SOFTWARE FAILURE REDUCTION IN PAKISTANI SOFTWARE INDUSTRY (PSI) WORKING ON AGILE METHODS

by

Muhammad Nadeem Raza

Supervised By

Dr. Basit Shahzad

Co-Supervised By

Dr. Muhammad Noman Malik

Submitted for partial fulfillment of the requirements of the degree of MSCS to the
Faculty of Engineering and Computer Science

NATIONAL UNIVERSITY OF MODERN LANGUAGES,

ISLAMABAD

December2019

SOFTWARE FAILURE REDUCTION IN PAKISTANI SOFTWARE INDUSTRY (PSI) WORKING ON AGILE METHODS

by

Muhammad Nadeem Raza

Supervised By

Dr. Basit Shahzad

Co-Supervised By

Dr. Muhammad Noman Malik

Submitted for partial fulfillment of the requirements of the degree of MSCS to the

Faculty of Engineering and Computer Science

NATIONAL UNIVERSITY OF MODERN LANGUAGES,

ISLAMABAD

December 2019

NATIONAL UNIVERSITY OF MODERN LANGUAGES

FACULTY OF ENGINEERING AND COMPUTER SCIENCE

THESIS AND DEFENSE APPROVAL FORM

The undersigned certify that they have read the following thesis, examined the defense, are satisfied with overall exam performance, and recommend the thesis to the Faculty of Engineering and Computer Sciences.

THESIS TITLE: SOFTWARE FAILURE REDUCTION IN PAKISTANI SOFTWARE INDUSTRY (PSI) WORKING ON AGILE METHODS

Submitted By: Muhammad Nadeem Raza   Registration #: 15/MS/CS/F16

Master of Science
Degree Name

Computer Science
Name of Discipline

Dr. Basit Shahzad
Research Supervisor   Signature: _____

Dr. M Noman Malik
 Co-Supervisor   Signature: _____

Col Jameel Ahmed Zia
Acting Dean (FE&CS)   Signature: _____

Brig. Muhammad Ibrahim
Director General (NUML)   Signature: _____

26th December, 2019
(Date)

CANDIDATE DECLARATION

I declare that this thesis entitled "software failure reduction in Pakistani software industry (PSI) working on agile methods" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature   : _____

Name   : Muhammad Nadeem Raza

Date   : December26th, 2019

ABSTRACT

Agile software development is a group of software development methodologies which is based on iterative development where the requirements and solutions evolve through collaboration between self-organizing and cross-functional teams. Agile has different techniques to develop software in diminutive duration. Now a day this methodology has becomes more popular as compare to traditional software development methodologies. Generally, medium scale projects use agile approaches and large projects uses traditional methodologies like waterfall model. However, in agile environment; the success rate of small projects is immense while it is not satisfactory in extensive project. On the other side, water fall model isn't well known for small projects however it can produce the precise and explicit result in large projects. Agile methodology has gain phenomenal success in the entire world including Pakistan. However, during the development activities, some factors are affected on Pakistani software industry that could be resolved for better and superior development. So there is need to identify the failure factors which in unclear in Pakistani software industry and it is yet lack of guidelines for Pakistani software industry. The purpose of this research is to identify the failure factors which are faced by Pakistani software industry. It is important to identify and then solve these factors for better and superior development in PSI. In this study, we highlight these software failure factors through systematic literature review and secondly by visiting the selected Pakistani software industries in distinct locations. Moreover, the analyses of these software failure factors and then shortlist some of them are the next phase of this research. It is mix method research which consists of qualitative and quantitative research. After that, this study contains some comprehensive guidelines with the collaboration of software professionals for Pakistani software industry. These proposed guidelines produce the preeminent and applicable results which can be utilize in Pakistani software industry. In future we can expand this research and provide a proper framework which could be meet the Pakistani environment. Furthermore, we can develop a mechanism which can convert the traditional method to agile in Pakistan.

Keywords: Agile methodology, Scrum, Survey, Analysis, Qualitative study, Quantitative study.

DEDICATION

This study is wholeheartedly dedicated to my beloved parents and teachers, who have been our source of inspiration and gave us strength when we thought of giving up, who continuously provide their moral, spiritual, emotional and financial support. To my sisters, relatives, friends and classmates who shared their words of advice and encouragement to finish this study.

ACKNOWLEGEMENT

First of all, I wish to express my gratitude and deep appreciation to Almighty Allah, who made this study possible and successful. This study would not be accomplished unless the honest espousal that was extended from several sources for which I would like to express my sincere thankfulness and gratitude. Yet, there were significant contributors for my attained success and I cannot forget their input, especially my research supervisors, Dr.Basit Shahzad and Dr. Muhammad Noman Malik and my teacher Dr.Fazli Subhan who did not leave any stone unturned to guide me during my research journey.

I shall also acknowledge the extended assistance from the administrations of Department of Computer Sciences who supported me all through my research experience and simplified the challenges I faced. For all whom I did not mention but I shall not neglect their significant contribution, thanks for everything.

Last but not the least, I would like to thanks my family especially my father Muhammad Najeeb who support me spiritually throughout my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PSI	Pakistani Software Industry
EP	Extreme Programming
FDD	Feature Driven Development
DSDM	Dynamic Systems Development Method
SDLC	Software Development Life Cycle
SLR	Systematic Literature Review
ARFF	Attribute-Relation File Format

CHAPTER 1

INTRODUCTION

1.1   Overview

Agile methodology is group of methods which are used to develop the software in slight duration. In software development, Agile requires a cultural shift in many companies because it focuses on the clean delivery of individual pieces or parts of the software. This chapter elaborates the agile technology with its scope and benefits. Additionally, we mentioned the research questions, objectives and its purposes in this chapter.

1.2   Motivation

There is need to understand the solid concept of agile methodology in all aspects. Following are describing the entire agile methodology in detail.

1.2.1   Dynamic and face to face communication

To ensure the fittingly and decorous communication between all the involved individuals are involved for superior and enhanced development through agile methods. In the field of software, several methodologies are used for software development and agile is one of them. Agile is a group of software development methodologies which is based on iterative development. Because of iterative development, the communication between involved members is foremost factor. At the end of iteration, all representatives examined the whole progress and re-evaluate

the significances then elevate it through next iteration. Whole iterations ensure the needs of customer and company goals [1].

1.2.2   Iterative development

Iterative development is a mechanism to break down the large applications into small chunks. All phases of software development are repeated continuously in the form of cycle. The key applies of agile methodologies are incremental and iterative development. The feature codes of iterative development are designing, development and testing. Agile methodologies focus on continues improvement and quality products, that's why these incremental and iterative mechanism ensure the software quality and endures improvement. The reason for working iteratively is to permit greater adaptability for change. In traditional methods (waterfall model), during the design of requirements there could be arisen some invisible snags before the starting of development. However, in iterative development the project team goes through a cycle where they evaluate with iterations, and regulate what changes are desired to produce a satisfactory and acceptable product [2]. A well organized and suited frame work can improve the agile practices in Pakistani software development industry.

1.2.3   Software failures

The failures of software are an important aspect where organizations should work continuously. The growing rate of agile methodology is high at international level but in Pakistan this growing rate is low due to the barriers. Samina et al. provides the solution of some significant and substantial barriers such as scope estimation, starting and ending time of project and variation in resources. Moreover, the samina describes the initial plan regarding software development and prepares the essential changes in documentation [3].

An agile practice is quite complex and fast development methodology that's why a lot of challenges occur during the development. Time duration is decided before the development, while much software takes more than allowed time cause software failure. Agile software development is novel approach which can develop software in short duration. Furthermore, the software's which don't meet the required specifications are also considered as software failure [4].

The purpose of this research is to identify the state of art of agile based software failures in Pakistani software industry (PSI). In response to the interactive sessions with the identity we identified the critical failures factors that cause the software failure in PSI. Failure factors could be the error in software, over budget software, exceeded from decided time duration and don't meet the required specification etc. Classification of these software failure factors then analyze it accordingly can help us to find out the authentic and precise way of development in Pakistan. These errors can be identified during the testing and debugging phase. The data is collected form most recent and topical studies and refined it consequently to find the state of art of software failure in Pakistani software development environment.

1.2.4 Failure factors

Agile methods are not much popular for large scale projects while it is considered as best in small software projects. The success rate of agile is better than traditional methods in small scale projects. However, this methodology is quite insignificant for large scale software projects whereas medium scale projects depend on its nature and sequence of requirements. Typically, traditional model such as water fall model is much better for large scale projects [5].

The attention of this research is to identify the challenges and software failure factors during the decision making and other development phases. These challenges and failure factors can be categories and discussed according to the local environment. A suitable and explicit development environment can provide the perfect and precise way of development in any country [6]. Likewise, communication factors are the basic key for successful development. Martin Mc Hugh highlights some issues during the communication and recommends their solution. Agile development team needs to improve five factors which are highlighted by Martin Mc Hugh. The first factor which author describe is academic and industrial training that can overcome the communication problems during the development of software. Secondly, effective and operative communication skills are the fundamental requisite of agile technology which should be considered in any case. Complicated organizational structure is the third factors which describe the author. Development processes and lack of latest technology are the fourth and fifth

factors which are important for successful development. However, we can deliberate these factors in Pakistani software industry and improve it consequently [7].

The core interest of this research is to identify the failure factors during decision making, communication, coordination, collaboration, development, testing and executing phase in PSI. These factors are derived through systematic literature review and industry survey from the source of questionnaires and interview. However, it is mix method research; the data is derived through the mechanism of qualitative way then analyze it through quantitative method. The guideline which we proposed in this research is based on collected failure factors which are organized through qualitative study. Moreover, to achieve the international standards, we need to develop some guidelines which is capable to overcome the issues related to management, developments, and customer satisfactions.

1.2.5 Software development model

Since early 2000 the agile practices are become increasingly popular in Pakistan. Similarly, Software industry can change the sensational development in economy. So we can improve the economy of Pakistan through successful development of software that meets the international standards. However, an appropriate and applicable model is needed in Pakistani software industry that can handle the failure factors specifically and provide the way of superior and exceptional development. Several software development models are discussed in this study that are used for effective and impressive development at international level and in Pakistan [8]. Two popular models of agile methodologies are discussed by Anwer et al. These models are related to the extreme programming and scrum which are the types of agile methodologies. The author prepares an investigations report from dual models. This Analyses report is based on the similarities, differences and explores their features which complement each other. However, this study evaluates the description of scrum and extreme programming. Additionally, the author demonstrated the depiction, their progression technique pros and cons. The report of critical analyses of scrum method and extreme programming is revealed in anwer et.al study. According to the result of critical report, the structure of different features of proposed model can produce more reliable results of small-scale projects [9].

Mateen et al. proposes a new model by combining the agile and traditional practices. Some common features are required from both models that cause efficacious and successful development. This study conducts a survey and highlights some issues in Pakistani software development industry and the author has recognized the noteworthy deterrents in PSI. Lacks of experience and software complexity are the major issues in PSI. Due to these issues the Pakistani industry doesn't prefer to apply agile methods. Software productivity and quality can be improved through management changes [10].

Finally, we suggest the guideline according to the expert's opinion at the end of this research. These inventive guidelines can be pooled collectively in the form of framework. However, the guidelines could boost the Pakistani software industry which can ultimately increase the quality of software and minimize the failure factors according to the state of art mechanism.

1.3   Problem Background

Agile methodology provides dynamic environment and efforts on individuals therefore this methodology is fast, flexible, lean and consistent. However, a regular inspection in a systematic way and consequently improvement in project will help us to finds the impediments and obstacles during the development of software [11]. This mechanism also boosts the leadership qualities of whole team members.

It is observed that agile methodology is not appropriate for large scale projects and it is popular in small and medium projects [12]. In the environment of Pakistan, the situation is not different from rest of the world and the projects have occasionally few failures as well. We can overcome these failure factors by implementing a suitable and appropriate framework. Mateen et al. [10] proposes a framework by combining the agile and traditional methods. This framework can improve the quality of software and handle cost factors during the development of software in Pakistan. Additionally, the model discusses the scalability and consistency of project which helps to improve the management and development phases. Some additional elements like arranging the requirements; Assign the task to developer, communication with client and deliver the complete system with documentation to the manager are also arraigns consequently in this framework. Ahmed et al. [10]

conduct a comprehensive report by comparing the agile software development methodology and traditional models like waterfall in the continent of Asia.

1.4 Problem Statement

The agile methodology has revolutionized the software development paradigm and it has gained phenomenal success in the world, including Pakistan in very brief time. The software development activity however is affected by some factors that are equally applicable to PSI.

Like other countries the success rate of software development in Pakistan is not satisfactory [14]. However, the state of the art for software failure based on agile development is unclear in PSI and it is yet to identify that how PSI compare with rest of the world therefore the guidelines in agile based software development in PSI are also lacking. Moreover, it is also important that such failures are not repeated and can also rectify. During the development, each phase is affected with failure factors which will produce the abortive and futile software.

1.5 Research Questions

Research question are as under:

1. (a) What is state of art in agile based software failures in PSI?
   (b) What are the factors causing these failures?
2. How the failure ratio is different from other countries?
3. What are the guidelines to improve the state of the art of software failures in PSI?

1.6 Aim of research

Fundamentally, the primary focus of any research is usually express the achieve the objectives of research. However, the current research will provide the following objectives.

1.6.1 Critical assessment

The purpose of critical analysis is to evaluate the collected data in some order which will increase the understanding of topic. Analyze the data critically and systematically is the main purpose of this research. This analysis will help us to understand Pakistani software industry and measure the software growth, interpretation of development environment and production techniques.

1.6.2 Provide a comparison report

Standish Group is an organization that formulates a report by collecting the data from different countries related to software. The organization prepares a comprehensive report related to software and shows it graphically on their website. Our aim is to identify that how the reasons of failures in PSI differ from the failure reasons in rest of the world.

1.6.3 Provide the guidelines

Main purpose of this study is to propose some agile based guidelines for Pakistani software industry which can help to achieve the international standard with quality software. These guidelines are taken from software professionals in Pakistan.

1.7 Research Objectives

Following research objectives can be achieved from this research:

- To identify the failures factors with respect to the process model in Pakistan.
- To analyze and compare the software failure factors between PSI and rest of the world.
- To provide the proper guidelines for Pakistani software industry.

1.8 Scope of Research

The scope of study is to get the firsthand knowledge related to software in Pakistani software industry. This study will focus to acquire data from software houses in Pakistan and find out the reasons of software failure. Moreover, the scope of research is to provide the overview and analyses report of software failure ratio in

Pakistan as compare to other countries. The next goal of this research is to identify any significant and substantial issues related to the environment of Pakistan and probably effects on what is happening in Pakistani software industry. According to these issues, an appropriate framework in the form of guideline is proposed in this research that recommends sharing exceptional practice in the development and implementation. Furthermore, this research includes identifying areas in which further development could be supported and providing advice on how this might be accomplished.

1.9   Thesis organization

The rest of the thesis is organized as follows:

Second chapter provides the background of agile methodologies with detail description and provide the explanation of each methods which are the part of agile family. Furthermore, the literature review form distinct and dissimilar articles related to the agile technology are added in this chapter. The purpose of this literature review is to highlight the failure factors and deliberate the efficacious development according to the Pakistani environment. Additionally, a systematic literature review is also the part of this chapter. A systematic literature review provides, and effective and proficient learning related to the concerned subject that can help us to understand the complications systematically and analytically.

Chapter three provides the methodologies of this research. A mix method research is employed in this research. Mix method research is the combination of qualitative and quantitative research. This chapter elaborates the whole research methodology and highlights the sequences of research. Chapter four includes the analyses and finding. These analyses are basically the quantitative data which we collect through interview and questionnaires. Findings are also elaborate at the end of this chapter. Chapter five provides the guidelines and recommendations for superior software development in Pakistan. The last chapter of this research is conclusion and future work. This chapter also includes the upcoming improvement in Pakistani software industry and added some recommendations for future.

Chapter 2

LITERATURE REVIEW

2.1 Overview

Agile is contemporary and modern technology that has become new phenomenon in software development society. It can often develop software more rapidly and expeditiously within a limited time and appraisal the requirements after each iteration that can help the stakeholder and development team by improvement in quality and budget diminution. This chapter describes the agile methodology by covering the maximum areas related to this technology.

2.2 Agile methodology

Agile methodologies are based on extensive collaboration, face to face communication and continual development. Iram et al. deliberates the requirements which are used in agile methodologies during the planning to execute and conduct a systematic literature review to find out the requirement issues in development activities. In this study five challenges traced from traditional methodology to overcome these challenges and provide the solution through agile technique [15].

Ahmed et al. prepares a comprehensive report by comparing the application of agile software development methodology and traditional models like waterfall etc. in Asian countries. The purpose of this research is to check the suitable model for small, medium, and large size projects by helping the development professionals. The suitable method decides through analyses the factors like scope, time, risk, and cost etc. The authors also discuss the description and explained overview of traditional and agile methodologies. A questionnaire was developed and filled by

various technologists of different software industries in different Asian countries. 59 employees responded from all over the Asia. Summarizing the result from the provided data, there was 62.7% organizations which use agile methodologies and 37.3% industries use traditional models. The professional feels that traditional models are better in large projects whereas agile is used in medium and small-scale projects. This proposed survey highlights some issues like a proper flexible model will be required in the Asian environment, complete documentation will also be needed from start to end and need to work on self-organization behavior in future [16].

2.2.1 Agile methods

Worldwide market, consistent pressure and worldwide availability are a significant force that promotes the agile methodologies. It is not an easy task to implementation the agile methodologies in PSI. For the successful implementation of agile methodologies, the organization wants to make the offices at different locations and hire local employees who work with their colleagues form different sites. Organizations prepare documentation at regular bases and clearly mention the barriers during the development. Software is made at numerous areas; so many social cultural and technical issues can be occurred during the development. The developing rate of agile methodologies at worldwide market is high while in Pakistan this developing rate is improving lower [17]. Figure 2.1 represent the methods which used in agile environment.

The approaches which are used for development in agile technology are as follows:

- Scrum
- Extreme Programming
- Feature Driven Development
- DSDM
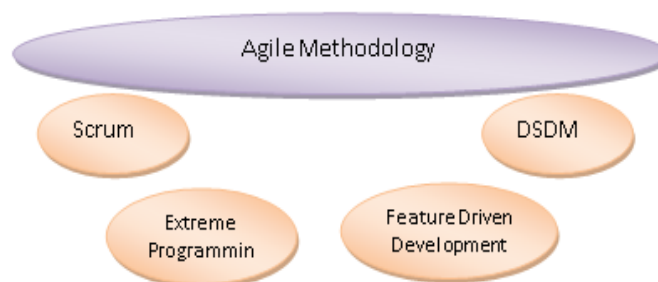
Figure 2. 1: Common approaches of agile methodology

10

2.2.2 Scrum

In the agile Scrum world, rather than giving complete, itemized portrayals of how everything is to be done on a project, quite a bit of it is surrendered over to the Scrum software development team. This is claiming the team will know best how to take care of the issue they are displayed.

