the environment and support they need and trust them to get the job done.

- Face-to-face conversation is the most efficient and effective method of conveying information to and within a development team.

- Working software is the primary measure of progress.

- Sustainable development is promoted , facilitating indefinite development

- Continuous attention to technical excellence and good design which enhances agility.

- Simplicity is essential.

- The best artifacts (i.e. architectures, requirements, and designs) emerge from self-organizing teams.

- The team regularly reflects on how to become more productive and efficient.

2.2.3 Agile Methods

Agile software processes are light-weight and attempt to minimize the project failure risk associated in the project by developing and releasing software in short iterations [42]. The objective of using Agile Methods is to produce higher quality software in a shorter period of time.

Agile methodologies were developed to streamline the development process and to remove barriers to accepting business requirement changes during the software writing stage [4]. In practice with Agile Methods, needs for locking the business requirements and design details in the development phase duration remain minimum. Most Agile methods share several common features, including prototyping, iterative development and minimum documentation. [4]. Agile methods, such as XP (Extreme programming) and Scrum, are widely practiced by many software firms. XP (Extreme Programming) agile developing methodology was created by Kent Beck. It has become very popular in recent years and has been adopted by many companies. It helps to develop and improve a software project in four essential ways: communication, simplicity, feedback, and courage. It also introduces 12 best practices for the XP programmers [5]. Scrum method is an agile, iterative, incremental developing method which assumes that changes of the business requirements and detail designs exist through entire development duration of the project and attempts to resolve these changes. Scrum method focuses on planning and tracking of the iteration, organizing requirements by business and technical value, and always selecting the most prioritized task to do [5].

Agile manifesto indicates a good overview of the intent of Agile Methods [71]. Supporting the four values which are mentioned in section 2.2.2 leads to some commonalities among various agile methods. There are several common features of the various agile methods, such as collaboration, code reviews, small teams, short release schedules, time-boxing, and

constant testing [71]. All the agile methods remain highly collaborative and rely on information communication and minimum documentation. Agile methods encourage code reviews, because code reviews enable the dissemination of key information. In XP, code reviews are continued through pair programming. All agile methods also encourage small teams which are required to foster collaboration. Agile methods schedule short releases, and at the end of each release a functional product is released to the customer, which allows the evaluation of the product. In time boxing the length of the release is fixed but the features are not, so the features are prioritized based on the release schedule. Agile methods emphasize the testing of the product throughout its lifecycle; they require integration testing throughout the development process, which includes automated testing with daily builds and regression tests to ensure all functionalities work.

2.2.4 Agile Methods and Continuous Integration

Continues integration concept is one of core elements of all popular agile methods, as agile development process delivers working software in multiple releasers so the high level of integration is required.

The term 'Continuous Integration' has originated with XP development process, as one of its twelve practices. Continuous Integration (CI) refers to a software development practice where members of a team integrates their code frequently, usually each person integrate at least daily which leads multiple integration per day. After integrating the code into a baseline, developers run a set of regression tests on it. Each integration is verified by an automated build to detect integration errors as quickly as possible. Continues integration increases quality as side effects of a change quickly uncovered. Since finding defects in early stage reduces the cost of fixing them, this aspect of the agile processes has a significant impact on quality and schedules. However, it also emphasis practice of writing comprehensive set of tests to be used as regression tests [74].

2.3 Intervention

The intervention refers to a specific software technology that addresses a specific issue. Software technology could be any software tool, method or procedure, for example; a technology for performing specific tasks such as system testing [8].

2.4 Motivation

In order to know what has been done in this research context, it is very important to summarize all existing information about agile project management in the area of software engineering in a thorough and unbiased manner.

The objectives of my systematic review are as follows:

- Summarize existing research related to agile project management.
- Identify any gaps in existing research on agile project management in order to suggest areas for further research. To identify the type of research done on agile project management (APM), the thesis uses a systematic literature review. Since managing projects in agile way is a relatively new concept compared to the traditional waterfall model, the results of the review provide an overview of the research conducted in this area. The results are expected to help practitioners and researchers by providing them with more information.

3. SYSTEMATIC LITERATURE REVIEW

This section provides an overview of systematic literature review (SLR); it describes the research methodology, the design and the execution of SLR.

3.1 Overview of Systematic Literature Review

The following sub sections describe in detail the systematic literature review process.

3.1.1 Definition

Systematic literature review has become a popular research methodology since the 1990s. In the 1990s it was widely used in medical research and within that field there are a number of well-documented standards to support its use [7]. The number of software engineering researchers performing systematic reviews has been continuously increasing since 2004 [7]. Many premier journals and Magazines have special sections for papers based on systematic review. In addition, a significant number of software engineering conferences seek submissions in this category [7].

According to Kitchenham,

"*A systematic literature review (often referred to as a systematic review) is a means of indentifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest"* [8]

The fundamental studies of the systematic literature review are known as primary studies, and the systematic literature itself is known as a form of secondary study.

3.1.2 Reasons for adopting Systematic Literature Review (SLR)

Systematic literature review must be undertaken in accordance with a predefined search strategy. The search strategy must allow the completeness of the search to be assessed. There are many reasons to perform a systematic literature review described by Kitchnham [8]. The most common reasons are:

- "To summarize the existing evidence concerning a treatment or technology e.g. to summarize the empirical evidence of the benefits and limitations of a specific agile method".

- "To identify any gaps in current research in order to suggest areas for the further investigation".
- "To provide a framework or background for appropriately positioning of new research activities".

3.1.3 Important features of Systematic Literature Review (SLR)

Systematic review differs from a conventional expert literature review; some of the features that contributed in creating the difference are stated below [8]:

- One of the important elements in systematic review is the development of the review protocol. The review protocol specifies the research questions being addressed and the methods to be used for undertaking a particular review.

- A defined search strategy is used to conduct the review. The aim of the search strategy is to identify the maximum possible number of relevant literatures.

- The search strategy and results have been documented for the future reference of the reader.

- To assess the potential primary study, SLR requires the specification of inclusion and exclusion criteria for study selections.

- Systematic review specifies that the information needed to be extracted from primary studies and evaluated them through quality criteria. Data extraction forms or other reviewing tools are used to document the extracted information.

- Systematic literature is considered as pre-requisite for the quantitative meta-analysis which provides integrated research studies from various sources on the same subject.

3.1.4 The process of Systematic Literature Review (SLR)

A systematic literature review involves various discrete activities. Three main phases in the systematic literature review are as follows [8]:

- Plan the review
- Implement the review
- Report the review

The above mentioned stages are briefly explained in the following sub-sections.

3.1.4.1 Planning stage in Systematic Literature Review (SLR)

Planning is the initial phase of the SRL which comprises a plan of all the steps to follow. The starting point of the SLR is the identification of need flowed by commissioning the review and formation of the research questions which are to be answered by the SLR [8]. The research question is formulated and presented in the review protocol.

After analyzing the need for the SRL on a particular area, the available databases and sources are thoroughly searched for any SLRs that answer the proposed research questions. The purpose of the search is to find if there already is a SLR that answers the question. A review protocol is developed which specifies the steps involved in the SLR. This pre-defined protocol is necessary to reduce biasness of the researcher involved. The protocol contains all the pre-plans for the SLR, such as [8]:

- Background information of the SLR
- Identity the research question of the SLR
- List of the databases from which various sources of data are to be searched
- Details of inclusion and exclusion criteria
- Checklists for the quality assessment of the individual studies.
- Techniques employed for data extraction are pre-planned and a validation technique is anticipated for the manipulation of the extracted data.
- A time table is prepared for the start dates and deadlines for the various phases of the SLR.
- Finally the constructed protocol is reviewed by experts.

3.1.4.2 Implementation of Systematic Literature Review (SLR)

This phase starts after the acceptance of the protocol review and consists of several steps. The initial step is to identify the sources from which the SLR is performed. This identification process is initiated by searching and querying of all the available databases for primary literature.

3.1.4.2.1 Search process

A search strategy is determined and followed to conduct the review. This search strategy is carried out with collaboration with the librarians and suggestions from experts in the corresponding field. The search is performed on both electronic databases, as well as other possible sources, such as journals, research registers and reference lists obtained from the primary studies. Publication bias should be reduced as much as possible, which means that positive, negative and null results should be published. The entire search process is documented, so that it can be transparent, replicable and possible to reanalyze.

3.1.4.2.2 Study selection

The study selection is used to identify and select the most appropriate and relevant study materials from the search documents. This identification process is performed with study selections criteria which include both the inclusion and exclusion criteria. This criterion is based upon the research question. Study selection is a multistage process, selection criteria should be interpreted liberally so that a study identified by the electronic and manual search can be clearly excluded based on the tile and abstract. The next step is to apply inclusion and exclusion criteria based on the practical issues such as language, journal, authors, settings, participants or subjects, research design, sampling method, date of publication etc. Sometimes, researchers take a third stage in the selection process based on the detailed quality criteria [8].

3.1.4.2.3 Study quality assessment

The quality of the identified primary documents is analyzed, which in turn helps in modifying the inclusion and exclusion criteria. The quality is based on three factors: bias, internal validity and external validity. A quality instrument which is a quality measurement tool is developed to evaluate the quality. This measurement tool is basically a checklist of

factors that needs to be evaluated for each study. The primary studies are evaluated with respect to the demands of the checklist and the quality level of the primary studies is evaluated by using this quality instrument [8].

3.1.4.2.4 Data extraction

The objective of this stage is to design data extraction forms to record the information obtained from the primary study accurately. Data from the primary studies are extracted and stored in the defined data extraction forms. Duplications must be avoided during this phase. Data extraction from unpublished or continued work should be reported and doubts should be clarified with the author of those primary studies. The data extraction strategy consists of two states: preliminary analysis and secondary analysis.

Preliminary analysis

Preliminary analysis is considered as the initial analysis of the obtained search results. The purpose of the analysis is to obtain appropriate research papers which are relevant to the proposed research question. Initially this is done by reading the abstract of the paper, since abstract is short concise version for the entire research paper. After the analysis of the abstract, a decision can be made whether further reading of the research paper would yield sufficient clues and answers for our proposed question. Since there would be a lot of hits for our input search keywords, this preliminary analysis would be the first filtering stage in the analysis process.

Secondary analysis

Once the preliminary analysis finds the relevant hits about the rest of the research paper, then secondary analysis is performed. In this secondary analysis, the heading and sub-heading of the entire research paper are analyzed. The appropriate section of the paper which yields proof and answers for the research question is highlighted and analyzed more deeply. This will give an insight into the research paper.

3.1.4.2.5 Data synthesis

Data synthesis involves collating and summarizing the results of the included primary studies. In short, the extracted data is then synthesized in order to report the results of the examined primary studies. This synthesis of extracted data actually gives the answer to the

proposed research question. The extracted answers may not come from a single study. The final answer could be constructed from hints and clues from several research papers and the extraction can be performed from different forms of sources. All the sources from which the answer is deducted should be specified and recorded so that it will be valuable for the future reference.

An answer to the searched questions can be analyzed and extracted from graph, chart or a theoretical proof of statements. Descriptive synthesis, quantitative synthesis and meta-analysis are some types of data synthesis methods. The synthesized data is then presented using various techniques, such as forest plot, funnel plot etc. Funnel plot helps to identify the extent of publication bias.

3.1.4.3 Reporting the Systematic Literature Review (SLR)

The final phase of a systematic literature review involves writing down the results of the review. SLR is reported either as part of the thesis or in a journal. The latter has a size restriction. It is very important that the review is reported accurately.

3.2 Research methodology

Systematic review is carried out by following Kitchenham and Charters guidelines for conducting Systematic Literature Review (SLR). Journals and articles from different sources are explored by using search keywords. The purpose is to obtain relevant study material to answer the given search questions. In general the review process progresses with the following steps which are adapted from [8]

  i.   Protocol preparation which included defining the process
         ➢ the process
         ➢ the research questions
         ➢ the inclusion and exclusion criteria
         ➢ the analysis procedure
  ii. Conduct of pilot study
         ➢ defining search strategy
         ➢ choosing the digital libraries and other sources of materials
         ➢ searching
         ➢ reviewing the results

      ➢ summarizing and analyzing the results

      ➢ refining the queries for the actual search

iii.   Conduct of the actual search

      ➢ selection of databases and search queries based on the pilot study results

      ➢ searches

      ➢ removal of duplicates

      ➢ application of inclusion and exclusion criteria

      ➢ classification if excluded articles

      ➢ summary and analysis of the results

iv.   Data Extraction

      ➢ review of the articles

      ➢ gathering information from the articles

      ➢ classification of the articles

      ➢ identification of primary studies

v.   Study quality assessment

vi.   Analysis of the results

vii.   Development of conclusions

viii.   Reporting

The review process starts with developing a protocol, which is a detailed plan for conducting the review, including the research questions. The protocol is presented in section 4.1.2; with defined search strategy, and selection and quality criterion for the primary studies of systematic review.

3.3 Systematic review

This section describes the design and the execution of the Systematic Literature Review (SLR). Figure 2 shows an overview about the steps involved conducting the review which are based on guidelines of Kitchenham and Charters.

Start Systematic Review
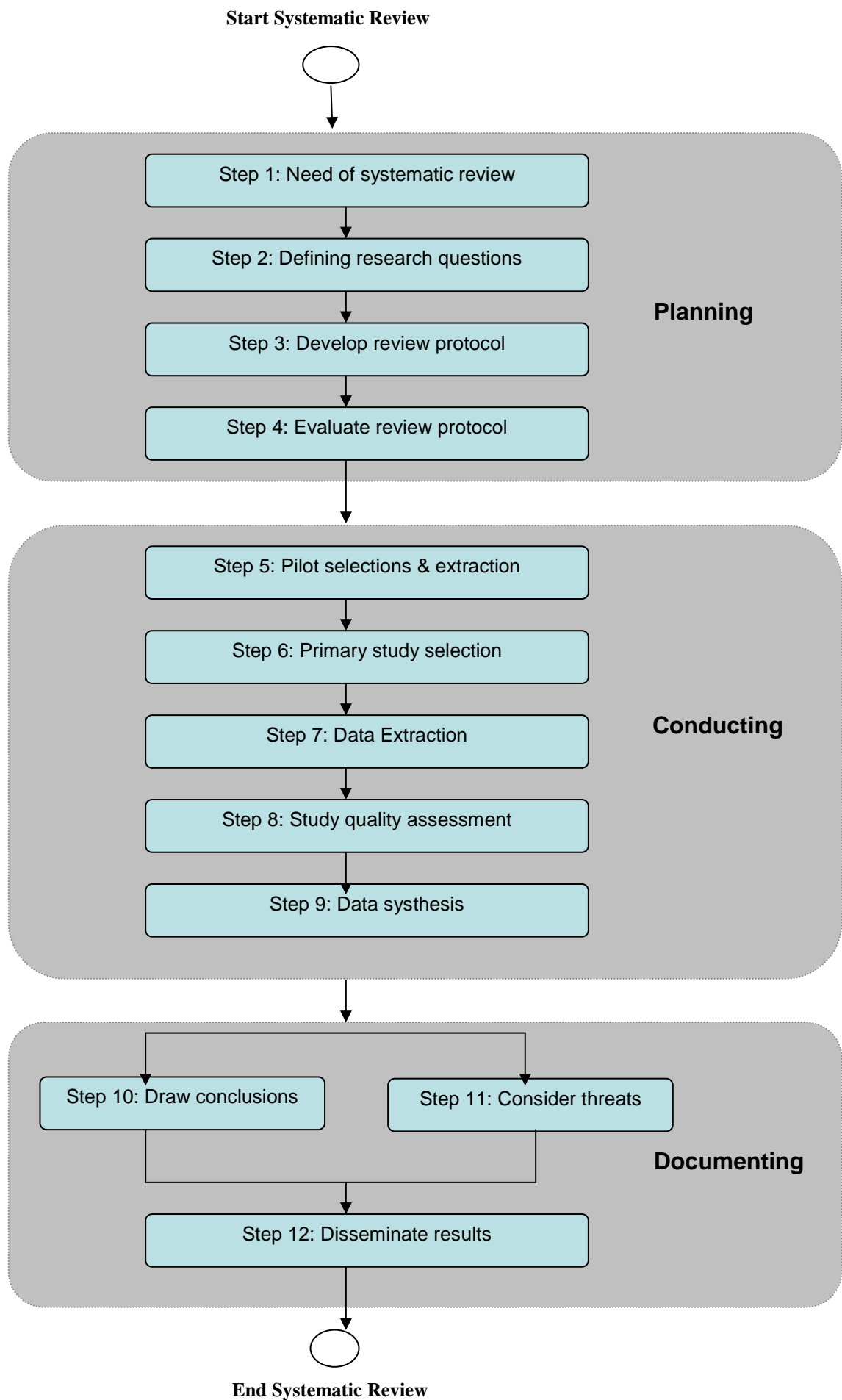
Figure 2: Systematic review steps ([8] [9])

3.3.1 Planning the review

The research starts with identifying the need for the review and developing a protocol including all steps, research questions, inclusion and exclusion criteria, and analysis procedures.

3.3.1.1 Identification of the need for a systematic review

The need for this systematic literature review (step 1, Figure 2) was described in the motivation in the previous chapter.

3.3.1.2 Development of a review protocol

Review protocol is a detailed plan for conducting a systematic review and provides a method for selecting primary studies [8]. This section defines a review protocol which will be used to conduct the actual study. The protocol is developed based on the review process described in the guidelines for performing the systematic literature review [8] which is presented in Figure 2. The review protocol which is adapted from [14] [15] [16] [17], is presented in Appendix A.

3.3.1.2.1 Background

The background information of the SLR is presented in section 2 of this report.

3.3.1.2.2 Research questions

The following research questions will be answered in this study:

ID	Question
RQ1	What is currently known about the project management methodologies in the Agile project management?
RQ2	What are the project management issues which have been addressed by the existing methods (RQ1)
RQ3	Do human and social factors have focus on agile project management?
RQ4	What areas in agile project management require further research?

3.3.1.2.3 Data sources and search strategy

The aim of a systematic review is to find as many primary studies relating to the research questions as possible. In order to fulfill this aim, a search strategy shown in figure is developed and applied to several electronic databases.

The search results are heavily influenced by the database and the keyword used in the searches. To get an overall idea about the quantity of the articles, a quick search is performed. It is defined as a trial search on Google Scholar with the input keyword *agile project management*. The search is modified by placing quotes around the keyword and running the search again. The actual identification of articles follows the developed search strategy.
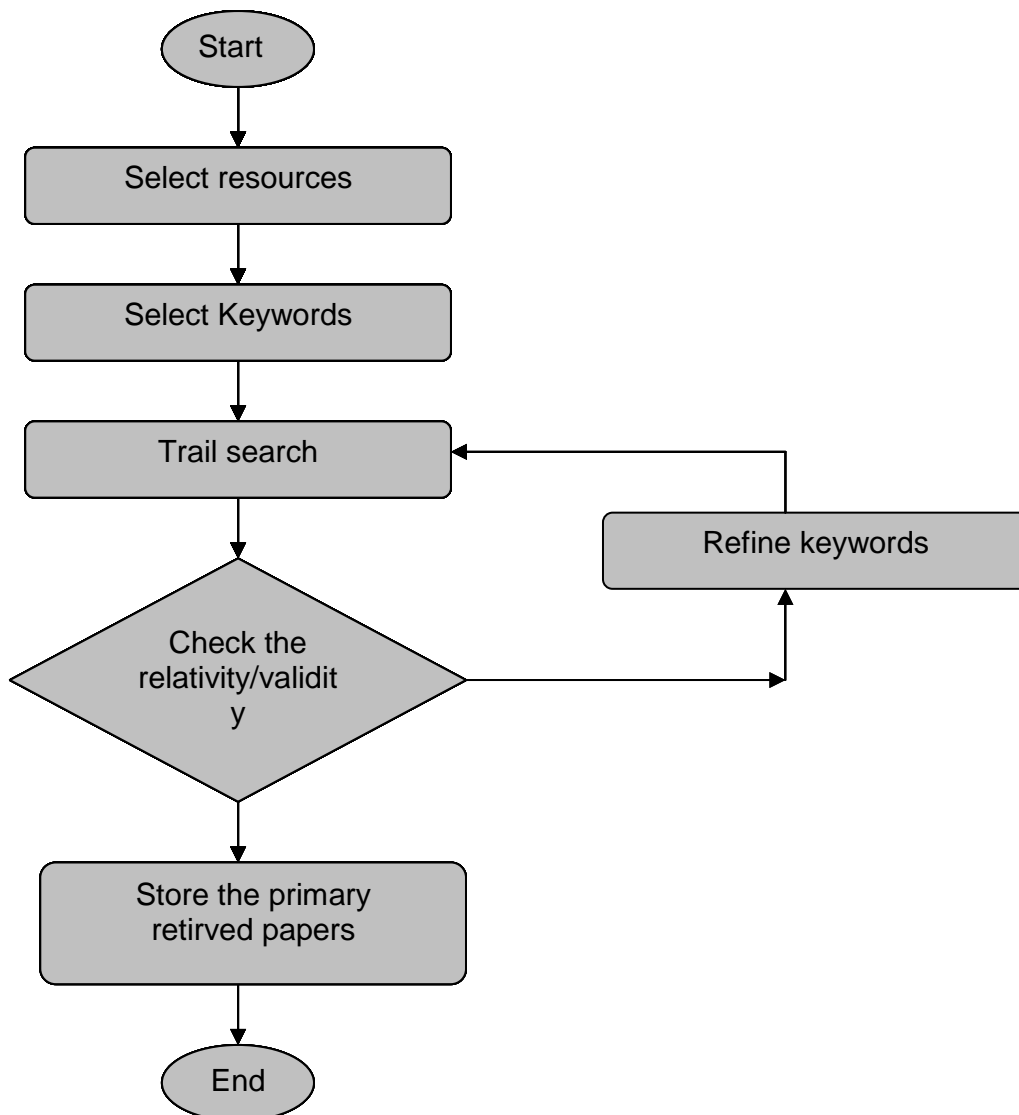
Figure 3: Search strategy (adapted from [9])