Abrahamsson et al. describe that scrum is rapid and self-organizing process model that makes the development procedure efficient, accomplished and produce the elegant results when it is delivered. Scrum model is divided into three phases as shown in Figure 2.2.Pre-game, development (Game phase) and post-game. Project Planning and project architecture are two major phases of pre-game in scrum method. In development phase of scrum is to handle the unpredictable requirements, quality, resources, and time frame and treated this phase as a "black box" because of unpredictable expectations. The third phase of scrum is to release the software according to the agreement which is made with customer.
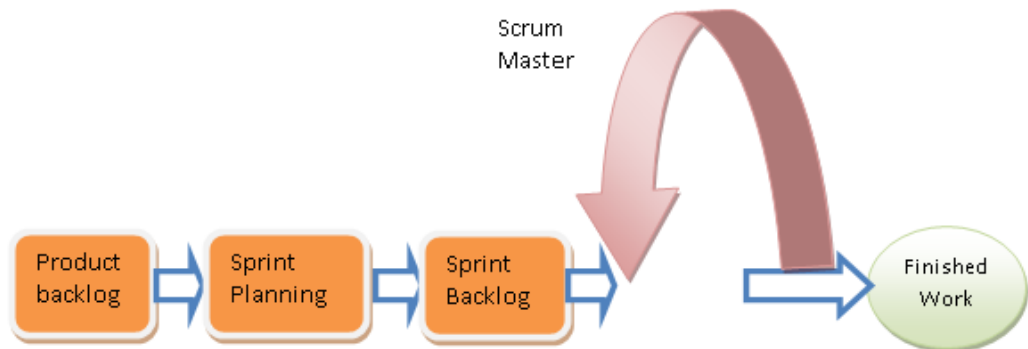
Figure 2. 2: Scrum agile software model

Jan et.al [4] purposed a frame work which improves the software development process in Pakistan. Scrum is one of the main models of agile practices. Mostly in Pakistani software industry used scrum method is used for agile based development. The author divides his article in six phases. In the first phase CMMI and agile concept are reviews. Next phase has some model of software development which is used in Pakistani software industry. Explain the reason that why we need new frame work for Pakistani software industry. The detail of proposed model is also the part of this study. Finally check the proposed model form software professionals and prove it that the proposed model working

more efficiently. In future at management level there is need to improve the 2nd step of CMMI model with agile methods.

2.2.3 Extreme Programming (XP)

Rather than parcel of documentation nailing down what client need in advance, XP stresses a lot of feedback. Anwar et al. [18] says that XP (Extreme Programming) have five levels. First level of extreme programming is exploration, in this phase requirements from customer will be taken and make a prototype of required system according to requirements. This phase can take few weeks, depending on the requirements and uses of technology in the project. Next phase of extreme programming is planning phase, it consists priority order for the requirements and done agreement to customer for small release. Planning phase can consume couple of days. Iteration to release is the next phase of extreme programming which is shown in Figure 2.3. Then exposed that planning phase is broken down to a number of iterations and sent it for production; this will take one to four weeks to implement. Next one is production phase which requires extra testing and accomplish fresh ideas and new changes given form customer. Finally, the maintenance and death phase is start. Maintenance phase is basically for customer support and in death phase means that customer has no more requirements. Moreover, in this phase the reliability and overall performance can be checked and finalized the necessary documents. This phase is occurred when system is delivered and desire outcomes [18].
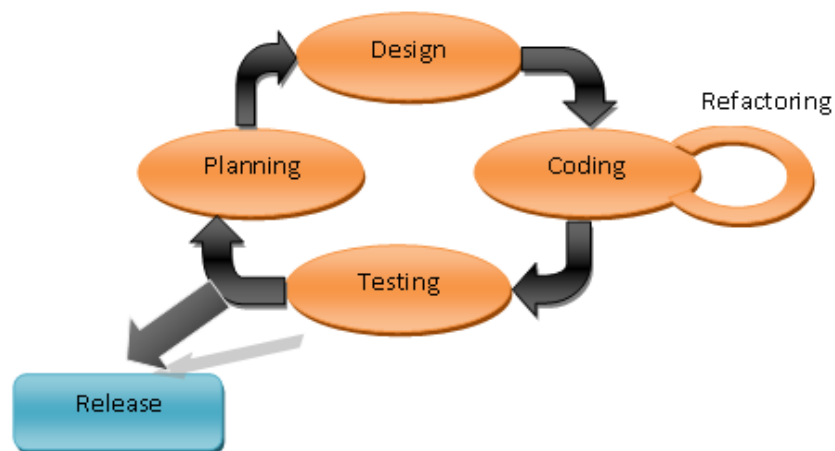
Figure 2. 3: Extreme Programming agile model

2.2.4 Feature Driven Development

It is an adoptive approach that focuses on software design and building phase rather than the entire software development. These model emphases the software quality, flexibility and perceptible deliveries.

Feature Driven Development is divided into five phases as shown in Figure 2.4. Abrahamson.et al. [19] as the development start, the experts should aware the scope, requirements and time duration of the system to build. Secondly provide a feature list for the system being developed and add the client valued function in the system. In "plan by feature phase", sequenced the features according to the feature priority and dependencies for better and acquiescent development. Finally, a small number of features is selected form feature list and sent it to design team. Design by feature and build by feature are both iterative procedures, that's why the development of selected features will be iteratively in Feature driven development
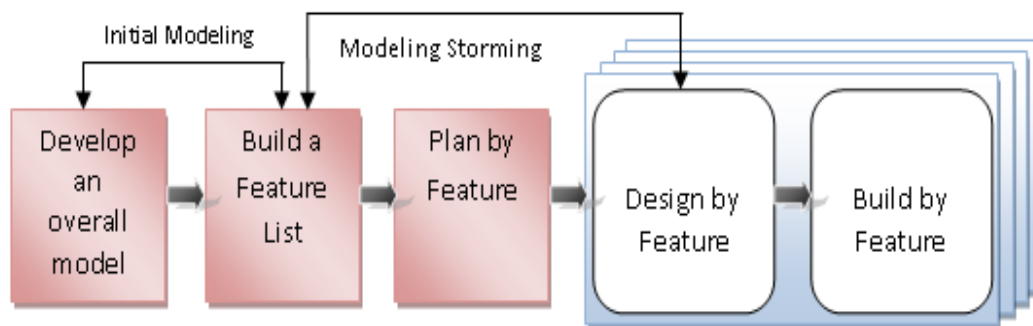
Figure 2. 4: Feature Driven Development agile model

2.2.5 Dynamic Systems Development Method (DSDM)

Abrahamsson et al. [20] it is a popular frame work for rapid and expressive development. Dynamic Systems Development Method (DSDM) preferred the time and resourced then regulates the functionality consequently rather than the other development models which preferred the functionality of system.

Feasibility study, business study, functional model iteration, design and build iteration, and implementation are five phases of DSDM which is highlight in Figure 2.5. The initial two stages are consecutive and done just once and the last three phases, among which the certain development work is done, are iterative and

incremental. The typical time box for software development in DSDM is few days or few weeks [20].
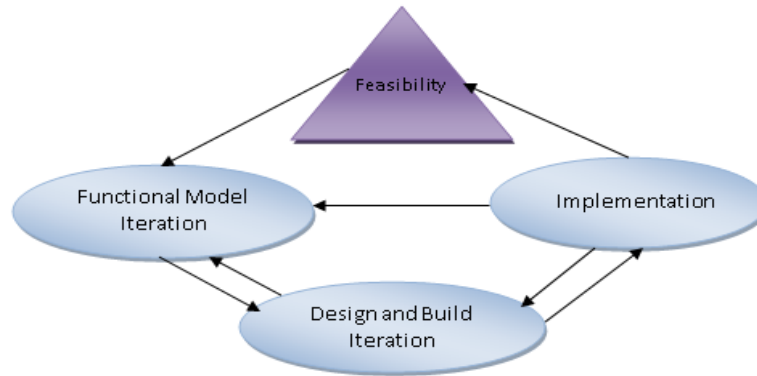
Figure 2. 5: DSDM agile model

2.2.6 Other agile frameworks

Mateen.et al. proposes a model by combining the agile and traditional methods. Introduction the Agile software development and traditional models are discussed in the first phase of Mateen's study. Moreover, the study related to the projection risk is also added in this phase. Improvement in quality and cost discussion is included in second and third phase respectively. Moreover, the discussion related to the scalability is added in next phase and the management and development of system is discussed in last phase. Arrange the requirements; Assign the task to developer, communication with client and deliver the complete system with documentation to the client are also discussed in final phase of this model. This proposed model is suitable for small projects. In future the researcher can assimilate this model and try it in large scale projects with some amendment [10].

CMM (Capability Maturity Model) certification is big problem for Pakistani software industries. CMM is globally accepted standard which provides the quality, development process control, and capability measurements. Khan et al. proposed a model that helps the software organizations to develop standard software. The authors used extreme programming to prepare a framework for consistent and regular development. In Khan Studies a framework is proposed which is useful for development and catch up to the standard of CMM. Furthermore, this study highlights some important issues which can explore in future, these issues can be problems in documentation, cost factors and investments equivocation etc [15].

A development model is proposed by Laanti et al. the model is uses for the development of large projects. This proposed model has five phases, Beginner,

Novice, Fluent, Advance and World class. A detail description of every level is mentioned in this study. The tool has been validated by experimentation and interviews. By using this tool a few organizations have been visited in Germany and provide efficacious and effectual results related to the software development process. In a near future a proper survey should be needed by visiting the most active organization and check weather this tool is suitable or not. Moreover, we can try this tool in Pakistani software development organizations [21].

Aziz et al. develops a web-based project management tool. This tool is used to overcome the obstacle for those industries which uses agile methodologies. It is observed that Pakistani software industry focuses on the small size projects when it is used any agile method. In Aziz study, a software development model is proposed which can develop the software meritoriously by reducing the communication gap between customer, management and development team. Moreover, prototype of this model is also evaluated in this study. The proposed tool is used for small size projects. In future we can integrate this tool and implement it in large software projects in Pakistani software organizations [22].

Software testing is very challenging task in development lifecycle. Latif et al. [23] propose a software checking framework. The proposed frame work is realistic and feasible for the quality production. This frame work is used to improve the productivity and quality of software. Three basic dimensions were derived from proposed framework. These phases are test process in scrum, opportunity for Application Program Interface, and quick evaluation of build's stability. A complete automatic system can be producing in future by extending the proposed frame work.

Sultana et al. develops an appropriate framework for Pakistani software industry to achieve the international standards. This study observes some existing agile software development models and inspects it critically then observes the strengths and weakness of these existing models. Finally, a suitable model is proposed for Pakistani software industry that can overcome the observed weaknesses and then checks this model from different expert organizations for efficiency. In future we must make principle of proposed model for avoiding the cultural issues in Pakistani environment. Furthermore, minimizing the communication gap between developer and user and proper documentation are the major areas where we can further research [24].

2.2.7 Agile Failure Factors

A major area of this study is to identify and formulate the agile based failure factors in Pakistani software industry (PSI). Ali et al. collected data from different software houses in Pakistan and identified some failure factors which can resolve in future by providing the appropriate and applicable way in agile family. Moreover, this study used survey approach and highlights many questions for adoption and rejection of agile methodology in Pakistan. The core identification of this study is lack of experience in Pakistani agile based industry. Furthermore, some additional factors can improve the productivity of software and can also highlight the benefits of agile software practices at different forums. Finally, this study observed that a preeminent and positive future is available for software industry by using the agile practices. Majority in Pakistani software industries are not used to agile methodology in small projects. According to the literature, a proper empirical study is needed in agile environment [25].

2.2.8 Failure factors in Global and Local Software Development

It is not much variance between local and global software development environment because local software market depends on the nature and requirements of project [26]. So the requirements could be different between different continents of the world whereas some factors such as quality and management are the same in local and global software development market.

Ghafoor et al. [27] highlights the issues in global software development (GCD) and in Local software development (LCD) through systematic literature review. This SLR selects 115 papers for collection of data from different resources by using the effectual and appropriate queries.51 papers were selected for this SLR and emphasis the nineteen challenges. According to the GSD scenario, these challenges are 'Geographical Distances', 'Socio-cultural Distances', 'Temporal Distances', 'Language Differences', 'Ineffective Communication', 'Insufficient Documentation', 'Lack of Trust Among the Agile Teams', 'Lack of Motivated Agile Team', 'Lack of Customer's Involvement', 'Lack of Requirements Understanding', 'Insufficient Infrastructure for Software Development', 'Architectural Challenges', 'Management Challenges', 'Lack of Appropriate Technology', 'Data Privacy Issues',

'Lack of Agile Training', 'Invisible Project Goal', 'Limited Support for Distributed Development and software integration issues [27].

From the Ghafoor study some challenges are also highlighted in local software. These are 'Insufficient Systems', 'Documentation', 'Lack of formal communication', 'Degraded software quality', 'Resistance to agile adoption', 'Frequent changes in requirements', 'Lack of team collaborations', 'Agile implementation issue', 'Lack of customer's presence', 'Lack of business knowledge', 'Lack of effective project plan', 'Lack of technical expertise', and Lack of proper agile development training. This study provides a way to conduct the systematic literature review in both environments. By using this protocol, the researcher can easily analyses the papers and find the lacks in local and global software development environment and then further solve it in possess way. In future we can alter this SLR and produce a new protocol for analyses the latest papers [27].

Awar et al. [28] highlight some critical factors which effect the distributed agile environment and also provide a reliable and consistent model to overcome these critical factors. However, three countries were selected to take data for identify the critical factors. These countries are Pakistan, Turkey, and USA. The current study provides the way to handle the distribution development environment which has multiple sites in different countries [28].

Richter et al. takes data from different software organizations in Germany. The study tries to detect the problems phased by global software development. The Richter research divided into five categories, some general activities are revealed in first phase and the discussion related to the agile activities and agile meetings are added respectively. Moreover, the current study discloses the failure factors at the time requirements gathering, technology failure, and fake data collection. The problems which are highlighted in this studyare: blurred rules, unclear outcome, fragmented documentation, mislead in guidelines, misunderstanding the requirements and don't follow the agile principles. In future we can highlight the problems in summarized form and exclude those problems which are not affecting on any organizations in local area [29].

2.2.8.1 Barriers in computerized devices

Now days the scope of software is explore at different stages like computerized devises, spaceship and extent the need of software gradually. A questionnaire based survey was conduct by Hugh.et al and highlights all the barriers related to software in computerized devices in medical and other fields. Moreover, a comparison is performed between the perceived and actual barriers. The current study summarized the data and provide a list of barriers in computerized devices which are: "Lack of Documentation", "Regulatory Compliance", "Lack of Up-Front planning", "Insufficient coverage of risk management activities", "Lack of Experience", "Management Opposed to Change ". When we choose any model for software development, it should be resolving the above factors [30].

Hugh et al. discusses the challenges faces by developer while developing the software for medical devices and also provide the solution of shortcoming by using the agile practices. Before making a frame work the proposed model is used a foundation which is taken from Ge et al. [2]. After selection the foundation the proposed model merges the agile practices with SDLC. A complete V-Model with different steps has been proposed in Hugh [30] study. The proposed tailored V-model will be developed for medical organization in Ireland. Once this model complete, it can be discussed and brought into use if suitable and appropriate environment is available in local software development industry.

2.2.8.2 Outsourcing and agile practices with the usability of software

Outsourcing explores the usability of software in numerous industries at international level. Shoaib et al. discusses the usability aspects and developments of software. Condensing the related work, this study proposed a typical approach of lithe techniques and ease of use. The detail description of common approach is mentioned in this research. Ease of use concentrates on how the end clients will work with the product and deft improvement concentrates on how the product should to be created. Solution of usability issues can improve the productivity of agile based software. In future a more detail survey could be conducted with some additional points like qualitative analyses and specific observation of agile methods and usability [31].

Sarfraz.et.al. [32] has shown how outsourcing and agile practices can work together. Now a day's outsourcing is very increasing factors in software development industries. The authors propose a model which helps the organizations to improve the outsourcing process. Outsourcing is used to overcome the barriers like communication, quality and coordination that may negative effect on software. To check the proposed model a case study is conducted. The proposed model has certain phases: Assessment, Decision and Negotiation, Implementation, Optimization and Refactoring. This research is handled just communication, quality and coordination factors. In future we can work on other factors which are used for outsourcing in software development industry. Applying the principle on this proposed model can be the future work. Outsourcing is an important issue in agile environments. A model is discussed which overcome the outsourcing factors. AZIZ.et.al. [22] develop a project management tool. This tool is used for small scale project; in future integration of this tool is needed. Another framework is proposed for the purpose of software testing. Extension of this frame work is needed in future. Computerized devices challenge related to software are mentioned above. Some challenges are also discoursed related to medical devices.

2.2.8.3 Quality attributes

The effective and perceptual software development model can deliver quality software. So, the quality attributes cannot be ignored in any stage for enhanced and concise development [34].

Lopes et al. introduces a technique which can identify the quality attributes and design their alternatives. Lopes [35] study focused on better decision at every phase of software development. According to this discussion a better decision can directly affects the quality of software; however, a bad decision can produce lot of problem in every phase of development. We can produce a better and appropriate decision by group discussion for superior development in every environment. For appropriate decision making, we use two methods which are CEADA (Collaborative Evaluation of Enterprise Architecture Design Alternatives) and are CBAM 2. At every step a detail description is available in the proposed system which should be following all the members of organization. All group members strictly follow the rules of group discussion. In future there is need to work on the quality of decision.

Some quality factors can be discussed in future for decision in architecture of software [35].

2.2.9 Effectual Models

A preeminent and appropriate software development model can overcome the failure factors and responsible for successful development. Software industry can boost through effectual model and quite important for the development of quality software. Tabassum et al. [36] developed a quality matrix model that simulates the data by using iThink technology through agile software practices. The purpose of this study is to check the suitable model in software industry, that's why twenty software companies are selected for collection of data. This data is analyzed and observed it for the decision of better development system. For the quality of products tabassum study is divided into three phases. First phase includes the development process and analyze every step for quality measurements. Secondly this study includes some additional steps for quality development. In third phase, make sure and measure the efficiency of every development phase. Every development organization doesn't want to compromise on the quality of product. In future categories the quality attributes are needed [36]. By using these quality attributes, a new model can be developed which could be perform better than other development systems.

2.3 Systematic Literature Review (SLR)

It is the best source to find out accurate and precise data from different researched material. Some discrete actions are involved in systematic literature review. Different journals books, conferences and other published data from 2010 to 2017 will be included in this systematic literature review. The purpose of this literature review is to find the failures factors in Pakistani software industry (PSI). Through this systematic literature review we can find some serious failures factors in systematic way. Hodaa.et.al [37] provides a systematic literature review on agile methodologies in different areas of software engineering. The concentration of this study is to find out some active research area in agile based software development. These areas can be: Agile Adoption, Agile Human & Social Aspects, Agile methods, Agile practices, Agile and CMMI (Integrating Capability Maturity Model with

agile), Agile and Usability, Agile and Global Software Engineering, Agile and the Organization, Agile and Embedded Systems, Agile Product Line Engineering. Moreover, this study also ranked the above research areas for the help of researchers.

The protocol which we adopted in this research choice from the book named "Guideline for performing systematic literature review in software engineering" which is written by Keele et al. and shows in Figure 2.6.

Initially, Keele divide its entire study into three basic segments. These segments are "Planning and review", "Conducting the review" and Report the review. In the first phase of their study is to plan the research by sighted the complete and comprehensive field of respective zone then review it precisely. However, the researcher should cover the need of research and identify the research questions in first phase of this LSR mechanism. It is quite important for a commissioned review. Moreover, research questions will be decided in this section by adopted the given mechanism.
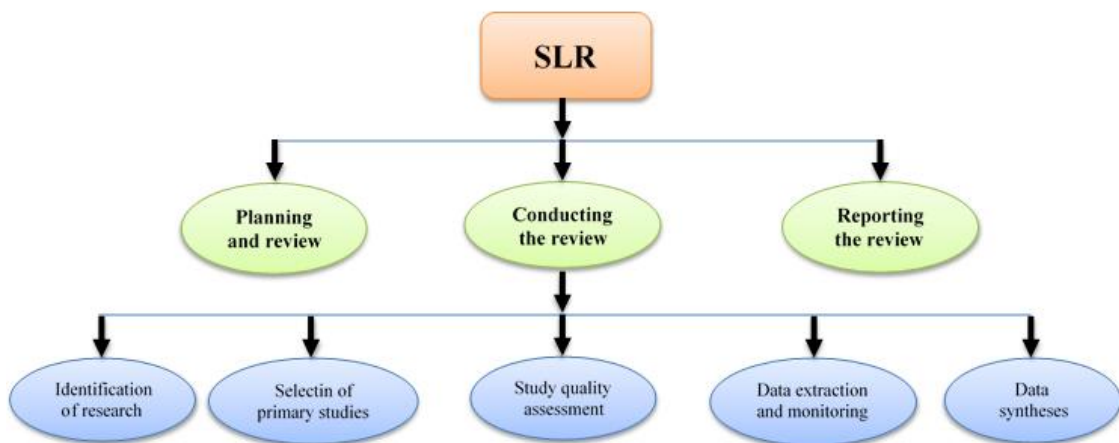
Figure 2. 6: Protocol for Systematic literature

Finally, evaluate the entire review which could be adopted by researcher and researcher must be agree to procedure for evaluating the protocol. Second phase of keele [38] study is conducting the review which will be start after agreed the protocol. This phase will be further divided into five phases as mentioned in figure:2.5. Final stage of this SLR is reporting the review. This phase consists of concluded results which will be produced from different circumstances. Finally, this stage includes the formatting and evaluation of whole SLR in particular way.

2.3.1 Search Strategy

The aim of this systematic literature review is to find out the material which is relevant to the research topic. We break down the questions in different parts and consider it as a query. The query which is driven from research questions will be used for searching the data from different sources. Other sources like references list from relevant primary study are also include in this SLR.

2.3.2 Search identification

This study produces the precise and particular way of development according to the agile methodology in Pakistan. So, there is need to collect the accurate and perfect data from different resources like electronic resources, through questionnaires or through interviews.

When we search the data from major electronic resources, we find the following papers which are mentioned in table 2.1.

Table 2. 1: Paper selection

Data Base	Total reviewed papers	Filtered papers
IEEE explore site	25	12
ACM digital library	20	10
Springer	15	8

2.3.3 Documenting the search

The following document explores and filters the relevant data which are selected from table 2.1.Table 2.2 explain the core concept of selected papers in systematic way. Features and limitation of entire selected papers are represented in table 2.2 which can help us to filter the software failure factors in Pakistani software industry in systematic way.

Table 2. 2: Papers evaluation according to date

Title	Features	Limitation
A comparative study on usage of traditional and agile software development methodologies in software industry of Asia. [10]	• Comparison of agile and traditional models. • Selection of suitable model fo large, medium and small scale projects. • Check the proposed model from market and prepare an analyses report. • Highlight issues such as scope, quality, cost, time and risk.	• A suitable and flexible model required in the continent of Asia. • Need to prepare the complete documentation from start to end of the development.
Survey on the state of agile practices implementation in Pakistan [20].	• Collect data from agile based software houses by using questioner strategy. • In the proposed research lack experience in the main factor for PSI. • Some earlier surveys are included in this research. • Software complexity increase in software productivity, Management and quality.	• More empirical study is required on this area.
SCXTREME Framework: A Customized Approach of Process Improvements in Agile Blend with CMMI Practices in Pakistan [3].	• Propose a frame work (CMMI which improves the PSI. • Some earlier implemented models in PSI are discussed. • Detail description, advantages and disadvantages of (CMMI) are discussed in this study. • Provide the solution of risk management, Quality assurance, Management, Project Planning and requirements. • Also discussed some management issues regarding local software development.	• Improve the steps of CMMI • Integrate the proposed model with some additional steps
Integrating Usability Engineering and Agile Software Development: A	• Discussion the usability and development of s/w through agile. • Tension during the usability o	• The future work will proceed to the present work • On more detail level utilizing subjective

Title	Features	Limitation
Literature Review [29].	agile methods. • Solution of usability issues • Quality measurements during usability of software	investigation by watching particular coordinated strategies
Agile methodology in software development (SMEs) of Pakistan software industry for successful software projects (CMM framework) [40].	• Purpose a development model which achieves the international standards. • Used extreme programming methods for development a new model • Explain the layers of extreme programming. • Documentation, cost and investment issues are handled in this research. • Some more issues are highlighted such as quality and management	• The model is used for local and offsure clients. • Modification in proposed model can utilized at international level.
Agile Practicing and Outsourcing [33].	• Discussion of outsourcing with agile practices in PSI. • Introduce a model which can help the organizations to hand the outsourcing issues. • Communication, Quality and coordination are some outsourcing factors which are handling in this research.	• Some other outsourcing factors could be discussed in future. • Apply the principles of the proposed model.
Supporting Agile Methodologies in Practice: A Study of Pakistani Software Industry [22].	• Develop a web based management tool which is use to overcome the obstacle of agile methodologies. • Prototype of proposed model i evaluated in this research. • The proposed model reduces the communication gap between management and developer team.	• This model is used for small scale projects • Integrate the model and apply this model on medium and large scale projects.
Optimized Order of Software Testing Techniques in Agile Process A Systematic	• Proposed a s/w checking fram work. • Three basic dimensions were derived from proposed	• A complete automatic system is required in future. • Extend this frame work

Title	Features	Limitation
Approach [23].	algorithm • The key finding of this study i software testing through proposed algorithms. • Handle software testing issues in this article	and utilize it in future.
Laanti, Maarit. "Agile transformation model for large software development organizations [21].	• Propose a model for large scal projects • The detail description is also the part of this research • Implement the proposed model and check the results • Pilot technique is used for implementation. • Highlighted investment issues during the development of software	• This tool is developed with the help of some organizations in Germany • In future integrate this tool by visiting the other country's organization and develop a new model
Barriers to using Agile Software Development Practices within the Medical Device [30].	• Highlight failures factors in medical computerized devices • Identify some s/w failures factors which can affect the computerized device • A survey report is mentioned i this research which highlights the barriers of s/w failures in computerized devices. • These barriers could be usability in computerized devices • Moreover, highlight some mo barriers such as software updating and relevancy with device.	• Highlighted failures factors can be solved in future for quality development • Try to overcome these barriers through agile methodologies in future.

Title	Features	Limitation
Integrating Agile Practices with a Medical Device Software Development Lifecycle [24].	• A model is introducing in this research for medical computerized devices • During the development of model, the authors were used mix approach. • The model provide the solutio of some barriers like software updating and implementation issues	• This model is developing fo the medical devices in Ireland. • In future after the changing in proposed model can implement in other countries.
Systematic literature reviews in agile software development: a tertiary study, Information and Software Technology [37].	• Conduct a systematic literatur review • Identify some active research areas in software development • Ranked these research areas according to their need and value • Highlighted the area of research regarding software failure such as maintenance, cost and managements issues in Pakistani environment.	• Another SLR should be conducted by selecting the period of time • Advantages and disadvantages should be declared in future
A hybrid model by integrating agile practices for Pakistani software industry [24].	• Purpose a suitable framework for Pakistani software industry • Summarize the issues from literature in systematic form • Detail description of every steps of proposed model in mentioned in this study • Highlighted some issues such as quality and management issues • Moreover productivity and maintenance issues are also involved in Pakistan	• Documentation needed for proposed frame work • Apply the principle of give framework
A model for applying Agile practices in Distributed environment: A case of local software	• Initiate the affected critical factors of distributed agile environment. • Three countries are used to collect the data. • Develop a model in local	• Prepare this solution according to the Pakistani environment. • After to modification of proposed model,implement it in Pakistani software industry.

Title	Features	Limitation
industry [28]	• environment. • The proposed model consists of some major parts. • Factors are English language, politics, marketing, job stress and lack of professionalism	
Optimized Quality Model for Agile Development: Extreme Programming (XP) as a Case Scenario [36].	• Develop a quality matrix model and simulate the data by using iThink technology. • Select the data from twenty software companies. • Developing new model, its quality and efficiency are discussed in this research	• Need to categories the quality attributes from proposed model. • According to the quality attributes, a new model is needed in future
Architectural Design Group Decision-Making in Agile Projects [33].	• introduces a technique which can identify the quality attributes and design their alternatives • Key point of this research is how to make better decision during the development of software. • According to the proposed mechanism an appropriate decision will be made. • Decision is the key factor of best management.	• In future there is need to work on the quality of decision.
Issues in Adopting Agile Methodologies in Global and Local Software Development: A Systematic Literature Review Protocol with Preliminary Results [27].	• Highlight agile issues in global software developments and local software development • Conduct the systematic literature for this purpose • Nineteen challenges were emphasis in this paper • Some common challenges are communication, management issues, lack of Experience and documentation are most common issues highlighted by author.	• In future there can be amendment in this SLR methodology and develop new protocol for analyses the papers.

Title	Features	Limitation
Problems in Agile Global Software Engineering Projects especially within Traditionally Organized Corporations: [An exploratory semi-structured interview study [29].	• Take data of s/w failures from different organizations in Germany • Prepare a questioner in five categories for collecting the data • After the collection of data summarize the results and prepare an analyses report. • The analyses report shows the challenges which faced by German software industry. • These challenges are quality o software, problems is software testing and software updating problems.	• In future summarize the identified problem in systematic way and exclude those problems which are not affected in software industry. • Select any of the identified problem and proposed a frame work for their solutic
Empirical Study of Agile Methodologies and Quality Management Success Factors in Pakistani Software Companies [40]	• Mismanagement in quality ca increase the quality of softwar • Classification of success and failure factors in Pakistan • Schedule of software, risk of software, Scope and software budget are highlighted in this article.	There is need to compare th agile methods and check how they affect each other and their impact on softwar industry in Pakistani environment.
A Study on Uncertainties in Software Project Management in Pakistan [41]	• Mentioned uncertainty with respect to software failure in Pakistan • The failure factor which highlighted in this article are taught development schedule, lack of latest technology and client uncertainty.	During the planning phase we should overcome the uncertainties which caused software failure in Pakistan industry.
Taxonomy of Factors Causing Integration Failure during Global Software Development [42]	• Work on global software development regarding software failure of software. • The issues that mentioned the author in this article are cost factors, overall quality of software and integration challenges. • Lack of quality, knowledge	The proposed strategy can be formulated in future which could be ultimately good effect on software development industry.

Title	Features	Limitation
	skills and issues in software designing is the major identification of this study.	
The Impact of Agile Methodologies and Cost Management Success Factors: An Empirical Study [35]	• The key factor which handle i this study is cost • Aim of this research is to take the opinions from experts that how can manage the cost in Pakistan. • Additionally, quality, risk and resources of software are also mentioned in this research.	Mentioned the correlation cost with other phases of software development.
Preeminent risk factor affecting software development [43]	• The objective of the research i to identify and analyze the vit: risks of software in Pakistan. • The identified risks are planning issues, requirements gathering, coding testing and deployment. • Moreover, analyzing, design and maintenance are also identifying of this research.	We can identify the risk factors according to the updated mechanism becaus the risks are changed according to the time.
Investigating Critical Success Factors of Project Management in Global Software Development: A Work in Progress [44]	• Global market becomes more popular in Pakistan. • Some issues are identified in this research according to the global market. • These issues are: configuratio managements, incompatible data format, version management, software integration and architecture	The study highlight some technical issues, in future w can identify the managemer issue and can provide a framework for affective software development.
Behavioral factors for IT project success in Pakistan: Moderating effect of leadership styles [37]	• Attained the behavioral aspect of project management. • Conduct a survey from software experts and identify some issues regarding failures • Lack of communication between team and client.	It is basically handle the behavioral aspect so in future we can dome it by moderator of accountability

Title	Features	Limitation
A Study on Software Metrics and its Impact on Software Quality [38]	• Focus of this research is the quality of software. • Client satisfaction will come from the quality of software. • Handle the problem which is called software metrics that directly affect the quality of software. • How we can increase the revenue from software industr is also discussed in it.	There is needed to make a mechanism for gather the information related to the quality enhancement.

In order to meet the objective of this research, we prepared a document by using SLR protocol that refine the failure factor from Pakistani software industry. Now, these failure factors will be used for further investigation from current software industry. Basically, it is output from SLR which clearly elaborates paper year, and features and limitations. This document filters the data regarding this research from different articles which published from 2010 to 2019. However, the focus of this document is to find out the software failure, software failure factors, important guidelines, and any successful factors according to the state of art mechanism. The limitation of each article is also elucidating at the end of this document.

2.4 Summary

From the above literature review, we cover the topic in all aspects and find the failure factors by using the systematic literature review. Moreover, suitable methods are discussed for large medium and small-scale projects. For the consequences of objectives for this research, we highlight challenges, failure factors and mentioned it on table 2.2. Additionally, the discussion of agile benefits, features of agile practices, some affected factors are also the part of this literature. We revealed some frameworks which are implemented in Pakistan and find the relevancy and comparison of this framework. Identification the challenges of agile development in PSI and some proposed solution are the part of this study.

The above literature covers the application of agile methodologies in number of circumstances. The factors which affect the software industry are identified in systematic manner. Through this literature there is still lack of research to identify the failures factors in a systematic way and summarize these factors in graphical way. We visit several software houses and come to know that currently in Pakistan most of software development is done under the agile environment through Scrum and XP models. To improve the agile methodologies in Pakistan, there is need to highlight the challenges at every phase during the development. According to these challenges a proper guideline is needed in future.

Chapter 3

METHODOLOGY

3.1 Overview

The aim of this chapter is to elaborate the methodology of this research in precise way and express the adopted process that equip the answers of research questions mentioned in the previous chapter. Furthermore, this chapter consists of instrument's structure, questionnaire distribution mechanism and collects the responses and analyzes the respondent's answers graphically and statistically in the form of tables and graphs. The analyzed results provide better comprehend regarding research questions and also provide the appropriate results which can help us to make the specific and particular decision related to this research. Moreover, the responses which we collect from respondents are further divided according the research questions and present that in individual tables to show the results graphically.

Basically, this research is mix method research. Where we focus the current agile based software industry and conduct the interviews from software professionals according to the research questions. Furthermore, the responses which we gain from software professionals are decoded using statistical tool and presented it in statistical form.

Since this is the mixed method research design. The outcome of both methods are compared at the end of this study for purpose of triangulation to see that how results of each study complement each other. The outcomes are used to highlight the common and collective problems which mentioned in research questions.

3.2 Operational Framework

The strategy which we use for this study is revealed sequentially in Table 3.1. The entire approaches and tactics which we accomplish in this study are mentioned here. We divide the whole research into five phases; these phases eventually help us to achieve the goal of this research in precise and systematic way.

Table 3. 1: Operational frame work

Method	Purpose	Outcome
SLR	• Latest articles are selected according to the SLR protocol which meets the research topic. • Key purpose of this phase is to highlight the software failure factors in Pakistani software industry (PSI).	• Selection of research papers • Highlight software failure and software failure factors in Pakistani software industry. • Factors are obtained and summarized is in table
Surveys	• Visit the local software industry and meet with software experts • Prepare the questionnaires and get responses from software professionals regarding software failure and software failure factors.	• Acquire more than hundred responses • Identify the failure and successful factors • Take guidelines to improve the software industry in Pakistan from software professionals.
Interviews	• Meet software professionals and conduct interview • Identification of software failure and failure factors • Gain the important guidelines for successful development in Pakistan	• Attained more than ten interviews • Identify the failure and successful factors • Take guidelines to improve the software industry in Pakistan from software professionals.
Triangulation	• Ensure the validity of data • Compare the both data and check validity • Result configuration	• Comparison report of both data • Final result are identified by ensuring the validity of data
Guidelines	• Key purpose of guideline is to improve the Pakistani software industry.	• Get opinion from software experts and conclude it consequently

At the initial stage of this study, we select the appropriate and suitable SLR protocol which pertinent the research topic. This protocol is used to find the relevant data regarding the research topic in systematic way. We select the articles from 2010 to 2019. Further we examined these articles to refine the problem which we mentioned in research questions. The purpose of this phase is to find the software failure, software failure factors and their appropriate solution. Typically, this phase is used for initial data collection and outcomes of this phase are ultimately observed

according to the mechanism of selected protocol. However, as the outcome of this phase, we prepare the document and formulate a table 2.2. This table shows paper title, features and limitation of each article.

Survey is the second phase that is another strategy which we use for data collection regarding research topic. A comprehensive and inclusive questionnaire is prepared in this phase and sends it in local software market. This questionnaire covers the research topic in all aspects such as respondent personal information, software failures, software failure factors, recommendation and successful factors. Moreover, some questions are also added in this questionnaires related to the ratio of software failure and successful software development. More than hundred responses are received from different resources then evaluate it consequently.