26

The process shown in figure 3 will be followed for the identification of papers. The search keywords are derived from the research questions (RQs). The search keyword is composed by the terms representing the population AND intervention in **Table 1.**

Population	Intervention
"agile project management" OR "agile project management methods"	method* OR approach* OR tools *

Table 1: Search keywords

The author of the thesis studied the prior reports on systematic reviews [10], [11], [12] in software engineering field and learned that they had mostly found the IEEE, ACM and ScienceDirect databases as the most useful ones. Therefore, these databases were selected for the searches, including the new ones. Another reason for choosing IEEE is that it is the large innovative association for excellence in the field of technology. ACM remains world's largest database for computer science. Springerlink was chosen because they coordinate with the academicians and authors in the scientific community. The following electronic databases were used:

- IEEE Xplore (http://ieeexplore.ieee.org/Xplore/guesthome.jsp)
- ACM DL (http://dl.acm.org)
- Science Direct(http://www.sciencedirect.com)
- SpringerLink (http://link.springer.com)
- ABI/Inform (http://www.proquest.com)
- Ebsco (http://search.ebscohost.com/)

The search will also be conducted on the following conference proceedings for papers on the use of thesis topic-agile project management.

- Agile Conference

3.3.1.2.4 Study selections criteria

The research study selections are based on the inclusion and exclusion criteria. Therefore, inclusion and exclusion criteria are presented as follows:

Inclusion criteria:

- Include primary studies related to the research questions
- Research article or journal topic closely related to the topic of the research question
- Articles explaining the agile project management
- Both studies conducted in industry and in an academic environment
- The article's full text is available

Exclusion criteria:

- Duplicate copy of the same research study
- Articles that do not describe agile project management
- Articles which were written in languages other than English
- Articles published on websites of the companies and student thesis reports
- Chapter of book will not be studied, only articles are considered for review

3.3.1.2.5 Study selections procedure

The study selection procedure involves studying the title and the abstract of the research paper. If they meet the mentioned inclusion criteria, these articles are considered for thorough and full reading.

3.3.1.2.6 Study quality assessment

Study quality assessment is conducted in order to evaluate the validity of the included studies. As Staples and Niazi [66] have described, it is very challenging to determine to what extent the validity threats have been addressed by the authors. Indeed, the quality assessment is performed based on research paper structure criteria. The potential primary study research paper will be evaluated on structure: Introduction, Research Method, Results, and Conclusion. The answer to the following questions is searched in each potential study.

Introduction: Does the research paper's introduction section provide an overview of agile project management?

Research Method: Does the paper clearly describe the research methodology used?

Results: Does the research paper define the study results? Are the results helpful to find the RQ (search questions)?

Conclusion: Does the paper report both the positive and negative findings properly? Does it also report the limitations imposed on the research?

Therefore, author's judgment about the studies based on papers keyword, abstracts, titles and content's relevance with the study context, publications organization of the research paper (i.e. IEEE) were also applied.

3.3.1.2.7 Data extraction strategy (Data collection)

In this stage, a form is designed in order to record the information obtained from the primary studies. From each primary study paper, data is extracted using a pre-defined data extraction form. Data extracted from each potential study involves some general information and some specific information which is shown in Appendix B.

3.3.1.2.8 Data synthesis

Data synthesis involves collecting and summarizing the results of the selected primary studies [8]. Due to heterogeneous nature of the data of the primary study, qualitative synthesis is performed on the extracted data. The results from the primary studies are documented in accordance to the RQs mentioned in the review protocol.

3.3.1.3 Validation of a review protocol

The review protocol acts as a guideline for the actual implementation of the study, thus it is the most important and critical element of a systematic review. The validation process is necessary to make the study transparent and good quality. Kitchenham [8] has proposed to perform pilot searches for identifying the potential primary studies using the search strings and resources defined in the review protocol. The review protocol developed for this thesis will be verified and reviewed by the Thesis Supervisor who is an experienced researcher in this field.

3.3.2 Conducting the review

This section describes the actual implementation of the review. The search strategy according to the review protocol is applied, starting with a pilot search and followed by the actual search.

3.3.2.1 Selection of primary study

This sub section of conducting the review describes the selection procedure of the papers which is included in the SLR.

Selection of databases and keyword to be given

To get an overall idea about the quantity of the articles, a quick search was performed on Google Scholar with the input keyword *agile project management*. Approximately 85,800 hits were found that include articles, patents, citations, etc. Then the keyword was modified by placing quotes around the keyword and running the search again, after which 2,720 hits were found. This indicates that "agile project management" as a single concept has raised considerably less interest that agile, project and management as distinct keywords. Since the Google Scholar searches across resources like articles, books, theses, abstracts etc [10], to get more precise result we continued our search in various databases. The actual identification of articles follows the developed search strategy presented in the review protocol. The search was conducted in two phases: pilot search and actual search. The main purpose of the pilot search is to identify the appropriate sources of articles. The source is used to find as many articles as possible and refine the search queries [10].

Pilot search

Since the aim of the pilot search is to find as many results as possible, no limitation was defined for the publication year while searching for the articles. In this stage, all the articles related to agile project management were included.

Search results

The result of the pilot search is shown in the Table 2; the result shown in numbers is the total number of the articles that were found with the defined keyword used. The table depicts that the high number of papers found in IEEEXplore, ACM, ABI and Science

direct database, though including paper from the IEEEXplore database remains high. Most of the relevant papers were found from the IEEEXplore digital library. The pilot search shows that the number of the papers found in the ACM digital library is 60, but only 9 papers are taken into study due to the relevance with the research context. Most of the included papers were also present in other database, so these papers were not recorded.

The pilot search resulted in a total of 273 hits that included 84 papers. The articles were selected by studying the title of each article. At this stage, articles with titles which clearly indicate that the articles are outside of the scope of review boundary were excluded and identified 84 relevant studies. The search terms "*Agile project management methods*", *"agile project management issue"* and *"agile project management approaches"* did not produce any relevant results in most of the selected databases, so those were excluded from the actual search phase as part of refinement of query. The inclusion and exclusion criteria such as non-English, non full-text, chapters of a book were applied in pilot search due the huge number of articles found.

Conference proceedings were not searched separately as those were already included in the IEEE database presented in Table 3, which shows the number of published papers on "agile project management".

Duplicate articles were not removed from the pilot search phase, so the results contain some papers several times.

Search Keyword	IEEEXplore	ACM	ABI	Science Direct	Springer	Ebsco	Total
"agile project management"	42/29	60/9	61/19	58/15	10/7	15/5	246/84
"Agile project management methods"	1/0	1/0	7/0	5/0	0/0	3/0	17/0
"agile project management issue"	0/0	0/0	0/0	0/0	0/0	3/0	3/0
"agile project management approaches"	0/0	2/0	3/0	0/0	1/0	1/0	7/0
Total	43/29	63/9	71/19	63/15	11/7	22/5	273/84

Table 2: Number of found and included articles based on the pilot search in various digital libraries

The number of papers including in the studies from the Agile Conference was based on the research articles; all the talks and workshop of type submission were excluded from the studies. In agile conference' 2005; 10 research papers, 25 experience reports and 6

educator papers were presented. Among them one paper was found under the search keyword provided which was included in the study. In Agile Conference 2006, total of 41 papers were submitted, 2 papers were found relevant to the research context and 1 was included in the review. In Agile Conference 2008, 1 paper was included out of 2. Table 3 also shows that 1 paper from Agile Conference 2009 and 1 paper from Agile Conference 2011 were included in the study.

Conference	Number of paper on APM	Included	Excluded
Agile Conference'2005	1	1	0
Agile Conference'2006	2	1	1
Agile Conference'2008	2	1	1
Agile Conference'2009	1	1	0
Agile Conference'2011	1	1	0

Table 3: Result of pilot search on 'agile project management' in Agile Conference

Actual search

The actual search was conducted in several digital libraries with the search keyword "agile project management" on February 18, 2013. The types of papers vary from empirical academic papers, industry experience case studies and theoretical studies. During the actual search, the search terms were searched in the selected papers abstracts and keywords. 51 papers were found in this stage.

Search results

Search Keyword	IEEEXplore	ABI	Science Direct	Springer	EBsco	Total
"agile project management"	27	8	7	5	4	51

**Table 4:** Result of actual search (table structure adapted from [10])

The final selection of the paper followed four screening criteria (quality assessment form Appendix C) to ensure that the selected paper addresses our research topic [18]. The articles title, abstract, keywords and conclusions were studied based on the screening criteria as follows:

1. Does a paper address the software project management in terms of agile way?
2. Does a paper discuss any industry case study of using agile project management?
3. Is the objective of the paper clearly mentioned?
4. Does the paper provide some hint for the RQs answer?

Figure 4 shows the primary study selection process and the number of papers identified at each stage. The search process started with pilot search where various search keywords were used to identify the papers from different database which is identical in figure 4 stages 1. At stage 2, the titles of all the identified 273 papers were analyzed. At this stage those papers that did not cover agile project management specifically were excluded. However, titles do not clearly indicate what an article is about. "*Some authors' use of 'clever' or witty titles can sometimes obscure the actual content of an article*" [19]. In such scenario, the articles were included for further study in next stage. At this stage, a total of 189 articles were excluded.