After that third phase of this framework, we prepared the structure of interview according to the research topic. This tool eventually helps to take data directly from software professionals. Although maintain the responders profile is one of the major activity of this phase. It is quite difficult to get time from interviewers then conduct interview accordingly. The purpose of interview is same as questioners where we collect data regarding software failure and software failure factors. The collected data is further evaluated through decoding mechanism and convert it into quantitative form by using the WEKA tool. The outcomes which we produced from WEKA tool are further used for comparison which is prolific for the validity of data.

Triangulation is the process which is used for the validation of data through cross verification [47]. Multiple sources are used for the collection of data in triangulation. It examines the constancy of findings obtained through different instruments such as questionnaires and interview and increases the chance to control, or at least assess, some of the threats or multiple causes influencing our results. The instrument which we used in this study is questionnaire and interview. Both data collects, summarize and compare it by using methodological triangulation method. Methodological triangulation involves more than one option like observation, interview, documentation and questionnaires.

Guideline regarding software failure and software failure factor is an important phase of this study which mentioned in chapter no 6. It is the finalized part of this study where we get the opinions from software experts and prepare the guidelines for Pakistani software industry. However, we can overcome the software failures in Pakistan through this guideline. At the end of this research, we conclude

the whole research and revealed some point related to agile software development that should be examined and solved in future.

3.3 Research design and development

Research design consists of methods and techniques which we adopted for this study. It provides vision to conduct research using the particular and specific methodology. Overall sketch which we adopted for this research is stated here:

3.3.1 Mix method research

Mix method research consists of quantitative and qualitative methods. These study emphases on collecting, analyzing and mixing both type of data in a single study or series of studies [48]. Its central premise is that the use of this approach in combine can provide better understanding of research problem and further it can produce the better results of data for analyses.

3.3.2 Features of mix method research

The core concept of mix method research is to collect qualitative and quantitative data and then analyze it in appropriate way, this way of research can give priority to one or both form of data [48]. Moreover, mix method research can also highlight the strength and weakness of qualitative and quantitative data. Mix method research is used where source of data may not be enough or initial results needs to be further explained.

3.3.3 Major designs of mix method research

Mix method research is divided into six different categories according to the specified criteria; the criteria are integration, priority, implementation and theoretical prospective. The types of mix method research are:

- Sequential explanatory design
- Sequential exploratory design
- Sequential transformative design
- Concurrent triangulation design
- Concurrent nested design
- Concurrent transformative design

3.3.3.1 Sequential Explanatory Design

It is straightforward research method that collects quantitative data and analyzes it by following the qualitative data analyses. The method gives priority to quantitative data and in addition the implementation of this design may or may not guide by a specific theoretical prospective. This type of research is useful for the projects where unexpected results may arise from quantitative study. Moreover, it is also important design method because the researcher can explore the quantitative results for further use and accurate findings from collected data. In this case the data will be examined more critically and in more detail to avoid such surprising results and produce more findings [49].

Sequential Explanatory Design is straightforward in nature that's why it is the main strength of this research method. Because of its nature it is easy to implement and conduct every step easily in separate stages. Consuming the additional time span during the data collection is main meekness of this research design.

3.3.3.2 Sequential Exploratory Design

Most of the features of this design are like the Sequential Explanatory Design. It is accomplished into two phases, priority given is added in first phase and this phase might not be implemented because of prearranged theoretical perspective. The initial phase of this design is to collect qualitative data and analyze it by following the quantitative phase. Therefore, the priority is given to qualitative phase. At the end the findings of both phases are collected and interpreted in interpretation phase [50]. The major advantages of this design are to describe the final report more clearly and concisely as compared to the previous design. It is useful for those researchers who want to magnify the qualitative findings. However, the researcher may find it difficult to build the findings from qualitative.

3.3.3.3 Sequential Transformative Design

This design has two distinct data collection phases. First one is quantitative data collection phase and second one is qualitative data collection phase [51]. First phase follows the second phase. However, in this method priority is optional, either it may give to first phase which is quantitative, or it may give to the second phase which is qualitative. This method is beneficial for researcher who wants to describe the problem according to the theoretical prospective. Sequential Transformative

Design uses distinct phases that are why strength and weakness are the same as Sequential Exploratory Design and Sequential Explanatory Design.

3.3.3.4 Concurrent triangulation Design

Concurrent Triangulation Design is most acquainted design of mix method. This method is used when researcher wants to conform the cross validation or verification the findings in single study. In this method, qualitative and quantitative phase are implemented separately to avoid the weaknesses of both methods. However qualitative and quantitative data collection is concurrent in this method. The priority of this method should be the equal between two methods. Concurrent Triangulation Design provides will- validated and authenticated findings form collected data which is expedient and beneficial for outstanding research. In addition, this method consumes shorter time span for data collection which is immense métier of this design [52].

3.3.3.5 Concurrent Nested Design

Concurrent Nested Design collects quantitative and qualitative data concurrently and guides the project by predominant method. Quantitative and qualitative methods are planted within the predominant method. Predominant method means that the collected data is mixed at analyses phase that's why it may not guide the project by theoretical prospective. The current design has verity of purposes like researcher may explore the project and findings, researcher wants to study different groups at different levels and this method could use within a framework for specified treatment conditions [53].

3.3.3.6 Concurrent Transformative Design

Concurrent Transformative Design is based on different ideologies like conceptual or theoretical framework, Advancement, perilous theory, participatory research and it used for theoretical prospective. This design method may involve a triangulation of both quantitative and qualitative studies which can help any organization to make polices [54]. This method shares the features of concurrent transformative design and triangulation and nested designs; however, this method also shares the strength and weakness of those methods.

3.3.4   Triangulation

Triangulation means using multiple methods to collect data on same topic for validation and authentication in research. It is a measurement technique used by researcher for precise and accurate findings. Furthermore, triangulation is used for increasing the accuracy in research, validity measurements and proliferation the credibility of research [55].

Theoretical triangulation, Investigator triangulation, Analysis triangulation and Methodological triangulation are the types of triangulation. In theoretical triangulation we use multiple theories in single study; this will help the researcher to find out the problems in comprehensive and inclusive way. The Investigator triangulation is defined as multiple researchers or data analyst will research or analyze the data in the same study. For validation purpose, same set of data will be used for two analyzing methods is describe as analyses triangulation. These two analyzing method could be the method for quantitative data analyses and qualitative data analyses [56]. Finally, the methodological triangulation is widely used in social science. This kind of triangulation may happen at the time of research design or gathering the data.

3.4 Mixed method research design for this study

Mix method approach is used in this research. This approach is basically the combination of qualitative and quantitative data, so the current study we collect data according to the qualitative mechanism and then analyze it statistically by using the
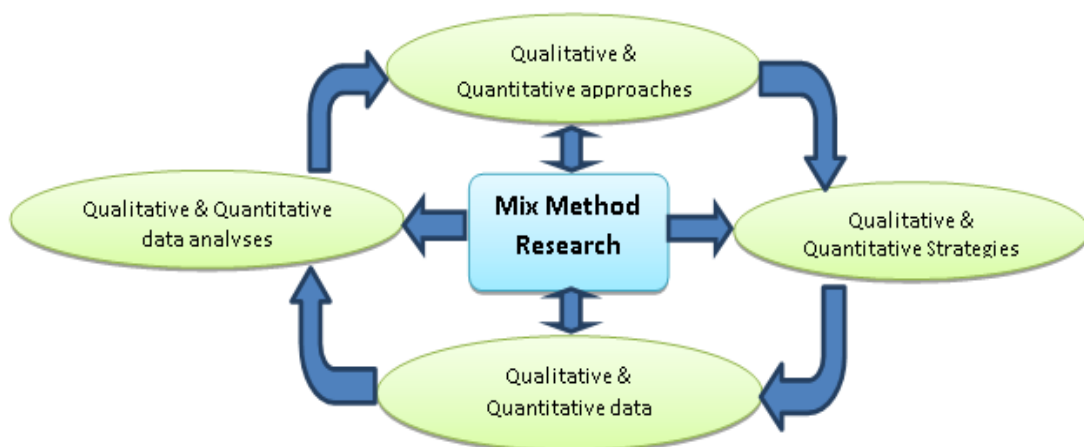
Figure 3. 1: General form of mixed method research

The instrument used for qualitative way of research is interviews. In this research we observe the data which we collect from interviews which consist of whole tasks that we mentioned in this research through research questions. Moreover, we design the instrument according to the investigating problems which we mentioned in research questions. However, in this study we choice sequential explanatory design which one the type of mix method research. This design contains the collection and analyses of quantitative data followed by the collection and analyses of quantitative data. Although our aim is the collection of data through questionnaires and interviews from software industry, this data is presented in qualitative form. After that, this qualitative data is converted into quantitative form same as the method of sequential explanatory design. The other mix methods research which are presented in sections 3.3.3.2 to 3.3.3.6 are not match in this research because of their nature and sequence of activities. The explanations of other methods are declared in section 3.3.3.

Moreover, the triangulation technique which we adopted in this research is methodological triangulation. In methodological triangulation multiple qualitative techniques are used for collection of data and established the validity when result of each method is same. We conduct data by using two types of instruments; first one is questionnaire and second is interview in this research. Both data are collected and analyses according to the method of methodological triangulation. The other types of triangulation are not matches with this research. Generally, theoretical triangulation emphasizes interpretation phenomenon of more than one theoretical scheme. Secondly, the investigator triangulation consists the team of investigators that examine the program with qualitative method. So the methodological triangulation technique is exposed for collection and analyses the data consequently.

Generally quantitative data collection scheme is divided into two main methods. First one is experimental and second is non-experimental. Non- experimental technique has descriptive way of analyses which consist of survey, correlation, comparative and evaluative study. We use non-experimental technique in this study because our focus is to collect the data related to software from current industry which will be done through survey.

3.5 Plausible framework

In this framework, our goal is to explain the whole research and summarize it from start to end that will provide us suitable and appropriate guidelines. These guidelines consist of data collection, summarizing data, analyzing data and produce the results according to the research questions. However, in this study we will collect data by using following two major data collection strategies.

3.5.1 Data collection approaches

Two basic strategies are used in this study for collection of data. These sources are:
- Primary data collection
- Secondary data collection

In this research we used both methods for data collection which shows in Figure 3.2. Primary data collection is done through questionnaires and interview from selected organizations in distinct area of Pakistan. This source provides us the data which we want to collect regarding software as mentioned in research questions.
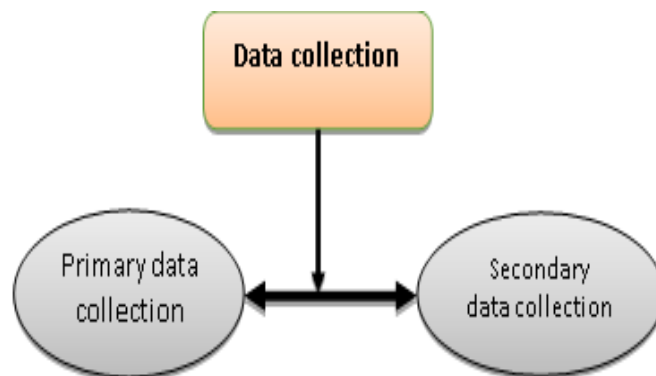
Figure 3. 2: Data collection technique

Secondly, we utilize secondary data source for those data collection which is already available on different data basis. This source helps us to formulate the existing problem which we want to investigate in this research.

3.5.2 Primary method for data collection

The basic technique which we adopted for data collection in this study is primary method for data collection which is shows in Figure 3.3. This technique

provides the efficient and appropriate way to collect newly data from current market that can help us to filter the accurate problem in Pakistani software industry.
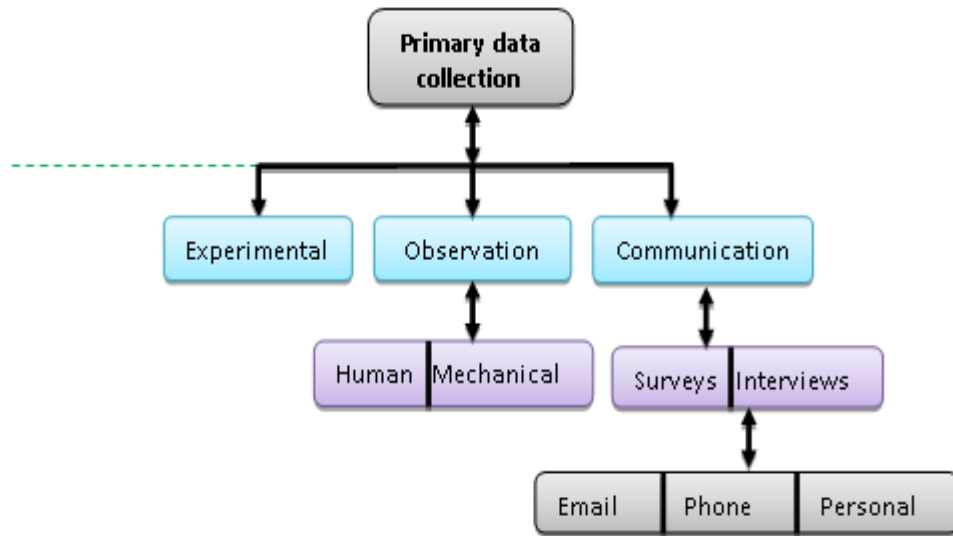
Figure 3. 3: Primary method for data collection

Numerous approaches are used in primary method; in this study we used two major approaches which are survey and interview [58]. In survey approach we construct an instrument questionnaire according to the research questions and distribute it in distinct area in Pakistan through E-mail, by post and personally visit the organization and fill questionnaires from experts. More than hundred responses are received from different software organizations and some individual professionals.

Table 3. 2: Distribution and responses record

Source	Total distribution	Received responses	Percentage of received responses
Email	96	43	45%
Social Media	50	10	20%
Personal	70	65	92%
Total	216	118	53%

When we analyze the table 3.2, we see that almost 53% people's response from 216 distributions. We distribute these instruments by using different sources such as email, by post and self-visit. These responses are quite enough to elaborate, summarize and filter the actual problem in software market. Secondly, we adopted

another way of data collection in primary method; the purpose of this method is accuracy and reliability of collected data. However, this second primary method is interview method which we collect from software professionals at personal level. Some interviews are collected through phone which is quite difficult way to collect data and communicate with professional. Furthermore, we compare the both data and produce the results to penetrate the actual problems which face the Pakistani software industry in current scenario.

3.5.3   Secondary data collection

It is useful and easily available information that we utilize in research to solve different types of research problems. Additionally, it is quite easy way to understand the problem which is under observe through secondary sources and can explain it more evidently and plainly to achieve the objectives of research. Moreover, we can save time and money by using such type of data. However, secondary data can be extracting from different resources such as books, electronic data bases, electronic books data bases, dissimilar journals, surveys, publications and dissertations. Secondary data can either be internal or external [59]

Internal data is available at internal side of any organizations. It is personal data and not available publicly. Internal data should be the reports of any organization, analyses of different problems etc. External data is available publicly at different platforms which is relevant any organization. External data could be the published annual reports of any organization.

In this research we conduct systematic literature review to collect the data. It is secondary way of data collection because we add different published data in this systematic literature review. This data includes the research papers which are published on dissimilar journals and survey reports that are available on websites and add some data from books. However, we use external data strategy in secondary way of data collection because it is easily available data.

3.5.4   Data collection strategies

There are two fundamental strategies which we use in this study shows in Figure 3.4. These strategies are surveys and interviews, surveys are done through questionnaires and interviews are done through personal meeting with software professionals. Furthermore, questionnaires are circulated to different organization

and some individual professionals through mail and other internet resources weather interviews are collected individually. However, we receive more than hundred responses from questionnaires and about seven responses from interviewee.
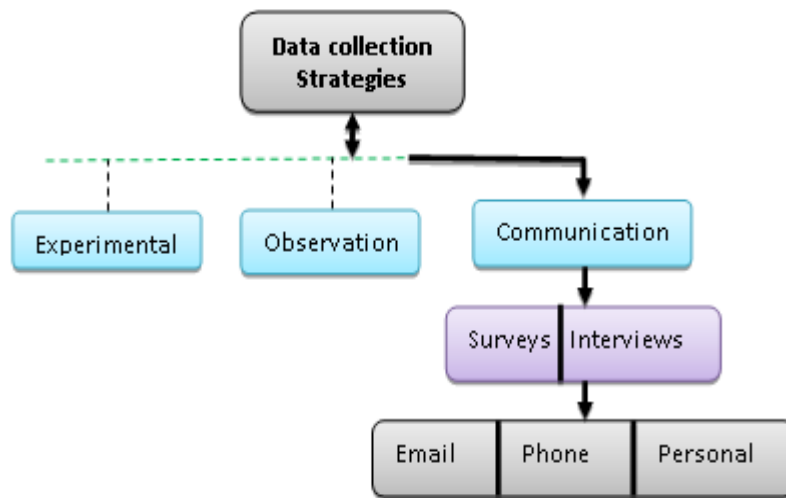
Figure 3. 4: Data collection strategy

Lot of strategies uses for data collection. Although, we used communication strategy that is surveys and interview as mentioned in image 3.4.

- Questionnaires
- Interviews

3.5.5   Questionnaires design

An instrument which is based on the series of questions related to research topic is known as questionnaires. Questionnaire is an instrument for any survey-based research. However, in this thesis we design a questionnaire according to the research question and circulate it in Pakistani software industry for data collection related to research topic. Moreover, we use the following mechanism to design the questionnaire [60].

3.5.5.1 Question about attitude

These questions are difficult compare to behavior questions. Attitude questions are subjective states and have no true answer. Attitude exists just in a man's brain. So the answer of the question can be steady or conflicting, clear or misty however they can't true or false [60].

3.5.5.2 Behavioral Intention Questions

There is frequently an expected connection between attitude and behavior. In case of sailing purchasing the products, peoples ask the attitude questions because it is depending on the attitude of peoples that what the product they buy. Behavior questions are used for opinions of peoples. The answer of this type of questions might be reflects. There are two major types of behavior questions, first one is Yes/No questions and second is likelihood questions. In telephonic survey Yes/No questions are frequently used and produced a specific answer. A Likelihood question provides the range of responses. The respondent selects the answer from given range and provide the information [61].

Another way to ask questions of behavior intention is to ask peoples that how frequently they will take part in the conduct within a predefined timeframe. It is basically the investigating approach and questions are asking either a fill in the blanks or as a frequency question. The researcher may formulate the questions according to the following points.

3.5.5.3 Unipolar and bipolar questions

In unipolar questions we take opinion from respondent about the object. unipolar scales are more contoured, allowing users to instead focus on the absence or presence of a single item. In bipolar the respondent makes a choice between two contrasting objects. Unipolar starts from zero whereas bipolar start from extreme negative. Unipolar questions have no natural mid points and goes to an extreme level while bipolar has a natural point and goes to opposite extreme positive.

3.5.5.4 Multidimensional attitude

Just avoid the multidimensional attitude about the objects because it is difficult to understand regarding objects. In this case the researcher needs to ask questions in such a way that respondent make choice between two alternatives. The concept of questions must be one-dimensional and don't have use complicated statements.

3.5.5.5 Questions filter

Sometime complex questions need to break it in multiple unipolar questions. Moreover, the answer of the question is unexpected according to the previous answer. Filtering technique will be using to overcome these issues. This technique is used to decompose the critical questions and don't use the multidimensional questions [62].

a. Questions that include a middle point

Commonly questions that include a middle point are used in survey research. The reasons to use these types of questions in survey research is a few peoples that are genuinely uninterested or in the middle. Middle alternative does not affect the size of categories and advantages and disadvantages of objects. The measure of the reaction to the center class can give additional data about the power of state of mind.

b. Avoiding Double-Barreled and One-and-a-Half-Barreled Questions

The questions which have opinion about two objects is joined together and respondents must answer the multiple questions with one answer are not include in questioner. Each issue elaborated clearly by separate questions which produced the preeminent and appropriate result. Double-barreled questions and even one-and-a-half-barreled questions can be avoided if the question writer is alert to the problem.

3.5.5.6 Open ended questions

This technique is used to record the answer to question. The purpose of this technique is the result must be meaningful when the response categories were incorporated into the question [63]. However, there is number of critical issues which we can consider and can overcome the disputes about questioners.

- Try to add the open-ended questions in your research. Because these are suitable for development work. Close ended questions are difficult to construct but he advantages of these questions are easier to analyze and can easily produce the result.
- Avoid the interviewer field coding. Just take it from respondent in case of necessary.

- Start the questions with least socially desirable, otherwise respondent may choose socially desirable question without read the entire set of responses.
- Use numerical scale and don't add verbal rating scale questions.
- Make the minimum alternatives in case of telephonic interview. In face to face interviews just add four or five alternatives. If more alternatives add in questions the respondent categories, the alternatives and choose more desirable options.
- By using the paired comparison questions, we can produce the raking.
- The information must be complete and valuable of each item individually.

3.5.5.7 Open answer format

The valuable part of every questioner consists of open-ended questions. The respondent answers the open-ended questions freely in their own words and can elaborate he question easily. The format of open-ended questions is considerable, and it does allow the respondent to express themselves in comfortable environment. These types of questions also take more time and concentration to answer then close ended questions. A great interviewer skill is required in open ended question.

3.5.5.8 Close ended Questions

In close ended questions a distinction is made between field coded and pre-coded. Field coded and pre-coded are interviewer selection and respondent selection respectively. In close ended questions the question should be identical and have open answer format [64]. The interviewer simply checks each topic and its related questions. The advantage of open format is that the respondent give answer in their own words with full confident in freely environment. Cognitive work has been done in case of preceded questions. Preceded question makes the task easier and more passive for respondent because the respondent can freely handle the questions without organizing their own thoughts and give answer quickly. But if the questions are not well formulating, it should be producing biases in the answer. Same terms are use in preceded questions. Because of these same terms it appears to guarantee comparability of responses across individuals. There are two purposes of preceded questions, the first one is response dimension and the second one is numerical codes which will help for simulation in future.

Table 3. 3: Structure of questionnaires with example

Sr No	Questions Type	Question example
01	Open ended questions	State your opinion about the quality of Hair's product and services? --
02	Close Ended Questions	
	Leading questions	How would you rate the products of Hair corporation? a) Fair b) Good C) Excellent d) Superb
	Importance Questions	**Cost- effected services are:** i. Extremely important ii. Very important iii. Somewhat important iv. Not very important
	Likert Question	Hair corporation's product must improve on quality i. Strongly Agreed ii. Agreed iii. Disagree iv. Disagree
	Dichotomous Questions	Do you like the product of Hair's corporations? i. Yes ii. No
	Bipolar Question	How would you describe the services of Hair's corporation? Efficient ----- ----- ----- ----- ----- Inefficient Fast ----- ----- ----- ----- ----- Slow .Reliable ----- ----- ----- ----- ----- Unreliable
	Rating Questions	How would you rate the services of Hair's corporation? Good Fair Poor Very poor
	Buying Propensity Questions	If mobile phone had an in built mp3 player, would you prefer to buy it? Definitely Probably Probably not Not sure Defiantly not
	Questions to be avoided	
	Embarrassing Questions	
	Positive/ Negative Connotation Questions	

3.5.5.9 Designed Questionnaires

The arraignment of questions is mentioned in table no 3.4. This table is created according to the above guideline that mentioned in table 3.3. These questions cover the dual part of first question and take data about research question no 3. We add some open and some close ended question in questionnaires and void embarrassing and negative connotation questions

Table 3. 4: Questions distribution

Sr No	Nature of Question	No of Question
01	Questions related to organization	03
02	Questions related to respondent's profile	08
03	Questions related to research question no 1 part "a"	04
04	Questions related to research question no 1 part "b"	04
05	Questions related to the research question no 3	05

We divide the entire questionnaires in five parts as mentioned in table 3.4. In the first part of this distribution, we add three questions related to the organization which is choose for data collection. The organization must have professional and project oriented environment. Secondly, the respondent's profile is an important part of this data collection strategy. The accuracy and validity of data is depending on the profile of respondent. So we include nine questions for selection the professional and expert respondent. Furthermore, we add some more questions according to the research questions. Basically the research questions no 1 have two part, first one is related to software failure and second is software failure factors. However, we include four questions for each part of this question and five questions are added for question no 3 which is related to the guidelines regarding the successful development in Pakistani software industry.

3.5.5.10 Questionnaires for this research

The format of questionnaires is mentioned in Appendix A which is used for the research. The arraignment of questions is mentioned according to the sequence of research questions.

3.5.6 Interviews

Interview refers to one to one conversation between an interviewer and respondent. Usually it is a research tool which is used to gain data from interviewee and evaluate it according to the specific area of research. Interview although can take place face to face by using the modern communication technologies such as

telephone interview and video conferencing. However, for qualitative research, interview is an important and significant mechanism used for data collection in precise and exceptional consequences. Additionally, interviews are quite dissimilar from questionnaires as they encompass social interactions and can ask different categories of questions to create the different type of data [66].

3.5.7 Types of interview

Interview types are: unstructured interview, semi structured interview, and structured interview [67].

3.5.7.1 Unstructured/ Informal/ Casual interview

An unstructured interview is an interview in which has no explicit arrangement of predetermined questions, although the interviewers often have certain theme in mind that they wish to cover during the interview. Unstructured interview flow like an ordinary discussion and incline to be more casual and open-ended. Unstructured or informal interview are generally the contrast of structured interview where a list of predetermined questions is used. Moreover, the interviewer must mindful the scope and purpose of the topic that they are hoping to discuss in research. However, the conversation between interviewer and interviewee should be in simple, minimal, meaningful and relevant to the concerned topic or area of study [67].

Unstructured interview is not used where we want to gain valuable and treasured information from interviewee. In this study our ambition is to collect authentic and reliable data related to the software development in current Pakistani industry. That's why this way of interview is not suitable for current research.

Example: An interview for job could be unstructured where several questions will be asked with the goal of prospective criteria and analyze the skills and expertise of candidate.

3.5.7.2 Semi structured interviews

Semi-structured interview is a data collection technique in which the analyst requests interviewers a series of prearranged but open-ended questions. In semi structured interview the researcher has more authority over the areas of the interview than in unstructured interviews [68]. More over the interviewer can change the order

of questions according to the environment and interviewee behavior. Moreover, the interviewer can give clarifications or omit the questions that may appear redundant. Example: Please describe any actual problems that you experienced while development of medium software project.

3.5.7.3 Structured/ formal/ standardized interview

In structured or standardized interview, several specific set of prearranged questions are equipped by the interviewer in advance and enquired these questions to entire interviewees in specific order. This interview strategy is generally used in survey research and ensures that each interview is presented with the same questions in the same order. We can include both open-ended and close- ended questions in structured interview. In close-ended questions, we can ask the interviewee for specific piece of information or the respondent can choose the information from the given list of alternatives [69].

We must make sure the scope and objectives of entire topic before the conducting of structure interview. Moreover, focus the goal of research should be clear in interviewer mind and the questioner won't veer off from interview schedule. In this study we will follow the mechanism of structure interview because the structure interview is easy to test and reliable as compare to other types of interviews. Additionally, it is fairly quick to conduct and can ensure with the short amount of time.

Example: Tell me about a time you're failed at a project (Situation/Task). How did you try to evade failure? (Action). What did that experience teach you? (Result). The order of questions will not be changed in above example. It means we can't ask the result questions before the situation and action question.

3.5.7.4 Pilot interview

A pilot interview is planned not for information accumulation as such but rather as a guide to the structure of later research. Initially pilot study will usually be unstructured, searching for themes, philological and ideas, but later ones may test the appropriateness of standardized interviews. Pilot interview has divided into two sub categories; first one is pre- pilot interview and second is complete pilot interview. In pre-pilot interview, initially we examine whether the subject is being researched satisfactory and implement according to the schedule or not. Secondly, the complete

pilot interview is generally a mini implementation of the entire research including data assortment, analyze the data and outline report etc [70].

In this research our goal is to get appropriate and reliable data which will be further use for statistical analysis, that's why initially a pilot interview will be conduct for improving the quality in research and avoiding the problems such as question's wording problem, technique of interview, problem in interview coding, analyses and matching issues in the whole research.

3.5.8   Interview conduction

Interview is best instrument for qualitative and subjective research. Interview can help us to clarify, well understand, and explore research topics, assumption, behavior, knowledge's, phenomenon, etc. usually open-ended and close ended questions are used for interview so that the depth information about your research topics will be composed. Finally, we consider the following important steps that involved in this interview:

3.5.8.1 Plan

We must focus the following points during the planning of depth interview.

- Prepare the list of stakeholders (source of information) and distinguish what information is required and from whom.
- Certify that the study will pursue international and national moral research guidelines.

3.5.8.2 Develop instruments

- Develop a protocol which has set of rules that guide the interviewees and simply put the instruction that are followed for each interview.
- Questions for beginning the interview including some unpremeditated information.
- Build up an interview guide that list the questions to be investigated during the conversation between interviewer and interviewee. Maximum question should be 15 and probes should be involved where helpful.

3.5.8.3 Train data collectors

- Try to express the questions in local language for producing the better response

51

- Categorize the interviewers and train where compulsory

3.5.8.4 Collect Data

- Explain the purpose of interview and re-explain the area of research and particular topic.
- Conduct the interview when you feel the interviewee has consented.
- Write down the responses consequently and verify the specified information given in interview as necessary.
- Immediately summarize the collected key information.

3.5.8.5 Analyze data

- Review and decipher data
- Look the pattern and theme from the replies by reading the responses critically and gravely.
- If there are verity of themes are available in responses, group them in any expressive approach.
- We can also distinguish the replies that appear to have been given with eagerness.

3.5.8.6 Disseminate findings

- Write a report which present the interviews deeply
- Disseminate to respondent, participants, funders, and the communal as suitable

3.5.9   Profile of respondent

The profile of respondent is foremost task for data collection. We add eight questions in questionnaires regarding the profile of respondent. First three questions are related to the basic introduction like name, email address and age. Fourth question is related to academic career and check the highest degree of respondent. For the purpose of technical knowledge, we add two more questions that are experience and area of software development. Moreover, to analyze the development activity, we add two more questions which show us the active role of respondent in organization. In these questions we check that how many projects are being developed by the respondent in last ten years and checked the role and participation of respondent in different software projects.

The following table no 3.5 shows the respondent's profile which we select in this study.

Table 3. 5: Respondent's criteria

Selection parameters	Restrictions	Detail
Degree	Degree >= bachelor	Must be bachelor or masters
Age	Age >= 25	Age should be more than 25 year of each respondent
Experience	Experience >=5	Five or more than five year experience will be considered
Role	Work as technical person and have active role	Developer, team leader, manager.
Method used for software development	Agile	Any method of agile methodology
Area of development	Developing any type of software	Web, desktop, mobile, graphics, games
Developments	Developments >= 5	More than five projects will be developed by respondent

For this research, conditions which mentioned in table 3.5 must match with the profile of respondent then we collect data from that individual. First parameter is degree; the respondent must have bachelor or master's degree. The age of respondent should be more than 25 years and the minimum experience is five years of each respondent. Generally, during the development of software there are many individuals are involved. We should categorize those individuals and considered just technical persons. Technical persons could be software developer, team leader or manager etc. following table 3.6 shows the profile of respondent's which we select for the purpose of interview. These respondents are belonging to the specific area of Pakistan. In this study we considered those respondents who have more than 25-year age as mentioned in criteria. Figure 3.5 illustrate that majority of respondents have age from 25 to 34 year who had fill this questionnaire.
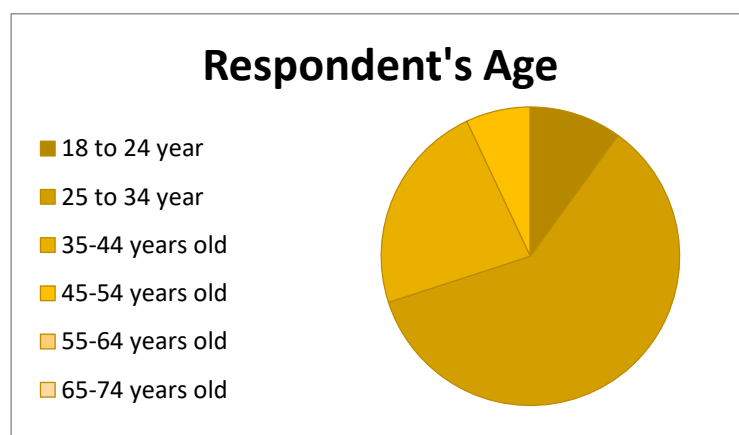
Figure 3. 5: Respondent's age

The qualification of respondents is very important in this study because we select just software professionals who have bachelor or master degree holder. When we check the qualification of respondents, we see in Figure 3.6 that almost all respondents have bachelor or master degree holder.
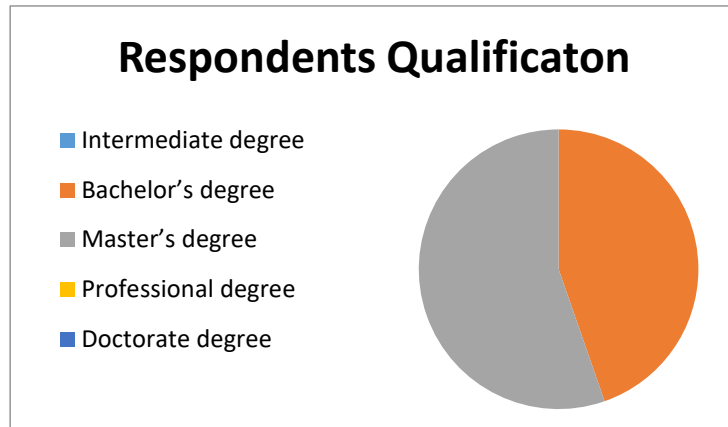
Figure 3. 6: Respondent's qualification

Another important and imperative option that we check before the survey is experience. An experienced and skilled individual can generate appropriate and accurate data. However, most of the respondents have more than five years' experiences as we observe before the data collection and represent it in Figure 3.7.
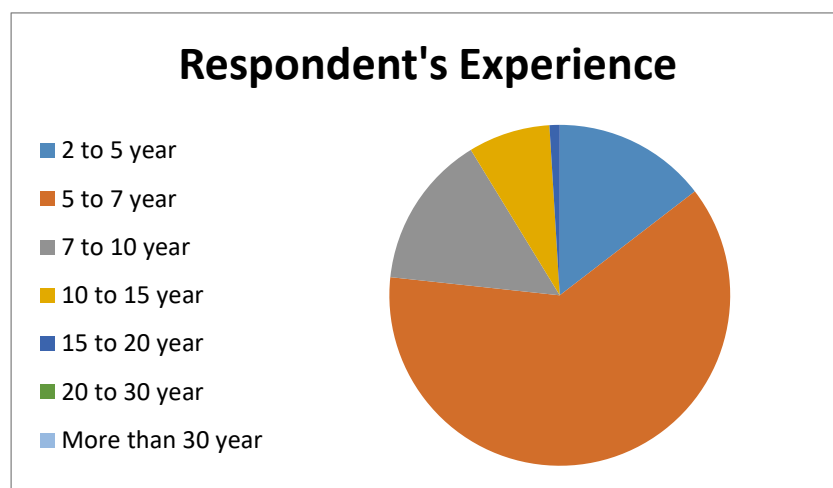
Figure 3. 7: Respondent's experiences

Moreover, we considered those individuals who have an active role during the development of software. They can develop any type of application software such as web application, desktop software, mobile software, graphics and games etc. The

method which used for development of software should be any type of agile method. And finally as we see in Figure 3.8, most of the respondents are software developers which can produce appropriate results for this research.
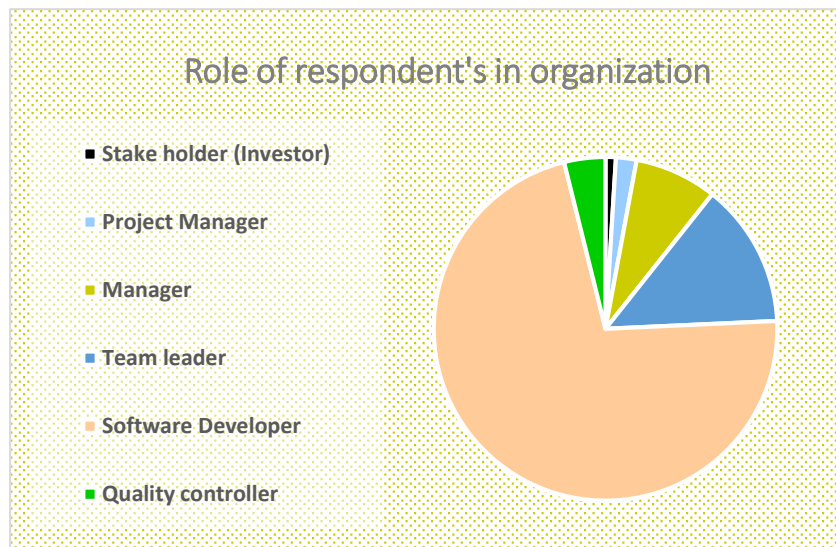
Figure 3. 8: Role of respondent's in organization

3.5.10 Coding Scheme

Coding is a way of indexing or classifying the text in order to prepare a framework of confined ideas. The codes which are adopted allow us to establish data in sequence and proper order, so we can observe and analyze them in a planned way. The approaches of coding schemes are concept driven coding and data driven coding or open coding in qualitative research [71]. In concept driven code, we look the concepts, ideas notions and theories from text sequentially whether the data driven code focus the text without preceding conceptualization and let the content justify itself.