At the next stage, the abstracts and keywords of papers were skimmed to find the search term "agile project management" and 51 papers were found. The final stage (stage 4) was completed by quality assessment of the papers; four screening criteria were defined for studying the articles. A paper was included if it passed the screening criteria. In this phase, duplicate papers were also removed from the study. Ultimately, 44 papers were selected for the final review.
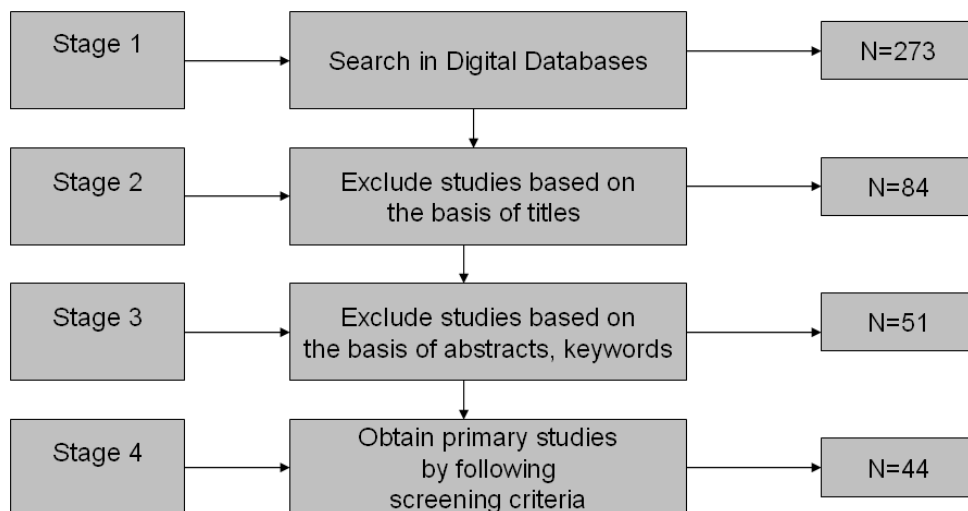
Figure 4: The selection process of primary studies [18]

Data extraction

During the data extraction phase, the data extraction form was used which was defined in the review protocol. Data was extracted from each of the 44 primary studies included in the review. The form enabled recording the full details of the papers, from general information of the papers to specific information, such as how to find the answers of the research questions.

Data synthesis

The extracted data is synthesized in such a way that it answers the research questions defined in the review protocol. The synthesis of data can be descriptive form and it can be complemented with quantitative summary of data. Other forms of synthesis are qualitative synthesis and quantitative synthesis [20].

Descriptive synthesis involves the extracted information about primary studies, including intervention, population, context, sample sizes, outcomes, study quality etc presented in consistent way according to research questions. The presented tables should be structured to explicitly highlight the similarities or differences between the study outcomes [20].

In quantitative synthesis the integrated results from the different studies are presented in tabular form which includes sample size of intervention, estimated effect size for each intervention with standard errors for each intervention, difference between the mean values for each intervention, and effect measuring unit used [20].

In primary studies researchers may have used different language terms and concepts with different meanings. Qualitative synthesis involves integrating such study results and conclusion cautiously [20]. Nobit and Hare [21] discussed about various approaches and phases of qualitative synthesis.

In meta-ethnographic synthesis, studies can relate to one another in three ways: directly comparable as reciprocal translations; stand in opposition to one another as refutational translations and represent a line of argument [21]. The table 5 shows seven-step process for conducting a meta-ethnography.

Sequence no.	Phase
1	Getting started
2	Deciding what is relevant to the initial interest
3	Reading the studies
4	Determining how the studies are related
5	Translating the studies into one another
6	Synthesizing translations
7	Expressing the synthesis

Table 5: Seven-step phases of meta-ethnographic [21]

The data was synthesized by identifying the theme emerging from the findings reported in each paper reviewed in SLR. The aim of the theme study was to find answers to the proposed research questions (RQs). In order to find the studies which can provide answers to the RQs, qualitative synthesis was used where the author of the thesis read and analyzed the research articles. First individual studies were analyzed and then, a set of individual studies was analyzed as a whole. All the identified sources from which the answer is deducted is specified and recorded as a reference of the studies.

3.3.3 Reporting the review

The results of the study are reported in this phase according to the review protocol. During the review, relevant data was extracted using the data extraction forms, the collected data was synthesized using appropriate data synthesis approaches and finally report was produced. The next chapter presents the results of the systematic review.

4. RESULTS AND ANALYSIS

44 studies on agile project management were identified which cover different study area, such as empirical study, industry experience report, case study, survey etc. Each study was reviewed by analyzing the context of the study, research questions, and empirical confirmation of the result. The studies cover a range of research topics within agile project management area and were conducted with a multitude of research methods.

The studies were categorized into the following main groups:

- APM introduction and adoption
- APM methods and approaches
- Team factor
- Comparative studies

Four (4) studies [41] [39] [44] [35] did not fit into any of the above categories. Hence, the content varied from one study to another. Two studies [35] [41] presented the connection of agile towards PMI. One article [39] provided information on properties of thriving systems and scrum architecture, which was regarded as too technical and architecture centric. The last one [44] presented an improvement theory in the area of project management approach based on OOSP.

The next section describes the characteristics of the studies. Then a summary of the included articles is provided, followed by a description of the included studies in the main categories defined.

4.1 Overview of studies

Publication year

Table 6 shows the number of papers published on agile project management in each year during 2005-2012. It can be argued that the publication volume of each year may be an indicator of researchers' growing interest in agile project management.

Year	2005	2006	2007	2008	2009	2010	2011	2012
Papers	6	0	1	5	8	9	9	6
%	14%	0%	2%	11%	18%	20.5%	20.5%	14%

Table 6: Year wise distribution of selected papers

Research method

The type of studies varied from empirical study, industry experience report, survey, case study and mix of both case study and empirical study. Table 7 shows the type of study reviewed. 25 studies (57%) were classified as empirical study which remains the highest among the categories. Total number of case study papers was 7 (16%), while the number of surveys was 3 (7%). Most of the case studies and surveys were from small and medium size companies in telecom industries. Total of 7 papers out of 44 present some industry experience report, and 1 study compares the agile project management and CMMI project management.

Study focus	Number of papers	Percentage	Reference
Empirical study	25	57%	[24][26][27][28] [29][30][31][34] [35][36][40][44][45][46][48] [49][50][54][55][56][61][62][63][65]
Case study	7	16%	[38][32] [42][47][53][58][64]
Survey	3	7%	[22][52][57]
Experience report	7	16%	[23][25][33][37][41][43]
Comparative	2	4%	[51][59]

Table 7: Types of study reviewed

27 out of 44 studies were conference paper and the remaining studies (17) were published in journals.

Units of analysis

In order to provide a summary of the included articles, several units of analysis were identified. These units serve as the basis for the analysis. The formation of units of analysis was done by identifying the theme emerging from each selected study. Each article's title, abstract, keywords, research methods, and conclusion were studied to depict the main focus of the study; which finally intended to define the particular unit of analysis of the reviewed research paper.

The identified units including its subcategories are shown below:

A. Adoption and awareness

- ➢ transformations towards APM tools
- ➢ SCRUM
- ➢ Distributed Scrum
- ➢ Challenges and opportunities

B. Company context

- ➢ Agile leaders
- ➢ Success factors
- ➢ Knowledge acquisition
- ➢ Lesson learned
- ➢ Experience

C. APM Framework

D. APM approaches

- ➢ Agile approach
- ➢ Agile attributes-to PMI
- ➢ APM in ubiquitous multi-projects environment

E. Requirements analysis

F. APM Methods

- ➢ Scrum, XP
- ➢ Lean development
- ➢ Mapping
- ➢ Distributed Scrum
- ➢ Release scheduling

G. Thriving systems theory

H. Improvements

I. Improvisation

J. Decision making

These 44 studies were analyzed based on unit of analysis. Table 8 summarizes the information about the studies selected for the review.

Units of analysis	Study topic/Area (summary)	Research approach	Type, Year, Ref
adoption and awareness	APM implementations, challenges and recommendations, Awareness of APM analyzed using three dimensions: business related industry related and theoretical.	Survey	conf,2010, [22]
company context - moving towards APM	Benefits of agile, problems and issues. Established three practices called Quality Practices, based on agile software development practices such as test-driven development, continuous integration, and planning with user stories	Industry experience	conf, 2012, [23]
APM in ubiquitous multi-projects environment	agile project management approach,Scrums,XP	Empirical	conf, 2010 [24]
company context, SCRUM, lean development	agile project management in Toyota way using lean development	Industry experience	conf, 2005 [25]
APM Framework	provide a APM framework which includes phases and stages of project management process in the frame of whole product life cycle.	Empirical	conf,2010 [26]
APM approaches	Extension of agile project management approach by Scott.W.Ambler to serve industry other than software	Emperical	conf, 2008 [27]
mapping	Provide guidelines and best practices that can help in successful agile BI implementations.	Empirical	conf, 2011 [28]
progress	Simplified set of earned value calculation in release level named as Agile Earned Value Management (EVM). AgileEVM	Empirical	conf, 2005 [29]

	was introduced in two small project to validate the authors research context.		
success factors	Critical success factors for agile project management from organization perspective	Empirical	conf, 2009 [30]
Knowledge acquisition	Identify collaboration among actors for knowledge acquisition in agile project management as well as provide mechanism for collaboration. A collaborative Semantic Web Portal Prototype is developed.	Empirical	conf,2005 [31]
Distributed Scrum	Agile project management with outsourced developed team. The company's scrum team consists of developers from multiple sites in various locations.	Industry experience with case study	conf, 2007 [32]
Lession leaned	Experience and lesson learn about managing project portfolio in agile way.	Industry experience (large company)	conf, 2008 [33]
APM approaches	Exploring the transient nature of agile project management practices based on two large scale projects.	Empirical	conf, 2010 [34]
agile attributes-to PMI	Describes the agile attributes of the agile community such as project, team, increments and iterations, roles, commitment etc.	Emperical	conf,2009 [35]
requirements analysis	Requirement analysis process under the guide of Scrum	Emperical	conf,2012 [36]
SCRUM	Adaptation of the SCRUM Agile Project Management Methodology in the context of the development of academic projects.	Lesson Learned/Experience	conf, 2009 [37]
APM Method-Scrum	Analyze scrum method, development flow and process through the case study software project of land-use system.	Case study	conf,2009 [38]

thriving systems theory	Properties of thriving systems and scrum architecture.	Empirical	conf, 2012 [39]
APM methods	Agile methods such as scrum,XP,lean software developement,FDD,DSSM with a proposed ontology project.	Empirical	conf,2008 [40]
Lesson leaned	Experience of teaching APM principles as part of the Project Management Institute (PMI)	Experience report	conf, 2005 [41]
adoption	Present the need for adopting agile methodology (Scrum) in the development of Cyber Forensic Tools.	Case study	conf, 2010 [42]
transformations towards APM tools	Experience on adopting agile project management tools, the transformation covers over a two years time span. Transformation not only affected the product team but also the entire organization.	Experience report	conf,2008 [43]
improvements	improvements in the area of the project management, approached based on OOSP	Empirical	conf, 2009 [44]
Adoption	Using Scrum as part of class project with measuring the outcome.	Empierical	conf,2012 [45]
requirement analysis	COSMIC method is used to analyze the quality of the user stories.	Emperical	conf,2011 [46]
Distributed Scrum	Case analysis to identify the success factors of distributed scrum.	Case study	conf, 2011 [47]
APM methods	Incorporated the APM method	Empirical	conf,2011 [48]
APM Approaches	Agile and traditional project management comparison.	Empirical	Journal ,2009 [49]