3.6 Analyses process

The chapter also enfolds the analyses process and explains how we analyze the collected data. However, we describe the way of analysis and outcomes by applying the framework which determined in his study. Moreover, we compare this outcome with CHOAS report for the sake of comparison of outcomes with

international report (CHOAS report). Moreover, this summarized data is representing statistically in tables and to formulate result accordingly.

Data analysis is a research technique used to make replicable and legal extrapolations by interpreting and coding textual data. This technique is generally used as a research tool that can conclude the existence of certain words or concepts from the textual data. To conduct content analyses, the textual data will be coded or broken down into manageable categories, phrases or sentences then critically, conceptually and abstractly examine it. Furthermore, some essential options which will be censoriously observed during the content analyses are existence of propaganda, intentions, and attitudinal responses and determine the psychological or expressive state of persons [72]. The general categories of content analyses are conceptual analysis and relational analysis. In concept analyses, an idea is decided for examination, and the investigation includes measuring and counting its essence. The concentration of this type of analyses is to observe concisely of selected term from textual data. However, the relational analyses explore the relationship between identified concepts. Moreover, the relational analyses focus on semantic and meaningful relationship of individuals [72].

3.6.1 Qualitative analyses

Qualitative analyses characterized as a precarious surveying strategy that focuses on observing data through open-ended and informal communication. Qualitative research is an umbrella term which consists of different techniques and philosophies that used to examine the people experience in detail. These techniques could be in-depth interview, content analyses, focus group discussion, observation and life histories and biographies [73]. However, it not enough to apply any qualitative method and produce the results automatically and conceivably, so there is need to identify the study participants in detail, understanding the meaning of response and regularly focus on interpretation that they give. Moreover, qualitative analyses are typically used for depth understanding of disputes and used where we need to explore the specific research topic and enlightenment the cultural problems in society [73].

3.6.1.1 Content analyses

Content analysis is a research scheme for reviewing documents and conversation artifacts, which might be texts of several formats. However, content analysis is a research tool or technique that helps to analyze the actual content and present it in objective and quantitative manner. Sometime content analysis is a term used to describe both quantitative and qualitative approaches to analyzing content. In this study, text is coded or broken down into manageable categories on a verity of levels like word, phrase, sentence or theme then examines the text by using one of the basic methods of content analyses. The results are then used to make inferences about the messages within the text. Content analysis are divided into two major categories, first one is conceptual analysis and second is relational analysis [74]. Following figure show the phases of relational content analysis with quantitative consequences.

There are two types of coding schemes which are deductive and inductive coding scheme. In deductive coding scheme, there is needed to develop a codebook as a reference that developed usually the start of data collection. The data on codebook could be changed, updated and reorganized; this should reflect the structure of data. Secondly, the inductive coding is used where we want to collect data of those topics which we know little about the area and used for improvements. Moreover, inductive approach is use for raw, qualitative data into useful quantitative data. However, we used inductive approach of coding for this study. Our aim is to collect data according to the research questions from Pakistani software industry; this data is basically consisting of raw and qualitative form. This qualitative data will further convert it into qualitative form same as the method of inductive approach. Deductive approach cannot be used for this study because this approach emphasis preconceived hypothesis. Moreover, the results from collected data cannot be produced from raw data in this approach. In addition, we avoid the misconceptions in advance and produced the precise and accurate data within the actual contents. The entire mechanisms which describe here are shown in Figure 3.9.
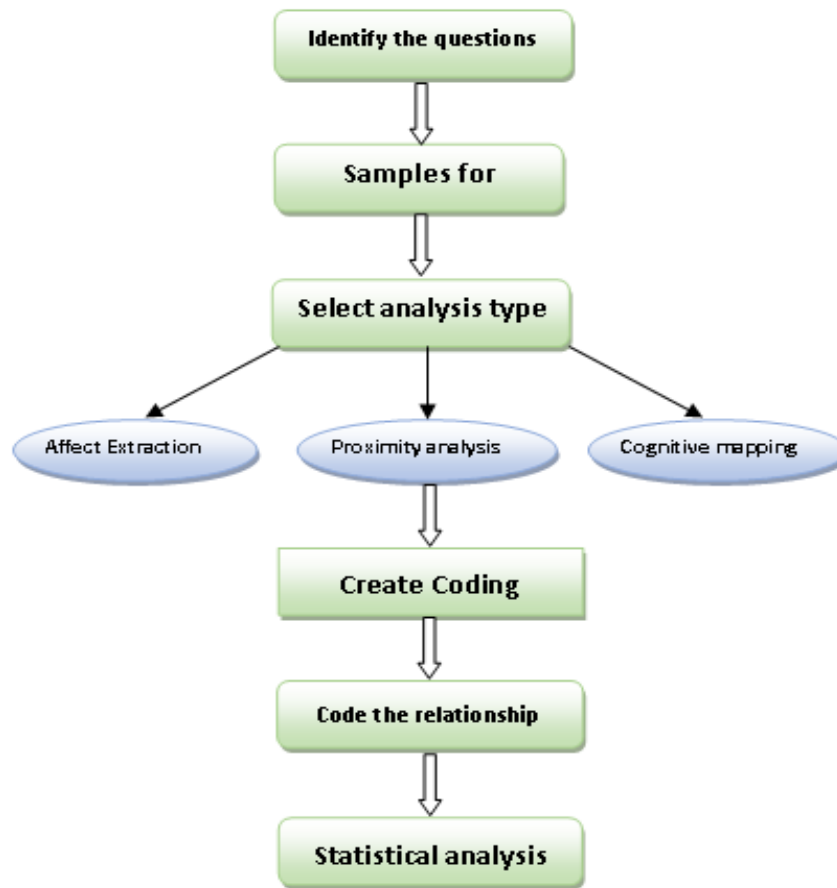
Figure 3. 9: Content analyses

In this research we used relational analyses strategy to analyze the content which we collect from respondent through questionnaires. Moreover, we analyzed the interview's responses through conceptual method of content analyses. So, we can say that we utilize the both methods of content analyses in this research.

3.6.1.2 Identify the questions

Question is imperative because it demonstrates where you are going and why. Without an absorbed question, the idea types and choices open to elucidation are boundless and subsequently the investigation hard to finish. However, we can investigate a specific component of a border topic through preeminent and dominant question and try to accumulate responses through interview or other sources. Example: What concrete information did the responded present in response related to the failure factors of software in current development environment?

3.6.1.3 Samples for analyses

Samples are basically the subset of data which used for further investigation according to the quantitative manner. It is important part of analysis that can avoid the research from bias and prejudice [75]. When the question has been documented, the researcher must choose parts of content/discourse from the gathered information. For relational analysis, the main deliberation is how much data is used to preserve for investigation. However, once the question is identified, there must be needs to select the portion of text from responses which is near to the software failure factor and use it for further investigation. We distribute the text sentence by sentence and investigate the problem according to the research questions which we identified in the previous section.

3.6.1.4 Select analyses type

There are two common types of content analysis: conceptual analysis and relational analysis. Conceptual analysis regulates the existence and occurrences of concepts in a text. Relational analysis builds up the theoretical investigation further by looking at the connections among ideas in a text. Each kind of analysis may lead to different results, decisions, explanations and connotations. Relation analysis begin with conceptual analyses, once the concept is chosen from investigation then explore the relationship between selected concepts and regulate it in specified sequences. There are three subcategories of relational analysis to look over preceding going on to the general phases [76].

a. Cognitive mapping

A visualization system should be available for either influence extraction or vicinity investigation [77]. Perceptive mapping endeavors to make a model of the general importance of the content, for example, a realistic guide that speaks to the connections between ideas.

b. Proximity analysis

An assessment of the co- occurrence of unequivocal ideas in the text is called proximity analysis. Text is characterized as a series of words called a "window" that is examined for the co- occurrence of concepts [78]. The outcome is the making of

an "idea framework", or a cluster of interrelated co- occurring concepts that would recommend a general importance.

c.   Affect extraction

A passionate assessment of concepts expresses in a text. A test to this technique is that feelings can differ crosswise over time, populations, and space. However, it could be powerful at catching the passionate and mental condition of the speaker or writer of the text. In this study we follow Proximity content analysis for check the actual concepts from text or responses in a concise way and then visualize it according to the Cognitive content analysis. This way of investigation will show the results graphically which will help the specified area of study in compressed form.

3.6.1.5 Formation of categories

After selection the subcategory of content analysis, we reduce the text to categories and code for word or pattern at the simplest level. It is not necessarily the case that effortlessness of technique prompts shortsighted outcomes.

3.6.1.6 Exploration of relationship among concepts

In this study we analyzed the relationship among the concepts from text according to the following three approaches. These approaches are:

Strength of relationship: this approach refers to the intensity of two are more related concepts. It is easiest way to analyze, compare and can make graph easily when all related concepts considered to be equal.

Sign of a Relationship: the approach explores the relationship between concepts whether these are positive are negative. For example, to illustrate the concept over cost is negatively related to the concept of for administration of software development but low cost is positively related to the concept of administration. The above example accentuates "low cost" as the negation of "high cost," but could be coded as being two separate categories, one positive and one negative.

Direction of the relationship: The direction of a relationship tells whether the values on two variables go up and down together.

3.6.1.7 Code the relationship

One of the main differences between conceptual analysis and relational analysis is that the statements or relationships between concepts are coded.

Example: At this point, to continue our extended example the excerpt below from a single response, we will code these statements as follows:

However, when examining the flip-side, failure, we sometimes cringe at the fact that it could happen to us. Perhaps therefore it seems to be one of the least discussed topics. Who wants to admit to their failure certainly not to your boss or company head? Yet failure still happens. I think you get the point. Before starting your project, knowing exactly what lays ahead lets the project manager, team, and client mitigate associated risks."

Above excerpt may be analyzed, for example, codes as "flip-side failure", "argued statement", "formal conversation", "important suggestion". These codes produced from the above excerpt after breaking down the text statement by statement.

3.6.2 Quantitative analyses

The data which we collect from qualitative way is then exploit through quantitative analyses and utilize it for further research. In this research we use quantitative analyses for understand the behavior of respondent from collected data by using statistical and mathematical way [79]. However, we arrange the data according to the research questions and summarize it to achieve the precise answers of research questions.

Measurement the result of dual instruments (interview and questionnaires) is the foremost part of quantitative analyses in this research. Moreover, we find the s/w failures, s/w failure factors and successful software development then compare the results of dual instruments in the following table. This comparison report shows the accuracy and reliability of data which we collect from different sources.

3.6.2.1 Statistical analyses

Statistical analysis is a technique that will be used for this study to collect, explore and then present the quantitative data in arithmetic or mathematical notation. This technique is become more reliable where we want to make useful and convenient decisions [80]. However, this research is obviously based on mix method

research, so we want to analyze the collected data in statistical way to find out the software failures and failure factors according to the current scenario in Pakistani software development industry.

A void rang of possible statistic techniques can be used to analyze the data and draw some inferences from collected information. However, in this study we apply one of the common techniques where we summarize the data in groups and visualize it sequentially

3.6.2.2 Analysis strategy

In Figure 3.10, at initial stage we typically categorize the raw data in groups and visualize it sequentially. Moreover, any type of graphs or charts is used for summarizing the entire data of each category. Following figure illustrate three categories of entire data which are software failures, software failure factors, and factors for successful development. These categories are basically the subpart of obtained data.
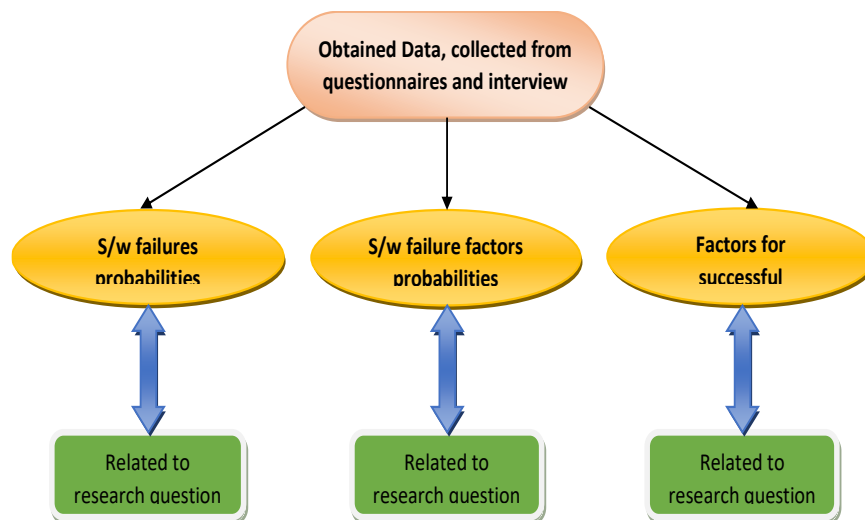
Figure 3. 10: analyses process

3.7 Summary

In   order to satisfy the research objectives, this chapter emphasizes the complete and comprehensive procedure which we adopted in this study. The operational frame work which we develop for this study is express briefly in this chapter. This operational framework consists of systematic literature review, surveys and interviews. From the results of surveys and interview we compare it through

triangulation mechanism. At the end of this framework, we describe the procedure of guidelines which we elaborate in chapter no 5. Moreover, how we design this research and how this research is conduct is exposes in this chapter. Typically, it is mixed method research which consists of qualitative and quantitative data. Some major mixed method designs are also describing in this chapter then select the method which meets according to the requirements of this research. The methods which we used for data collections are also expressed here in detail. An important aspect of this chapter is the designing of an instrument. The instrument which we use in this study is questionnaires and interview. Structure of interview and questions are elucidated that help us to collect data from Pakistani software industry. The conduction of interview and questionnaire is an important part of this research. However, the procedure of conduction the interview and questionnaires are described here at the end of this chapter.

Chapter 4

ANALYSIS AND FINDINGS

4.1 Overview

This chapter describes the evaluation of data which will be observed through discussion from the research findings. The findings relate to the research questions that guided the current study. Data were used to describe, explore and analyzed to identify the software failure and software failure factors and designate some data to clarify the impact of failure factors on Pakistani software industry (PSI). In the first phase data were acquired through questionnaires, completed by 105 respondents (n=105) at 53% percentage rate. During the collection of data, it is observed that insufficient peoples respond through email and social medic whereas the respondent percentage is high when we visit directly to software houses and met software experts. Characteristically, we received 118 questionnaires, however, just 101 questionnaires are usable that accomplish the required inclusion and meet the criteria that discussed in previous chapter. So we assume that half of the total responders respond us as well. These responses represent almost 40% of anticipated organizations in distinct area in Pakistan. The remaining 17 questionnaires considered unusable, 10 questionnaires did not longer complete while 7 respondents stated that they had not enough experience to fulfill this questionnaire and don't meet the selected criteria according to this study. As we mentioned in previous chapter, this study in basically mix method research so, secondly, we acquired data through interview instrument. During the conduction of interview, we try to visit maximum reputed organizations from selected area in Pakistan and hardly access 20 software experts but most of them are not agree for interview. So by using the

personal sources we conduct interview from 8 experts who meet the criteria which we mentioned in previous chapter.

However, the data which we collect through interview are decoded accordingly and convert it into quantitative form. As we mentioned in earlier chapter that coding is technique which is used to convert the qualitative data into quantitative form and have two types. These types are deductive coding scheme and inductive coding scheme, however we utilize inductive coding scheme in this study and convert qualitative data into quantitative form. Now, we apply triangulation process on both data which we collected from questionnaires and interview. Finally, the results which we produced through triangulation process are disclosed consequently.

4.2 Conduction of sample size

Sampling is a technique which is used to select the part of population that is studies in specific research. Sampling makes the research activities manageable, controllable and convenient for the research [84]. So, sampling has two major types which are probability and non-probability. In probability sampling we acquired information from entire available population randomly whereas non-probability sampling doesn't give the equal opportunity of all individuals but select those individual who meet the specific criteria. Furthermore, the methods of these types are available which should select according to the research requirements.

In this research we select a non-probability sampling technique which is suitable for out study. Various methods are available in non-probability sampling but we select quota sampling method. Although, the aim of this study is the collection of data regarding software failure and software failure factors, so we can collect data from those individuals who have deep knowledge of software and meet the selected criteria. In this case we cannot select sample randomly however we have to select those individuals that meet our selected criteria and have deep knowledge of software and software development process.

To find out the probability of selecting individuals we follow the following formula:

n =total number of persons to be sample

N=total number of eligible persons

The probability of person l is $r = n/N$

4.3 Conduction of qualitative survey strategy

Qualitative research strategy is use to collect data that seeks answers to questions. Initially, we collect data from interview and questionnaires by using the qualitative approach and results are evaluated in table no 4.1 and 4.2 respectively. The structure of interview and questionnaire has been discussed in previous chapter. Usually, it is an initial stage of data; it will be evaluated through triangulation process and reached at its final stage which is the findings of this study.

4.3.1 Obtained data through questionnaires

Data which we collect through questionnaire is itemized in table 4.1. However, in this research we summarize the entire responses in the form of groups according to the research questions and analyze it to find out the percentage of entire elements which we are observed. In this research we collect data from more than hundred responses of software houses and software professionals then evaluate it accordingly and mentioned it in table 4.1 for further investigation.

First of all, we collect features that mentioned in table 4.1 as the headings of possibilities are selected from systematic literature review. In chapter no 2 we collect SLR and prepared a document that evaluate briefly regarding software failure and software failure factors in table no 2.2. From that table we identify some software failures and software failure factors and used in instrument as features. Basically our instrument is consisting of questionnaire and interview, so we prepare questions according to that identified features. Hence, we examine that identified factors through questionnaire and acquired data from industry then noted it in table 4.1.

Once we get data through questionnaire, secondly, we categorize it according to the nature of research questions. We make six categories in table 4.1. The first category used to check the project software failure that meets the first question. Second category of this table is partial or absolute software failure which is also meets the first research question. The goals of these categories are to cover the research question no 1 in all aspects. The third phase of this information is basically an additional phase which holds the percentage of software failure percentage in Pakistan according to the current scenario. Next category is related to the second part of research question no 1 which is the identification of software failure factors in Pakistani agile based software industry. Last category of this collected is related to

the research question no 3. Research question no 3 is basically the guidelines which will take from software experts for Pakistani software industry.

Entire collected data through questionnaire are mentioned below in table 4.1 according to its category.