Agile approach	Agile approaches (i.e. Crystal Clear method) suited to innovation and creative teams for rapid development of products.	Empirical	Journal, 2010 [50]
Improvisation	Comparison among improvisation and APM, common areas of two working styles are exposed.	Comparative	Journal, 2009 [51]
Adoption	The questionnaire based survey shows adopting agile methods improve management of development process and customer relationships	Survey	Journal, 2005 [52]
Decision making	Reasons for ineffective decision making in agile team	Case study	Journal,2009 [53]
Agile leaders	A change in thinking that if fundamental to a success agile project.	Empirical	journal, 2011 [54]
decision making	Examine decisions made across four stages of the iteration cycle: Iteration planning, execution, review and retrospective.	Empirical	Journal,2012 [55]
progress	Indicators for track and report progress of the project.	Empirical	Journal, 2010 [56]
release scheduling	conceptual model for agile scheduling	Industry experience/Survey	Journal,2011 [57]
Adoption	APM techniques adopted in order to ensure that project remained responsive to change management.	Case study	Journal,2011 [58]
mapping	mapping between CMMI and the agile method Scrum	Comparative	Journal, 2008 [59]
adoption	adoption and architectural extensions of the Scum method in developing new service applications of large financial IT systems	Case study	Journal,2012 [60]
Challenges and opportunities	APM in E-Science	Empirical	Journal, 2011 [61]
APM method -	APM using the Scrum	Empirical	Journal,2010

Scrums	methodology as a method for more effectively managing and completing projects.		[62]
Planning and Controlling	Evaluation of agile method for planning and controlling innovative project.	Empirical	Journal, 2010 [63]
APM method	The agile method DSDM should enhance user participation as well as improve other aspects of the management projects.	Case study	Journal, 2011 [64]
APM method	APM methods	Empirical	Journal, 2005 [65]

Table 8: Summary of the included studies

APM introduction and adoption

Thirteen(13) studies[22][23][25][31][32][33][42][43][45][47][51][58][60] addressed how agile project management is introduced and adopted in various companies, and in class room as graduate course. The natures of these papers are mainly based on survey and case study. The studies showed that, adopting agile methods improves management of development process and customer relationships, knowledge sharing, better collaborations and communications. One study [23] focuses on awareness of APM; awareness was analyzed using three dimensions: business related industry related and theoretical. Two studies [32] [47] addressed distributed Scrum, where scrum team consists developers and testers from multiple sites which are geographically separated locations.

APM methods and approaches

Major percentage of the studies included in the thesis falls into this category. This category varies from APM methods such as Scrum, XP, lean software development, crystal, FDD, DSDM etc. Articles which addressed the basic agile project management concepts like planning of release, project progress monitor, requirement and change management also fall under this board category. Total twenty one (21) studies [24] [26] [27] [29] [30] [34] [36] [37] [38] [40] [46] [48] [49] [50] [56] [57] [61] [62] [63] [64] [65] out of 44 can be listed under this category. Among the studies, two studies [29] [56] addressed project progress measure and monitor through agile method, two of them [57] [63] covered the

release scheduling and planning and controlling. Requirement analysis and change management are important stages in management of project, and two studies [36] [46] discussed this area. Rest of the papers addressed the tools used in agile project management.

Team factor

Not many studies addressed team issues, such as motivation, social skills, and communication as a main study area. These were addressed as part of the APM methods. Three (3) studies [53] [54] [55] fitted into this category which mainly covers the decision making among agile team and leadership.

Comparative studies

Only three studies [51] [59] [28] present comparative analysis. One study compared CMMI and the agile method Scrum. The study addressed major gaps between CMMI and Scrum and identified how organizations can align these two processes. Another study provided a comparison among improvisation and APM and the last one provided guidelines and best practices that can help in successful agile BI implementations.

5. DISCUSSION

This section discusses the answers found to the research questions defined in the earlier chapter.

A) RQ 1 - What is currently known about the project management methodologies in the agile project management?

The purpose of this research question was to identify the currently known methods in scope of agile project management. There are 15 papers that can help find an answer to the research question 1(RQ1)," *What is currently known about the project management methodologies in the Agile project management?*"

Analysis of the extracted data revealed that most of the papers in this scope mainly focused on Scrum and Extreme programming (XP) as a popular method in agile project management. Some of them discuss methods such as lean software development, crystal, FDD, DSDM. Based on the SLR results, the well known methods of APM are as follows:

SCRUM Method

One article [62] particularly addresses agile project management method through Scrum. "*Agile project management is an outgrowth of the agile software development* [62]". Agile project management is deeply rooted in the principles of manifesto for agile software development. APM emphasizes two important concepts, project risks minimizations and direct communications with partners. The risk is minimized by focusing on short iterations of clearly defined deliverables. Communications with related stakeholders help project team adapt quickly to the rapidly changing requirements. These concepts are realized through using of Scrum method. "*In terms of APM, a Scrum is simple and agile, lightweight process for managing and controlling software and product development in rapidly changing environments [62]*"

Articles [24] [37] [38] [40] [62] provide deep knowledge of Scrum method. Scrum provides APM techniques by more concerning with team organization, planning of work, division of responsibilities among involved parties. The Scrum method is built on three main components: roles, process, and artifacts [62] .The traditional project manager role is absent here and a new role introduces a Scrum Master (SM). These following roles are involved in Scrum:

Scrum Master (SM) is responsible for practices of scrum values and removing impediments.

Scrum team typically is a cross-functional team which consists of five to ten people, the team is self-organizing.

Product Owner (PO) role has the ownership of the product. The PO needs to convey the requirements as clearly as possible. PO is responsible for Product Backlog (PB) which is a prioritized list of requirements, and ensures that the functionalities with highest priority are developed first.

The Scrum process consists of the following activities: kick off, sprint planning meeting, sprint, daily Scrum, and sprint review meeting. Sprint planning meeting is a meeting of the Scrum team, Scrum master and product owner. It takes place at the beginning of each sprint. In the meeting product owner presents the user stories from the product backlog which is a list of user stories ready for developing. This meeting generates the sprint backlog which a list of user stories. Team commits to delivering sprint backlog items at the end of the sprint.

Once the sprint planning meeting is done, the sprint begins for an agreed number of weeks (i.e. four weeks) during which the team develops the stories from the sprint backlog.

In the daily scrum meeting that typically lasts 15 minutes, each team member's answers three questions:

- What did you do since the last Scrum?
- What are you do doing until next Scrum?
- What obstacle did you face with your work?

Thus, the main purpose of the daily scrum is to monitor the progress of the team, as well as allow team members to communicate with each other and resolve the impediments with the presence of the Scrum master.

The sprint review meeting is held at the end of sprint to demonstrate the developed user stories to the product owner.

The sprint retrospective meeting is done at the end of each sprint to analyze the action list in order to improve in the next sprint. The team tries to find the good and not so good things from the last sprint which consolidate as an action plan. Each team member answers the following questions: What was good in the last Sprint? What should be improved?

The artifacts of the Scrum model include the product backlog, the sprint backlog and the burn down charts. The product backlog is the prioritized list of requirements which is managed by the product owner. The product backlog is presented in the sprint planning and the team provides estimations for each backlog item.

The sprint backlog is the subset of product backlog items for a particular sprint. The team commits to complete the sprint backlog item.

The progress of the sprint can be seen through a burn down chart. The purpose of the burn down chart is to provide information about the ongoing sprint in an easy and comprehensive way. Each task is typically represented in terms of time (shown in x-axis in the graph) and duration (the y-axis). A typical sprint burn down chart depicts the total sprint backlog hours remaining in the sprint per day as an estimated amount of time left in the sprint. A burn down chart can be depicted for sprint, release and product. The sprint burn down chart presents the progress of the sprint; a release burn down chart shows the progress of the release and, a product burn down chart documents the overall project progress.
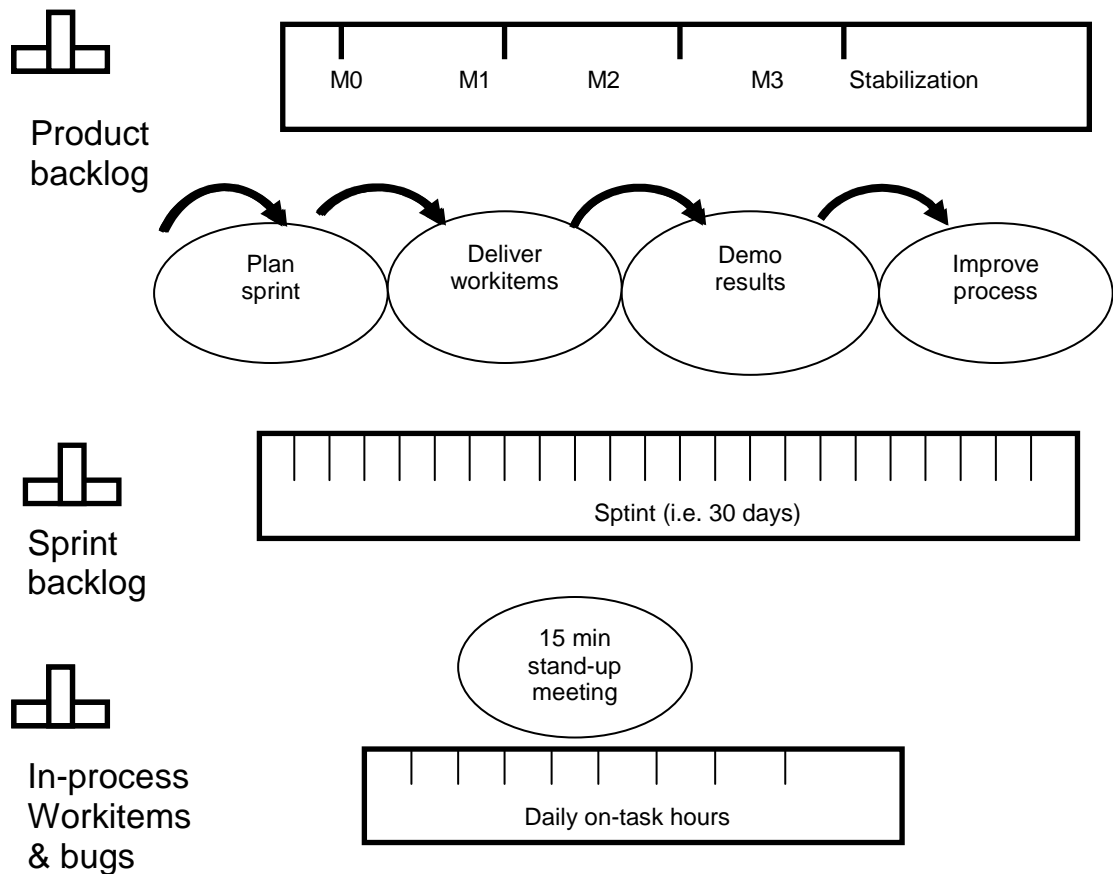
Figure 5: Development flow in SCRUM ([38])

A recent trend can be identified from the result which is distributed Scrum: managing project in geographically separated teams. Articles [32] [47] shows managing multi-site project using Scrum. The article [32] addressed the challenges encountered in global team.