Table 4. 1: Obtained data through questionnaire

| Observed precincts | Possibilities | Total responses=100 | | +ve | -ve |
		Questionnaire Responses	Percentage		
Software project failures	Not delivered timely	20	20%	20	80
	Lack of quality	82	82%	82	18
	Over budget projects	55	55%	55	45
	Fulfill additional requirements	65	65%	65	35
	Implementation problems	55	55%	55	45
Partial or absolute software failure	Overtime in s/w development	45	45%	45	55
	Not meet requirements	89	89%	89	11
	Additional budget	50	50%	50	50
	Security and quality problems	70	70%	70	30
Software failure ration	0 to 5 %	30	30%	30	70
	5 to 10 %	78	78%	78	22
	10 to 20 %	80	80%	80	20
	20 to 40 %	33	33%	33	67
	40 to 60 %	30	30%	30	70
	60 to 80 %	14	14%	14	96
Failure factors in agile based development	Management problem	66	66%	66	34
	Initial planning	75	75%	75	25
	Communication gap	30	30%	30	70
	Ignorance about new technology	57	57%	57	43
	Low budget	60	60%	60	40
	Unsupported management	49	49%	49	51
	Absence of stack holder	30	30%	30	70
	Inexperienced staff	91	90%	91	9
	Imitation organizational structure	10	10%	10	90
Project successful ratio	10 to 20 percent	10	10%	10	90
	20 to 40 percent	23	23%	23	77
	40 to 60 percent	50	50%	50	50
	60 to 80 Percent	71	71%	71	29
	80 to 100 percent	30	30%	30	70
Abilities for successful development	Learner attitude	60	60%	60	40
	Responsibility	67	67%	67	33
	Utmost relationships	36	36%	36	64
	Work Independently within Groups	88	88%	88	12
	Analyze user needs	81	81%	81	19
	Background in programming	90	90%	90	10
	Best communication skills	47	47%	47	53

In order to satisfy the research questions, the results are often used to compute the percentage of entire feature individually. This percentage will further help us in triangulation process and during the creation of guidelines.

Hence we select the first pair of data that is software project failure where we identify the concept of software failure according to opinion of software experts. Five possibilities/ features are highlighted in this pair of data which are "not delivered timely", "lack of quality", "over budget software", "fulfill additional requirements" and implementation problems. Twenty respondents respond in the favor of first feature which is not delivered timely while eighty respondents are not in this favor. So the probability of this feature is not much high. Secondly, we observe the feature lack of quality. It is quiet important feature because 82%respondents respond in favor of this feature whereas only 18% are navigate. Over budget and fulfill additional requirements are the fourth and fifth feature of first pair. 55% and 65% respondents support these features respectively while remaining respondents are neglect it accordingly. The last one is implementation problem which is supported by 55% respondents.

Later on some more failure factors are examined that's categorized it as partial or absolute software failures. Four more software failures are highlighted in this category which is overtime in software development; don't meet requirements, additional budget, and security and quality issues. However, two major causes of software failures are highlighted in these pair that has high probability; these causes are do not meet requirements and security and quality issues. Moreover, we check the failure ratio in Pakistan that will help us to compare the data CHAOS report. This data will help us to clarify the problem as we mentioned in research question no 2. Afterword, our category is related to the second part of research question. The name of this category is in agile based development and highlighted factors are management problems, initial planning, communication gap, and ignorance about new technology, low budget, and unsupported management, absence of stakeholder, inexperience staff and Imitation organizational structure. These factors are observed individually after the collection of responses. As we observed that five factors are quite important because more than fifty percent respondents positively highlighted these. However, 91% respondents highlighted inexperienced staff which is very important factor.

Finally, table 4.1 emphasizes the last category which is abilities for successful development. The purpose of this question is to identify the successful factors that will help us to establish the guidelines for Pakistani software industry. Most of the successful factors which we highlighted in this question are also endorsed by respondent.

4.3.2 Obtained Data through interviews

Interview is second source which we used for the collection of data. Usually interview is collected where you want accuracy and exactness in data. Interview's data is enumerated below in short form which we collect from software experts. In this interview strategy we divide the entire process from qualitative to quantitative in five phases. The first process is containing the structure of interview which is mentioned in chapter no 3. Basically it is the initial stage where we create the structure of interview. This structure is created according to the sequence of research questions. The arraignments of questions in this interview are established according to the arraignment of questionnaire. Typically, it is mixed method research so we collect data from both methods accordingly.

Once the structure of interview is established, the second phase is selection of experts, take time for interview and meet directly to interviewers. It is an important and significant phase because the collection, validity and accuracy of whole data are depending opens this phase. In this study, we approach twenty software professionals but unfortunately some of them are not agreed for interview because of their personal issues. So at the end we make it possible to conduct interview from ten of them. It is quite enough interviews for the accuracy and validity of data. Before the interview we examine the profile of whole selected professionals by using personal sources then select consequently. It is quite tough job in the entire research because most professionals are not agreed.

After the conduction of interview, now the data is available in qualitative form. So the next phase is decoding of this qualitative data by using any decoded strategy. We describe the decoded strategies in chapter no 3. However, we used concept driven coding technique because this coding scheme collects data from text conceptually and used to find ideas and theories from plan text. We have done this job manually and decode the entire data which we collected from software professionals. After that the whole data have been converted into quantitative form

and illustrate in table no 4.2 consequently. Furthermore, by using the data which is illustrated in table no 4.2, we prepare a file called arff (attribute-relation file format) file. "Attribute-relation file format" is a file format which used on WEKA tool for statistical findings. The purpose of this analysis is to find the software failure and software failure factors according to its probability. WEKA tool process the arff file and produce data in graphical form that can be easily analyzed.

Table 4. 2: obtained data through interviews

Observed precincts	Possibilities	Total responses=10		+ve	-ve
		Interview Responses	Percentage		
Software project failures	Not delivered timely	3	30%	3	3
	Lack of quality	8	80%	8	2
	Over budget projects	6	60%	6	4
	Fulfill additional requirements	6	60%	6	4
	Implementation problems	6	60%	6	4
Partial or absolute software failure	Overtime in s/w development	4	40%	4	6
	Not meet requirements	9	90%	9	1
	Additional budget	5	50%	5	5
	Security and quality problems	7	70%	7	3
Software failure ration	0 to 5 %	2	20%	2	8
	5 to 10 %	8	80%	8	2
	10 to 20 %	8	80%	8	2
	20 to 40 %	7	70%	7	3
	40 to 60 %	2	20%	2	8
	60 to 80 %	0	0%	0	10
Failure factors in agile based development	Management problem	7	70%	7	3
	Initial planning	7	70%	7	3
	Communication gap	1	10%	1	9
	Ignorance about new technology	6	60%	6	4
	Low budget	5	50%	5	5
	Unsupported management	5	50%	5	5
	Absence of stack holder	1	10%	1	9
	Inexperienced staff	9	90%	9	1
	Imitation organizational structure	3	30%	3	7
Project successful ratio	10 to 20 percent	1	10%	1	9
	20 to 40 percent	1	10%	1	9
	40 to 60 percent	5	50%	5	5
	60 to 80 Percent	7	70%	7	3
	80 to 100 percent	6	60%	6	4
Abilities for successful development	Learner attitude	6	60%	6	4
	Responsibility	7	70%	7	3
	Utmost relationships	4	40%	4	6
	Work Independently within Groups	9	90%	9	1
	Analyze user needs	8	80%	8	1
	Background in programming	9	90%	9	1
	Best communication skills	5	50%	5	5

After all interview's data for this research is derived from professional interviewee and summarized in statistical form. The format of this data is similar with the format of questionnaires responses. It is done because we have to apply the triangulation process on both data. During the preparation of interview's structure, we arrange the sequence of questions according to the questionnaires format.

However, after the decoding of data we summarize it in table 4.2 and divide all questions into six categories. First of all, we try to find the concept of software failure and create questions accordingly. The interviewee highlighted multiple options according to software failure as we mentioned in first category of this table 4.2. Three interviewees emphasized the software delivery issue causes software failure in Pakistan. Hence, lack of quality in software development is highlighted from eight interviewees out of ten. It is observed according to the responses of respondents that quality is the major cause in Pakistan and we considered the software failed which have low quality that can't meet the international standards. However, three more software failures are also highlighted which are over budget, additional requirements and implementation problems. The occurrence of these failures is low then the quality failure. So, according to this analyzed data we considered failed software that have low quality, over budget, fulfill additional requirements and implementation problems. According to the research question no 1, our aim is to find the software failure in all aspects. For this purpose, we checked partial or absolute software failures in Pakistanis software industry. Two more failure are recognized in this category which are don't meet requirements and security and quality issues. As a whole we documented that these seven failures caused software failure in Pakistan.

Software failure ratio is another feature that we analyzed through interview in this study. It is quite important because we utilize it to compare from international market. This ratio is typically measured from Pakistani software industries in limited area. As we observe from above data, the software failure ratio is 5 to 20 percent in Pakistan according to the eighty percent interviewees whereas seventy percent says that this ratio is twenty to forty percent. All together, we can say that twenty percent software is failed in Pakistan.

Furthermore, we find failure factors in Pakistani software industry through next category. According to this category we decode the data where we find some failure factors which are highlighted by respondents or interviewee. The factor which most of the interviewees highlight is inexperience staff, this ration is about 90%. So we can say that Pakistani software industry can boost up through experienced staff members. Moreover, some other factors are also highlighted in this data which are management problems and initial planning issues. Total interviewees who support these factors are 7. It means these factors are also important and could be solved for precise and particular development in future.

Additionally, we examine the software successful ratio in Pakistan through software experts. The successful ratio in Pakistan is 60 to 80 percent according to the seven interviewees while five interviewees expressed that this ratio in 40 to 60 percent. However, this ratio is not much satisfactory in Pakistan. Lastly, we get some successful factors from experts that will ultimately help us to establish the guideline for Pakistani software industry. Some important successful elements are predicted here. According to the software professional's developer should have deep knowledge of programming and can able to work independently and within any team or group. This opinion gives by nine interviewees out of ten. Some respondents also identified that the developer should have learning attitude and responsible.

4.4 Triangulation process

Although there is need to compare the above summarized data that will provide us appropriate and suitable answers of questions. Even though, the purpose of this study is to collect data through questionnaires and interviews then consequently compare it. However, it is quite important and significant way to find the answers of research questions [81]. Hence, triangulation encourages the validation of data through cross check of those data which collected from multiple sources. Moreover, triangulation tests the consistency and reliability of results that obtained from different types of instruments. Various types of triangulation are available that explain in chapter no 3. However, we select methodological triangulation in this research because we take data through interviews and questionnaires as exactly the concept of these types. This way of investigation is play a vital role in this study because it is very important to measure the consistency

and reliability of collected data. Following table 4.3 shows the comparison report according the triangulation process.

4.4.1 Software failures

We analyzed the data that mentioned in table no 4.1 and table no 4.2 through triangulation process and obtained another table 4.3. This table shows the results according to the first part of research question no 1. How software is considered as failed software, we analyzed it by analyzing the two questions which are software project failure and partial or absolute software failures.

Table 4. 3: Software failures

Research question	Formulate research questions	Possibilities	Questionnaires results	Interview results	Difference
Software failures	Software project failures	Not delivered timely	20%	30%	**10%**
		Lack of quality	82%	80%	**2%**
		Over budget projects	55%	60%	**5%**
		Fulfill additional requirements	65%	60%	**5%**
		Implementation problems	55%	60%	**5%**
	Partial or absolute software failure	Overtime in s/w development	45%	40%	**5%**
		Not meet requirements	89%	90%	**1%**
		Additional budget	50%	50%	**0%**
		Security and quality problems	70%	70%	**0%**

As we observe the above the results of table 4.3, we see that there is very low difference between both collected data. However, according to this comparison we would say that the software is failed which have low quality, over budget software, fulfill additional requirements, implementation problems, overtime, don't meet the requirements, additional budget and security and quality issues. Just one cause has big difference which is not delivered timely. So we neglect this point and don't considered is as software failure.

4.4.2 Software failure ratio

Software failure ratio checked through triangulation from collected data because of comparison purpose. As we mentioned in research question no 2 that we compare the current data with CHAOS report. CHAOS reports are produced after

some time from Standish group. Standish group collects data from different countries and prepare a report which consists of software failures ration, software successful ration and some other factors. However, we produced this ratio from current Pakistani software industry and enlist in following table 4.4.

Table 4. 4:Software failure and successful ratio

Research question	Formulate research questions	Possibilities	Questionnaires results	Interview results	Difference
Software failure and successful ration in Pakistan	Software failure ratio	10 Percent	25%	20%	**5%**
		20 Percent	78%	60%	**2%**
		30 Percent	80%	80%	**0%**
		40 Percent	68%	70%	**2%**
		50 Percent	30%	20%	**10%**
		60 Percent	14%	0%	**14%**
	Software successful ratio	20 Percent	10%	30%	**20%**
		30 Percent	57%	60%	**3%**
		40 Percent	50%	50%	**0%**
		50 Percent	20%	30%	**10%**
		60 Percent	11%	20%	**9%**

Two major identifications are highlighted in table 4.4. In this table we compared software failure and software successful ratio in Pakistan according to the opinion of software experts. As we see the above data 80% respondents from both type of data says that the failure ratio Pakistan is about 20% while the successful ratio is 40 to 60 percent. Now this ratio will be used for comparisons purpose as the concept of research question no 2.

4.4.3 Software failure factors

It is an important and significant side of this research where we find the software failure factors according to results of instruments. The opinion of interviewee and questionnaire's respondents are exposed in table no 4.5 according to the obtain data of table 4.1 and table 4.2. It is quite important to find the software failure factors from Pakistani software industry for successful effective development. Some important software failure factors are highlighted from software experts that we considered in this research according to percentage of respondents. We can solve these factors by using the appropriate guidelines which is suggested by the professionals.

Table 4. 5: Software failure factors

Research question	Formulate research questions	Possibilities	Questionnaires results	Interview results	Difference
Software failure factors in Pakistani software industry	Failure factors in agile based development	Management problem	70%	70%	0%
		Initial planning	70%	70%	0%
		Communication gap	10%	30%	20%
		Ignorance about new technology	60%	60%	0%
		Low budget	50%	60%	10%
		Unsupported management	50%	50%	0%
		Absence of stack holder	10%	30%	20%
		Inexperienced staff	90%	90%	0%
		Imitation organizational structure	30%	10%	20%

From the triangulation process we highlighted five serous failure factors. These failure factors are management problems, initial planning issues, ignoring the new technology, unsupported management, and inexperienced staff. When we see the validity of data, the difference ratio is quite acceptable of these failure factors. However, communication gap, absence of stack holder and complex organizational structure are element that doesn't accrue the validity of data. So we considered just those factors that have very low difference.

4.4.4 Recommendation for successful development

According to the last research question, another aim of this study is prepared the guidelines for Pakistani software industry that meet the international standards. For this purpose, we add a question named 'Abilities for successful development' in questionnaires and interview's structure. This will ultimately help us to develop software precisely and specifically. According to this guideline we prepared seven abilities and conduct response from responded through questionnaires and interview. These abilities are produced from systematic literature review then use it as an option in questionnaire and interview. By using these abilities, we take opinion from experts, apply triangulation process and mentioned it in following table 4.6.

Table 4. 6: Abilities for successful development

Research question	Formulate research questions	Possibilities	Questionnaires results	Interview results	Difference
Guidelines for Pakistani software industry	Abilities for successful development	Learner attitude	60%	60%	**0%**
		Responsibility	67%	70%	**3%**
		Utmost relationships	36%	40%	**6%**
		Work Independently within Groups	88%	90%	**2%**
		Analyze user needs	81%	80%	**9%**
		Background in programming	90%	90%	**0%**
		Best communication skills	47%	50%	**3%**

We observe from compared data that is mentioned in table no 4.6 that all these abilities are needed for successful development in Pakistan. There is very low deference between both data; it means most of the respondents recommend these abilities. According to opinion of respondents, successful development depends on learner attitude, responsibility, and utmost relationship, able to work independently or within group, detail analyses of user's requirements, background knowledge in programming and have best communication skills. By using these factors, we can boot the Pakistani software industry as well.

4.5 Findings

This study resolves the core issues related to agile based software development in Pakistani software industry. These issues are based on agile development with respect to software failures, software failures factors, and guidelines for better development in Pakistan. The description of these issues is mentioned in chapter no 1 in the form of research questions. Now in this study, we find the results according to the   research questions from comprehensive analyses which we find from gathered data. Additionally, limitations and advantages are also added in data which we collect from interview and questionnaires. However, this study determined the limitations from inclusive analyses that can determined the actual benefits and drawbacks of agile based development in Pakistani software industry. The findings that we produced here are quite important for this research because entire guidelines depend on these findings.

4.5.1 Research question no 1a

As we mentioned in previous chapter, our aim is to find the software failures in Pakistani software industry. Classically it is the first turn of this research where we find that state of art in agile based software failures in Pakistani software industry (PSI). We have done this task by collecting the up-to date data through questionnaires and interview according to the questions that shows in figure no 4.1.