Extreme programming as a method

Extreme programming (XP) is a representative methodology for managing agile projects shown in figure 6. XP provides a software development life cycle by simplicity, feedback, respect, and courage. In XP, a requirement is represented as a story which is a unit of work description defining how a system is executed. Development team follows the XP plans for developing software with the concept of story cards which is mapped into unit of work. XP has a series of principles [24]:

  ➢ XP practice a whole development cycle with short releases
  ➢ Planning is performed together with customers. Developers estimate the needed effort to implement the stories and customers decide the scope and timing of releases.

48

- ➢ Customers are available full time for providing feedback
- ➢ Software is developed in test-driven development where developer writes code for the test first.
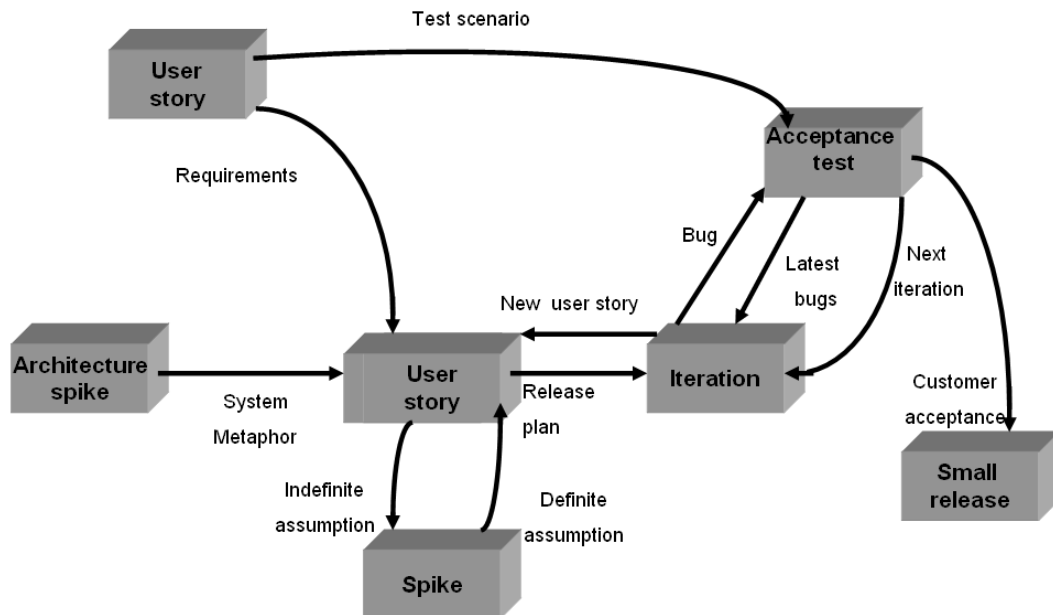- ➢ Pair programming is used when writing code.

Figure 6: Life cycle in XP ([24])

Therefore, it can be observed that the method is lightweight, customers are focused and there is very little management overhead. Risks are managed due to small iteration and involvements with customers.

Crystal clear method

Crystal clear method is mentioned in several studies [38] [40] [50], though only one article details the method [50]. Crystal is a family of methodologies (Clear, Yellow, Orange and Red) originated by Alistair Cockburn. The method is based on project size and criticality. The number of people involved are about 1-6,-20,-40,-100. The criticality determined by defects which cause loss of comfort, discretionary money, essential money or life. *"As the team size grows, Crystal implementations change to add more formality to the structure and management if the project [50]"*. Depending on the nature of project criticality, the rigidity of the project needs to be increased to ensure that the expected demands can be delivered. Therefore, Crystal method acknowledges that each project may require tailored

set of policies and process to meet project's unique characteristics. Crystal method focuses on people (people centric), communication and conversations among people." *The focus is on achieving project success through enhancing the work of the people involved, to reduce the paperwork and bureaucracy to the least that is practical for the parameters of that project, and to start with something just smaller than you think you need, and grow it just enough to get it the right size for you[50]*".
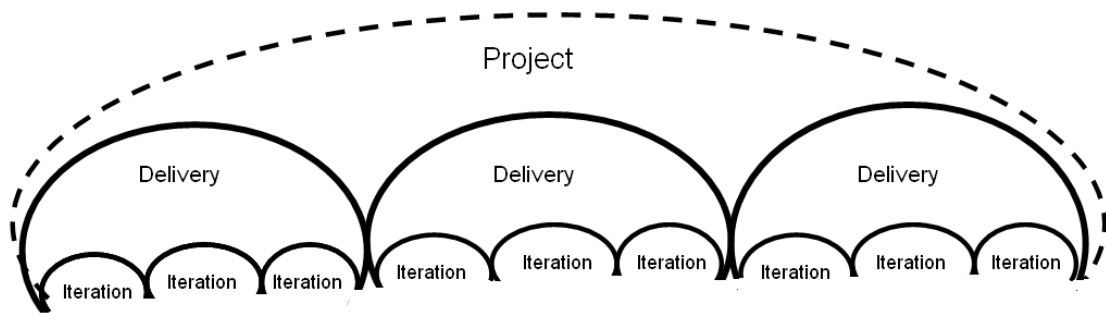
Figure 7: Iteration and delivery cycles with a project ([50])

Figure 7 shows that the method uses nested cyclic processes of various lengths: the development episode, the iteration (i.e. one week to three weeks), the delivery period and the full project.

There are several defined properties of successful project in Crystal. The first three from the following lists are required, while the presence of the next four helps the team to reach in the safety zone where team members are most comfortable and working at their best.

1. Frequent delivery: as the development is conducted in small iteration since deliverables are ready in every couple of months. Stakeholder can see the deliverables, intermediate versions and be able to provide feedback.

2. Continuous feedback and reflective improvement: team member focuses on the activities to ensure that the project is headed in the expected direction.

3. Constant communication with co-locations. Team locations bases on the project size, small project expect the entire team to be located in the same room, and the larger projects expected to be co-located in the same facility.

4. Personal safety: team members can communicate and be effective without fear of reprisal.

5. Focus: team members knows the top prioritized items which need to be delivered first and then each member should given time to complete them without interruption.

6. Easy access to users, stakeholders, and experts

7. A technical environment: that supports version controlling, automated testing, and continues integration of the system components.

Lean programming as method

Lean programming focuses on eliminating anything which does not add value to the final product which means that, to define, build and deliver complex software system which is exactly what a business really needs to stay competitive in the market. A lot of effort is put to gathering proper requirements that are also defined in clear, complete, and verifiable ways [50].

Dynamic systems development method (DSDM)

DSDM as an agile method has been found from the study [64] which addressed how to achieve high user participation using this method. The DSDM framework is built and used since the early 1990s by DSDM Consortium members. DSDM method claims to recognize that most of the projects fail because of people issues rather than due to problems with technology. Therefore, DSDM method takes care of both social and technological aspects of the developed system. The goal is to improve communications among stakeholders and project team. "*The approach views people, process, and technology as intertwined components of any business solution. Changes to one component will affect the others; therefore a business change project must include and manage all three aspects [64]"*. The various activities of DSDM include planning, mapping end-users needs, describe the new system, select architecture, design, model, code and test which are mostly similar to any APM method.

The results show that methods like EVO, Sprial model, Future Driven Development (FDD), Agile Unified Process etc. were also mentioned in several studies[25][40], but further information about the methods could not be found.

Although several methodologies are covered in the agile project management area, very little is mentioned about other methods. For example, in the lean programming method

much focus remains on gathering the requirements, although it is only one phase in project management. It does not enlighten anything about progress tracking or managing a project. The study results also show that Scrum and XP are most popular APM methodologies since their presence frequency in the published papers is quite high compare to other methods.

B) RQ2 - What are the project management issues which have been addressed by the existing methods (RQ1)

The project management activities are scope, plan and launch, monitor and control, and close [59]. The purpose of the RQ2 was to figure out what kinds of issues are addressed by the study in relation to project management activities by using of APM methods. The study identified only 4 papers [42] [36] [49] [56] which can guide to find the answer of the research question 2, "*What are the project management issues which has been addressed by the existing methods (RQ1)*"

Requirement phase is a fundamental and important phase in the development life cycle, as this phase defines what is to be built. The costs of fixing errors in the system are not the same in different stages of development life cycle. As shown in figure 8, the statistical results from TTE, TRM and IBM depict that the later the errors are found, the bigger costs their fixing will generate [36]. Therefore, managing requirements is the most fundamental function.
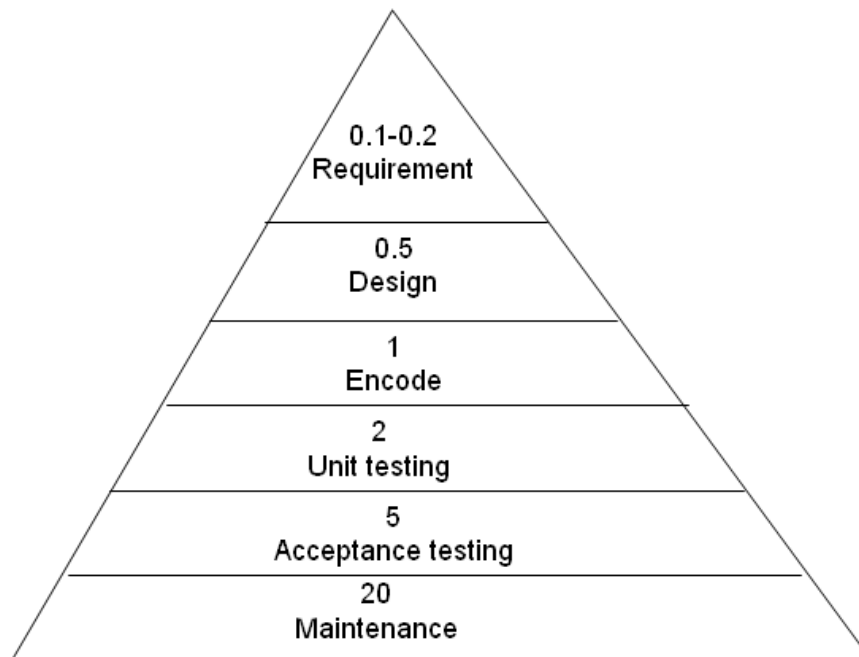
Figure 8: Cost of projects required to correct mistakes in different stages [36]

APM methodologies accept changes in requirements during the software writing stage and continuous feedback, thus the errors in the requirements correction time and effort are minimum.

Monitoring progress and reporting about it are basic functions during the project execution. In Scrum environment, the progress is tracked and reported by using burn down chart in sprint, release or product level. The burn down chart shows two key indicators: the overall rate of progress and the amount of remaining work [56]. The entire team member is aware of the status of the project through participating in daily scrum meetings, collaboration and communication. Customer and product owner could provide feedback in the sprint review meeting and after delivery of iteration. Therefore, corrective measures can be considered and addressed early.

The study results suggest that the project management issues, challenges and their possible solutions covered less in the research of agile project management. The current research focuses on the APM methods in general. Agile Method focuses on the minimizing of risks involved in every phase. The incremental and iterative natures of the agile project

management method address the risk minimization, for example: focusing on the short iterations of clearly defined deliverables helps to identify and mitigate the risks early.

C) RQ3- Do human and social factors have focus on agile project management?

Team work and collaboration are two major principles of agile method [31]. In order to be successful in an agile project, each member must be a team player. Thus, one objective of this thesis was to find out if any kind of human and social factors have been discussed in the APM studies. One paper [31] discussed knowledge sharing among team members, providing a model for collaborative knowledge acquisition through prototype. Team characteristics, such as good interpersonal skills, respect for others, responsibility, interactions, self-organization and collaboration are the most important human and social factors for a successful agile project. The study results show that most of the Scrum papers provide overview of the human and social factors.

Human and social factors, such as decision making and the quality of the agile leader are covered in the study [53] and [55] respectively. Several aspects which influence the decision making and related outcomes (group interaction, for example) are considered as important human factors. APM method practices mediate the interaction between individuals and the team as whole and support social identity and collective effort through focusing on providing commitment for the delivery as a team.

D) What areas in agile project management require further research?

The current global business nature enables geographically separated locations, people from different time zones working in the same project, difference in work culture etc. In such environment, a trend of using distributed Scrum has been observed only in two studies [32] [47]. This area could be a possible candidate for further empirical research, which would help the business remain global.

Only one paper covered [29] measuring Earned Value Management (EVM) in agile project. Scrum method focuses on maximizing Return of Investment (ROI), but does not define how to manage and track cost to evaluate actual ROI against vision [29]. The study adapted EVM using values defined in Scrum which is called AgileEVM (Agile Earned

Value Management). ROI in agile methods could be studied more, because analyzing ROI helps businesses to stay on the right track.

Very few articles discussed the issues and challenges that have been addressed when using APM methods. Most of the studies generally discussed about the APM methods, without explaining much about the project management context. That is why APM issues and their possible solutions should be researched further.

Moreover, analyzing the human and social factors in the context of agile project management could be a potential topic for further research. It could be particularly interesting to study which human and social factors affect the success of projects managed by APM methods.

6. LIMITATIONS AND VALIDITY THREATS

In this chapter, limitations of the review and validity to threats are identified and discussed.

There are several limitations of the SLR that should be taken into consideration while working with the reported findings:

➢ Only research articles were included in the study.
➢ The review did not include chapters of books about agile project management.
➢ The review only included articles that were accessible in the listed digital databases in review protocol.
➢ The review only included articles that were available in full texts.

Validity threats constitute a factor that can influence the accuracy of research in a negative way. For this reason, it is important to identify and handle these threats to make the review results as reliable as possible. The study has several threats to validity, which are divided into four categories: investigator bias, publication bias, biasness related to primary studies and threats to data extraction process and its results.

Since the review was conducted by an individual researcher, there is higher potential of threats to validity in comparison with review conducted by several researches. In order to tackle this biasness, the author carried out some tasks twice to ensure the quality of the work. For example, reading the abstracts was conducted twice to minimize possible mistakes by author.

Publication biasness is related to the problem that positive results are more likely to be published than negative results [8]. There is a chance that the author may have included some articles which are not solely on agile project management, since the search keyword was generic "agile project management" which could also include some papers that focus on agile development. In order to mitigate this problem, the author performed a pilot search which was followed by the actual search. Defining the search strategy in the review protocol also helped to minimize the publication bias.

In order to minimize the threats to identification of primary studies, the search strategy defined in the review protocol was used to cover as many studies as possible; the search string was applied in several most well known databases. In addition, the titles and the abstracts were read several times to include the right studies.

Another threat to validity is related to data extraction phase. The author defined the data extraction form and data extract process while designing the review protocol and followed that to record information about studies. This procedure helped to minimize the data extraction process bias.

7. CONCLUSION

The thesis presented a systematic review of literature on agile project management (APM). The aim of the work was to identify currently known methodologies for agile project management, as well as issues and challenges addressed by the method. Additionally, research was conducted with an intention to find out if any focus has been established among human and social factors, and APM.

The review was conducted by following the guidelines of Kitchenham and Charters [8] about conducting a systematic review, and it fulfilled all the requirements of standard systematic review. The defined search strategy identified 273 articles, of which 44 papers, published between years 2005-2012, were included in the review as primary study papers. The thesis answered all the research questions which were defined in the review protocol and achieved the set aims and objectives. The results of the review were presented in several stages. Initially, the studies were categorized and presented into four main groups: APM introduction and adoption, APM methods and approaches, team factor and comparative studies. Quantitative data presentation showed year wise distribution of published papers and types of studies based on the used research method. In the following stage several units of analysis were indentified and a summary of the included articles was presented. In the last stage, data extraction and synthesis was carried out in order to find answers to the research questions (RQs).

The results of the review show that most of the case study based papers are about adoption of agile methods: experience reports about how practitioners implemented agile methods. This provides an overview of adoption process and possible challenges. The study results also show that there are several APM methods, such as Scrum, extreme programming (XP), Crystal clear method, DSDM and lean programming. All of the methods enable iterative and incremental development focuses in a team, communications and collaborations and minimum documentation. The results suggest that current research on agile project management methodologies addresses an overview of the various methods without explaining the context of project management in detail. Although the empirical based research is important for a deep understanding of the APM methodologies, work from the practitioners to address the challenges and issues and their possible solutions by

using APM methods seems insufficient. Some work has been done on managing global projects using distributed Scrum by the practitioners, which gives some indication on how software industry can successfully adopt distributed scrum and manage geographically separated teams. Most of the Scrum papers shade light on the human and social factors, such as good interpersonal skills, respect and responsibility, interaction among team members, self-organization, work through collaborations, shared responsibilities and collective effort towards a shared goal. These factors play an important role in the successful adoption of APM methodologies.

The results of the review are expected to help researchers, software managers, and software engineers by providing information on the existing methods of APM, research that has been conducted so far on APM, and about the areas that require further research.

7.1 Future work

Though the results of the review provide an indication for the APM as a whole, some suggestions for further research have been provided in order to enhance the review results. The author of this thesis plans to conduct a comprehensive survey to identify issues and challenges experienced in software projects using APM methods.

Another interesting research goal could be identifying the human and social factors and study their impacts on the success or failure of the projects using agile methods.

The review covered the APM methods, whereas the tools of these methods fall outside of the scope of this research. In this context, another future research topic could be analyzing supporting tools used with APM methods.

REFERENCES

[1] Molhanec, M.; The Agile Methods - an Innovative Approach in the Project Management; Electronics Technology, 30th International Spring Seminar; 9-13 May. 2007

[2] Martin Fowler; The New Methodology; http://martinfowler.com/articles/newMethodology.html;Accessed Date, 29 April 2013

[3] Kieran Conboy, Brain Fitzgerald; Toward a conceptual framework of agile methods : a study of agility in different disciplines, Proceedings of the 2004 ACM workshop on Interdisciplinary software engineering research; Nov.2004

[4] Livermore, J.A. ; Factors that impact implementing an agile software development methodology; SoutheasrCon, Proceedings.IEEE; 22-25 Mar.2007

[5] Xiang-xi Meng; Ya-sha Wang; Lei Shi; Feng-jian Wang; A Process Pattern Language for Agile Methods; Software Engineering Conference ; APSEC 14th Asia-Pacific ; 4-7 Dec.2007

[6] Agile Alliance; http://www.agilealliance.org/the-alliance/the-agile-manifesto/; Accessed date 16.August 2012

[7] Babar Muhammad; Zhang He; Systematic Literature Review in Software Engineering: Preliminary Results from Interviewers with Researches

[8] B. Kitchenham and S. Charters ; Guidelines for performing Systematic Literature Reviews in software engineering; Keele University and Durham University joint report ; 2007

[9] Unterkalmsteiner Michael and et al; Evaluation and measurement of software process improvement-A Systematic Literature Review

[10] Maglyas Andrey;Nikula Uolevi;Smolander Kari; What do we know about Software Product Management

[11] A Guide to the Project Management Body of Knowledge (PMBOK Guide)-Forth Edition

[12] Tatnall Arthur;Shackletion Peter; IT Project Management: developing on-going skills in the management of the software development projects; Software Engineering: Education and Practice, 1996. Proceedings, International Conference

[13] Glennon Carol; An Overview of Agile Development Methods for Engineers and Tech Professionals;http://www.todaysengineer.org/2012/Nov/Agile.asp;Accessed Date, 29 April 2013

[14] Kithenham Barbara; Dybå Tore; Jørgensen Magne; Evidence.based Software Engineering; ICSE 2004;PP 273-281

[15] Kithenham B; Procedures for Performing Systematic Reviews;Joint Technical Report,Keele University TR/SE-0401 and NICTA 0400011T.1; 2004

[16] Dybå Tore; Kithenham Barbara; Jørgensen Magne; Evidence-based Software Engineering for Practitioners; IEEE Software,2005

[17] Jørgensen Magne; Dybå Tore; Kithenham Barbara; Teaching Evidence-Based Software Engineering to University Students; 11th IEEE International Software Metrics Symposium;2005

[18] Hossain Emam; Muhammad Ali Babar; Paik Hye-young; Using Scrum in Global Software Development: A Systematic Literature Review; 4th IEEE International Conference on Global Software Engineering;2009

[19] Dybä;Dingsøyr Torgeir; Empirical studies if agile software development :A systematic review; 2008

[20] Kithenham B; Procedures for Performing Systematic Literature Reviews in

Software Engineering; *EBSE Technical Report, ver.: 2.3,* Keele University & Durham University; UK, 2007

[21] Noblit G.W. ; Hare R.D. ; Meta-Ethnography: Synthesizing Qualitative Studies, Sage Publications, London;1988

[22] Ekanayake, L.L.;Jayawardena, D.S.; Adaptation analysis of Agile Project Management for managing IT projects in Sri Lanka; IEEE Conference Publications ;2010

[23] Kim Eunha ; Ryoo Seokmoon; Agile Adoption Story from NHN; IEEE Conference Publications;2012

[24] Lee Jihyun; Hur Sung Jin; Agile Approach to Manage Projects in Ubiquitous Multi-Project Environment; IEEE Conference Publications;2010

[25] Morien Roy; Agile management and the Toyota way for software project management; IEEE Conference Publications;2005

[26] Molhanec Martin; Agile project management framework; IEEE Conference Publications; 2010

[27] Molhanec Martin; Agile project management in product design; IEEE Conference Publications;2008

[28] Rehani, Bhawna; Agile way of BI implementation; IEEE Conference Publications;2011

[29] Barton, B.;Blackburn, T.;Sulaiman, T.; AgileEVM - earned value management in Scrum Projects; Proceedings of AGILE 2006 Conference ;2006

[30] Jianbin Chen; De Ying Fang ; Tong Shi; Analyse Changing Risk of Organizational Factors in Agile Project Management;Information Science and Engineering (ICISE);2009

[31] Valentina Milicevic; Miomir Stankovic ;Tosic, Milorad;Collaborative Knowledge Acquisition for Agile Project Management;EUROCON 2005;The International Conference;2005

[32] Viktorov Anton ; Blount Jack; Sutherland Jeff; Puntikov Nikolai; Distributed Scrum: Agile Project Management with Outsourced Development Teams;Proceedings of the 40th Annual Hawaii International Conference on System Sciences (HICSS'07);2007

[33] Baker S.W ;Thomas, J.C.; Establishing an Agile Portfolio to Align IT Investments with Business Needs; AGILE '08. Conference;2008

[34] Krzanik, L.;Kuvaja, P.;Rodriguez, P.;Rohunen, A.;Simila, J; Exploring the Transient Nature of Agile Project Management Practices; System Sciences (HICSS), 2010 43rd Hawaii International Conference;2010

[35] Fewell Jesse; Growing PMI® Using Agile; Agile Conference; AGILE '09; 2009

[36] Xukan Xu;Bao-feng Zhang;Jie Lin;Management Information System Requirements Analysis Model Based On The Agile Development;2012 International Conference on Control Engineering and Communication Technology;2012

[37] Barreto, R.;Caxias, M.;Figueiredo, C.M.;Lucena, V.;Pacheco, C.;Pinto, L.;Rosa, R.;Xavier, C; On the use of SCRUM for the management of practical projects in graduate courses; Frontiers in Education Conference, 2009. FIE '09. 39th IEEE;2009

[38] Hu Zhi-gen;Yuan Quan;Zhang Xi; Research on Agile Project Management with Scrum Method; Services Science, Management and Engineering, 2009. SSME '09. IITA International Conference; 2009

[39] Schiano, W.T.;Waguespack, L.J.; SCRUM Project Architecture and Thriving Systems Theory; System Science (HICSS), 2012 45th Hawaii International Conference;2012

[40] Morien, R.;Wongthongtham, P. ; Supporting agility in software development projects - defining a project ontology; Digital Ecosystems and Technologies, 2008. DEST 2008. 2nd IEEE International Conference,2008

[41] Griffiths, M.; Teaching agile project management to the PMI; Agile Conference, 2005. Proceedings;2005

[42] Balan, C.;Dija, S.;Vidyadharan, D.S.; The need to adopt agile methodology in the development of cyber forensics tools; Computational Intelligence and Computing Research (ICCIC), 2010 IEEE International Conference;2010

[43] Mun-Wai Chung;Nugroho, S.;Unson, J.F. ; Tidal Wave: The Games Transformation; AGILE '08. Conference;2008

[44] Molhanec, M.; Towards an agile project management in product design; Electronics Technology, 2009. ISSE 2009. 32nd International Spring Seminar;2009

[45] Wagh, R; Using Scrum for Software Engineering Class Projects; AGILE India (AGILE INDIA), 2012;2012

[46] Abran, A.;Desharnais, J.-M.;Kocaturk, B. ; Using the COSMIC Method to Evaluate the Quality of the Documentation of Agile User Stories; Software Measurement, 2011 Joint Conference of the 21st Int'l Workshop on and 6th Int'l Conference on Software Process and Product Measurement (IWSM-MENSURA); 2011

[**47**] Pries-Heje, J.;Pries-Heje, L.; Why Scrum Works: A Case Study from an Agile Distributed Project in Denmark and India; Agile Conference (AGILE), 2011;2011

[48] Alley, E.;Bundick, C.;Kenna, E.M.;Kozitsky, A.;Lane, R.;Lloyd, M.;Mondragon-Torres, A.F._1;Stanley, P.; Work in Progress - An Agile Embedded Systems Design Capstone Course; Frontiers in Education Conference (FIE), 2011;2011

[49] Fernandez Daniel J.; Fernandez Jhon D.; Agile Project Management - Agilism Versus Traditional Approaches; Journal paper; The Journal of Computer Information Systems; Winter 2008/2009; 49, 2; ABI/INFORM Global:2009

[50] Chang May; An Agile approach to library IT innovations; Library Hi Tech
Vol. 28 No. 4, 2010; 2010

[51] Leybourne A.Stephen ; Improvisation and agile project management: a comparative consideration; International Journal of Managing Projects in Business Vol. 2 No. 4, 2009;2009

[52] Martina Ceschi, Alberto Sillitti, Giancarlo Succi,Stefano De Panfilis: Project Management in Plan-Based agile companies; www. c o m p u t e r. o r g / s o f t w a r e IEEE SOFTWARE;2005

[53] John McAvoy; Tom Butler; The role of project management in ineffective decision making within agile software development projects; European Journal of Information Systems (2009) 18, 372–383;2009

[54] Hernandez Valena; Agile Project Leaders Redefine IT(Innovative Thinkers); BUSINESS INTELLIGENCE Journal • vol. 16, No. 4; 2011

[55] Meghann Drurya,, Kieran Conboy,Ken Power; Obstacles to decision making in Agile software development teams; The Journal of Systems and Software 85 (2012) 1239–1254;2012

[56] Eduardo Miranda a,;Pierre Bourque; Agile monitoring using the line of balance; The Journal of Systems and Software 83 (2010) 1205–1215;2010

[57] Ákos Szoke; Conceptual scheduling model and optimized release scheduling for agile environments; Information and Software Technology 53 (2011) 574–591;2011

[58] Rob Procter, Mark Rouncefield;Meik Poschen; Yuwei Lin & Alex Voss; Agile project management. A case study of a virtual research environment development project; Computer Supported Cooperative Work (2011) 20:197–225; 2011

[59] Ana Sofia C. Marçal ;Bruno Celso C. de Freitas ;Felipe S. Furtado Soares Maria Elizabeth S. Furtado Teresa M. Maciel ;Arnaldo D. Belchior; Blending Scrum practices and CMMI project management; Innovations Syst Softw Eng (2008) 4:17–29 ; 2008

[60] Tuomas Ihme; Scrum adoption and architectural extensions in developing new service applications of large financial IT systems; J Braz Comput Soc; 2012

[61] Dimitrina Spencer, Ann Zimmerman & David Abramson; Special Theme: Project Management in E-Science: Challenges and Opportunities; Computer Supported Cooperative Work (2011) 20:155–163; 2011

[62] H. Frank Cervone; Understaning agile project management methods using Scrum; OCLC Systems & Services: International digital library perspectives Vol. 27 No. 1, 2011; Accepted 2010

[63] Edivandro Carlos Conforto;Daniel Capaldo Amaral; Evaluating an Agile Method; Project Management Journal, Vol. 41, No. 2, 73–80 © 2008 by the Project Management Institute Published online in Wiley InterScience; 2010

[64] Kristin Lofthus Hope; Eva Amdahl; Configuring designers? Using one agile project management methodology to achieve user participation; New Technology, Work and Employment 26:1;2011 Blackwell Publishing Ltd ;2011

[65] Sanjiv Augustine;Bob Payne; Fred Sencindiver;Susan Woodcock; .AGILE PROJECT management steering from the edges; COMMUNICATIONS OF THE ACM December 2005/Vol. 48, No. 12;2005

[66] Staples M.; Niazi M., "Experiences using systematic review guidelines," Journal of Systems and Software, vol. 80, no. 9, pp. 1425–1437, Sep. 2007.

[67] Wu Ching-seh;Chang; Wei-chun; K. Sethi Ishwar; A Metric-Based Multi-Agent System for Software Project Management;Ching-Seh Wu ; Wei-chun Chang ; Sethi, I.K. Computer and Information Science, 2009. ICIS 2009. Eighth IEEE/ACIS International Conference; 2009

[68] IEEE STD 1058-1-1994, "IEEE Standard for Software Project Management Plans", *IEEE* 1994.]

[69] D. Simmons, N. Ellis; H. Fujihara;W. Kuo; Software Measurement: A Visualization Toolkit for Project Control and Process Improvement, Prentice Hall, Upper Saddle River, NJ ;1998.

[70] Tatnall Arthur; Shackleton Peter;Project management software-the fourth tool?;Software Education Conference, 1994. Proceedings; 1994

[71] Coram Michael; Bohner Shawn;The impact of agile methods on software project management;Engineering of Computer-Based Systems, 2005. ECBS '05. 12th IEEE International Conference and Workshops; 2005

[72] Abrahamsson, Pekka;Salo, Outi; Ronkainen, Jussi;Warsta, Juhani; Agile Software Development Methods: Review and Analysis;VTT Publications 478;2002

[73] Beck Kent; Embracing Change with Extreme Programming; Computer; Volume 32;Issue 10;Pages 70-77;1999

[74] Martin Fowler; Continuous Integration;
http://martinfowler.com/articles/continuousIntegration.html; Accessed Date, 30 April 2013

APPENDIX

Appendix A

Review protocol

1   Background

2   Research questions

3   Search Strategy

      a. Search Strings

      b. Resources/Database to be searched

4.   Study selection criteria

      a. Inclusion criteria

      b. Exclusion criteria

5.   Study selection procedure

6.   Study Quality Assessment checklist and procedure

7.   Data Extraction Strategy

8.   Synthesis of the extracted data

Appendix B

Data extraction form

1. General Information about the paper

  1.1 Article Title

  1.2. Article Author(s)

  1.3 Source (i.e. Conference or journal)

  1.4 Search string(s) used to retrieve the paper

  1.5 Publication Date

2. Specific Information about the paper

2.1 Research methodology used in primary study

       2.1.1 Case study

       2.1.2 Experiment

       2.1.3 Survey

2.2 Study area of the research paper

       2.2.1 Academic study

       2.2.2 Industrial study

2.3 Participants involved in primary study

       2.3.1 Professionals

       2.3.2 Students

       2.3.3 Number of students

2.4 Relevant area of research

  2.4.1 Existing methods and approaches in agile project management.

  2.4.2 Project management issues addressed by agile project management

  2.4.3 Human and social factors in agile project management.

Appendix C

Quality assessment form

Screening criteria

5. Does a paper address the software project management in terms of agile way?	☐ Yes ☐ No
6. Does a paper discuss any industry case study of using agile project management?	☐ Yes ☐ No
7. Does the objective of the paper is clearly mentioned?	☐ Yes ☐ No
8. Does the paper provide some hint for the Research questions (RQs) answer?	☐ Yes ☐ No