4.5.1.1   Software failures

The parameters which we select regarding agile based software failures in modern scenario are highlighted in the following figure 4.1. However, we collect data according to the following parameters through questionnaires and interview. Moreover, graphically results are also mentioned here which we produced from responses. This result shows the definite software failures according to the opinion of software experts. The factors that we observed from software industry regarding software failure factors are highlighted in Figure 4.1. This is the first question which we used for data collection according to software failures

Figure 4. 1: Software failure observation
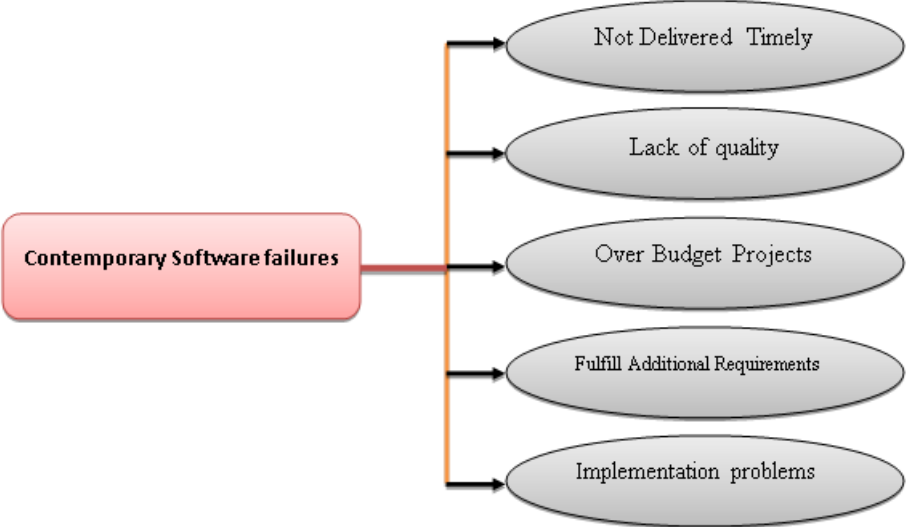
Secondly, we check partial or absolute software failures by creating a question which shows in Figure 4.2. It is an additional question that we create for software failure that mentioned in figure 4.2 according to its observed options. From the combination of these two questions we produced the causes of software failure that meets the requirements of research question no 1.
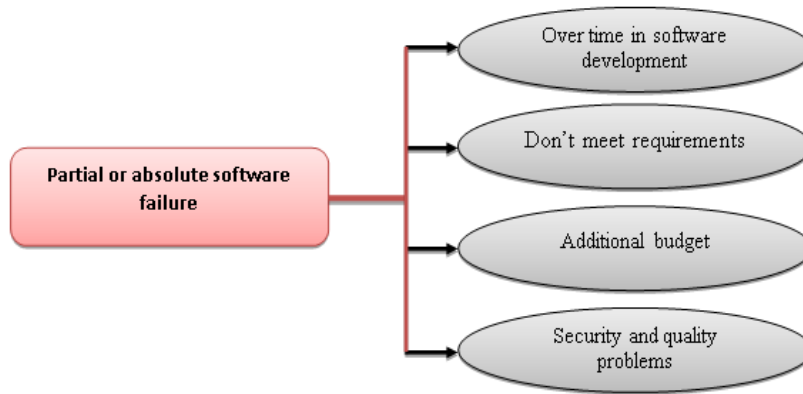
Figure 4. 2: Partial or absolute software failure observation

Sometime, a little amount of software also available in market which is working but users are not satisfied completely. So, we observe that software and check the responses through asking the question of partial or absolute software failures. However, the parameters which we set for this question are mentioned in figure 4.2. This question is also used to find the software failures in Pakistan as well. We also include the option of this question and find the end value as whole for this research question. This result will show us the actual software failure in Pakistani industry as well.

4.5.1.2   Outcomes

The factors which we observed in this research regarding software failures are mentioned in figure 4.1 and 4.2. We collect data from both instruments (questionnaire and interviews) and examine it consequently. Hence, we illustrate here the questionnaires and interview's data in graphical form. Figure 4.3 highlight the contemporary software failure which is lack of quality.

Figure 4. 3: Contemporary s/w failure (Questionnaires outcomes)

78

Figure 4.3 illustrate the result of related to software failures in Pakistan. It is questionnaires result which we produced from hundred profe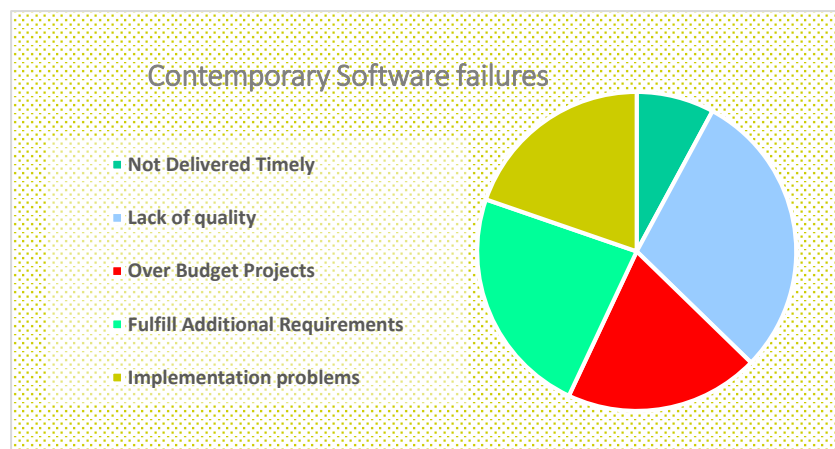ssionals. As the above graph we considered five causes related software failures seriously because most of the respondents highlighted these factors. These factors are lack of quality; fulfill additional requirements, overbought and implementation problems.

Moreover, for the validity of data we observe these factors from interview's data through WEKA tool and illustrate in Figure 4.4.

Figure 4.4 exposed the WEKA results which we produced from interview's data. According to this result we perceive that only three responses agree with the factor 'not delivered timely' while eight responses approved that lack of quality caused software failure in Pakistan. Moreover, according to the remaining three causes, we see that six of each respondent agree with these causes.
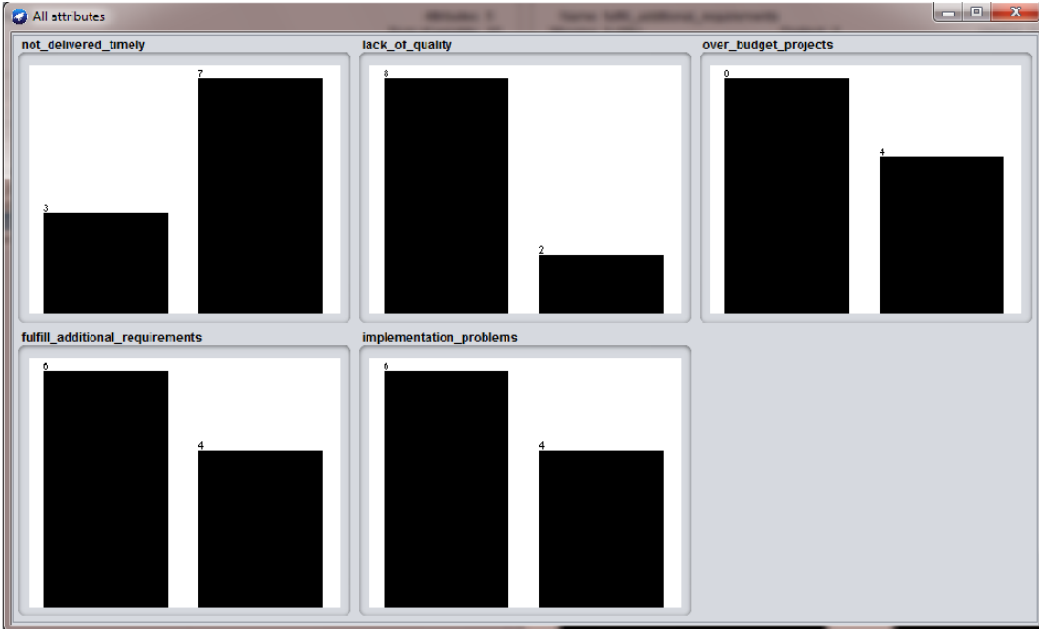
Figure 4. 4: Contemporary s/w failure (interview outcomes)

Secondly, when we see the partial or absolute software failure according to the opinion of questionnaire's respondents and interview's respondents, the following results display each factors concisely and illustrate it in figure 4.5 and 4.6 respectively. The results of different elements regarding partial or absolute software failures are revealed in figure no 4.5. This figure is created from the data which we collect form the responses of questionnaires and represents it in graphical form accordingly.

4.5.1.3 Partial or absolute software failure

When we see the concept of software failure according to the opinion of software experts, we discern that the software that don't meet the user requirements are considered as failed software because most of the respondents highlight this option as mentioned in Figure 4.5. However, other three options are also available with high majority. From those three options security and quality are also caused software failure in Pakistani software industry because seventy percent respondents highlight this option.

Figure 4. 5: Partial/absolute software failures (Questionnaires outcomes)

Moreover, according to the data of interview, the following WEKA results show the partial or absolute software failure in Figure 4.6.

Figure 4. 6: Partial/Absolute s/w failure (Interview's outcomes)

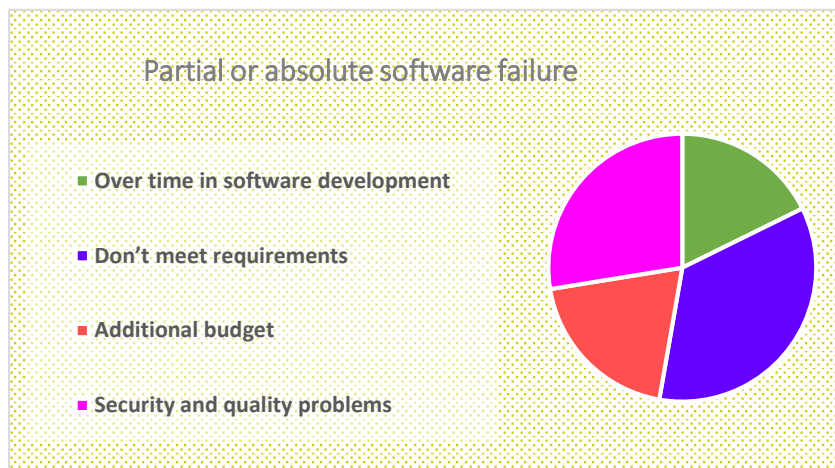The result of WEKA tool regarding partial or absolute software failure is quite similar as questionnaire results. Mostly respondents focused on lack of quality, over budget software, additional requirements and implementation problem. According to the above figure we can see that professionals are indicate that lack of quality in software is considered as failed software. Somehow, some interviewee says that the software which consume additional budget and fulfill extra requirements are also considered as software failures.

4.5.2 Research question no 1 b (Software failure factors)

This research question covers the maximum factors which caused software failures in Pakistani software industry. Although, this research question is the subpart of previous question, so the purpose of this research question is to detect the software failure factors of current Pakistani industry. We collect data from different sources through questionnaires and interview then comprehensively analyze it and show the following result. These results evidently mentioned the factors which caused software failure.
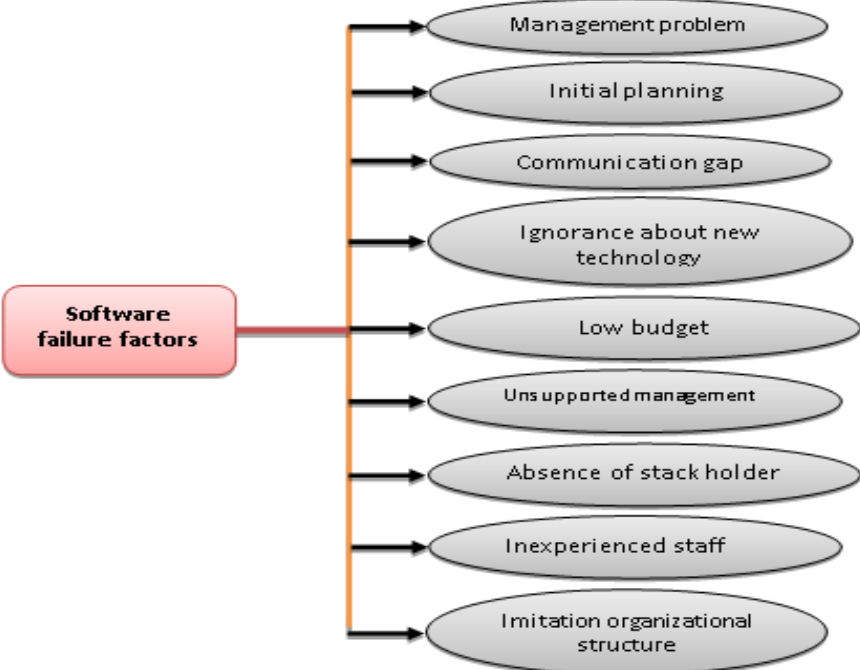

Figure 4. 7: Software failure factors

An important aspect of this research is highlighting the failure factors from up to data software industry. For this purpose, we eliminate the nine factors which illustrate in Figure no 4.7. These factors are used in questionnaires and interviews for best opinion of software experts. Based on this opinion we select the factors

which effect seriously on software in Pakistan. However, the outcomes that we produced from experts are mentioned in table 4.5. Hence, the graphical form of this outcome mentioned below in figure no 4.8 and 4.9. These outcomes are questionnaire and interviews results respectively.

4.5.2.1   Outcomes

The result which displays in below Figure 4.8 is clearly indicating the results of software failure factors from collected data. This outcome eventually shows the factors that affect extremely software failure. We obtained the following Figure 4.8 from questionnaires after analyzing the entire collected data collectively.
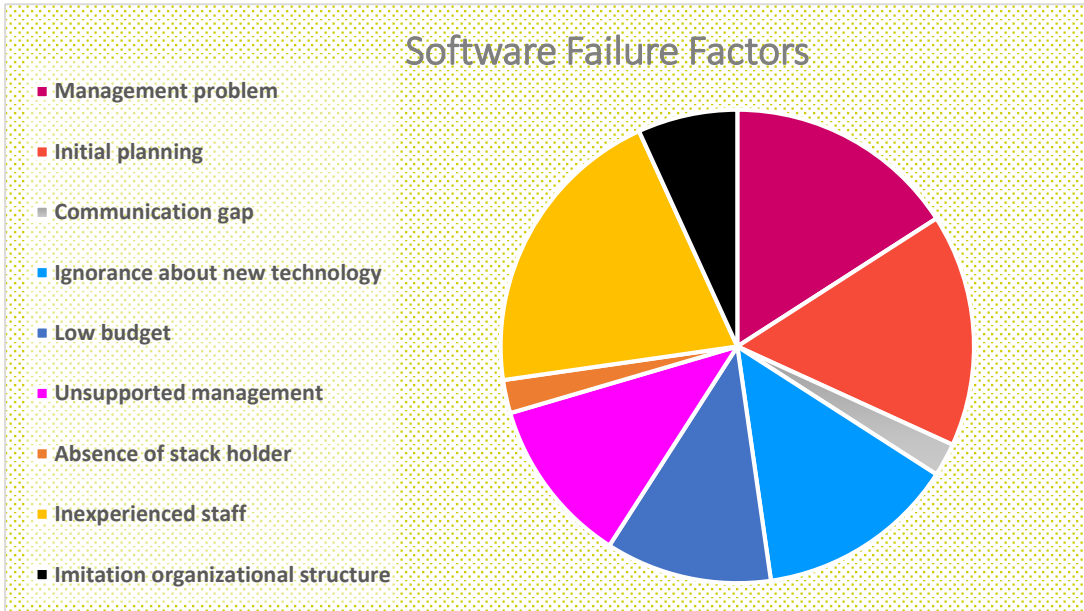
Figure 4. 8: Software failure factors (Questionnaires outcome)

As we discuss in previous chapter that we collect more than hundred responses from software experts. However, the responses regarding software failure factors are mentioned in figure 4.8where respondent's highlights in their expertise. From the analyze results we can see that respondent's highlights three major factors. These factors are inexperienced staff, management problem and initial planning issues. Additionally, some factors can also affect the industry, but these effected ratios are low as compare to above mentioned factors. These factors are communication gap between team members, lack of knowledge about new technology and not fully sport from top management. As a whole when we collectively summarize the entire research, we observe that six main factors are tremendously affect the software

industry according to the software professional's point of view. We observe then select these factors because more than fifty percent respondents emphasized these factors as well. These factors are inexperienced staff, management problems, and issues at initial planning, ignorance of new technology, low budget and unsupported managements. No days, these factors tremendously affect the development of software which caused software failures.

Secondly, Figure 4.9 shows the complied data which we collect through interview and analyze it by using WEKA tool [82]. The number and nature of questions regarding software failure factors are same as questionnaires because of triangulation process. Anyhow, figure 4.9 shows the interviewee's results graphically.
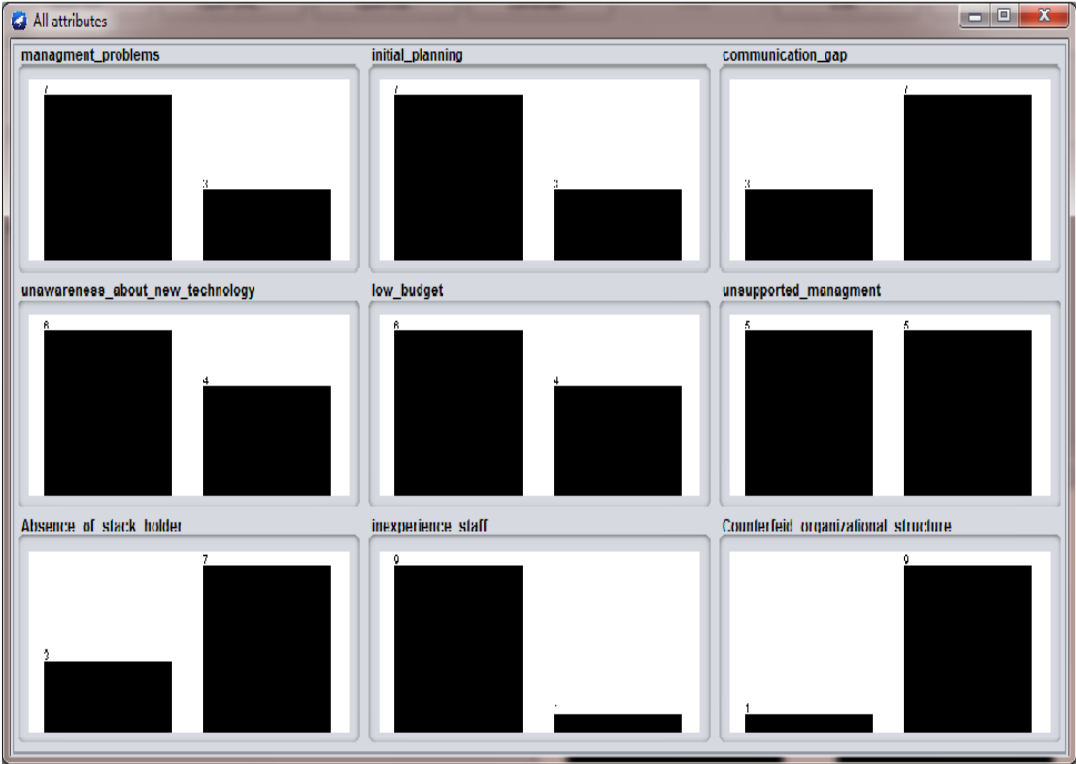
Figure 4. 9: S/W failure factors (Interview's outcome)

Now these nine factors are observed for sake of this research question through WEKA tool and receive the ensuing result. These outcomes are quite similar as questionnaires outcomes, however, the factors which majority of respondent's highlights are management problem, initial planning, and unawareness about new technology, low budget and inexperience staff. Anyhow, these factors can't be ignored in any case during the development of software. Additionally, respondents had ignored some factors. It means these ignored factors can't much effect on

83

software industry regarding failures. According to this result we observe that those six factors that highlighted in questionnaire's results are quite similar as this outcome. So we can exceptionally observe that these factors are most important factors for successful development. We can improve our industry to avoid these factors through any precise framework.

4.5.3   Research question no 2 (Comparison with CHAOS report)

The purpose of this research question is to analyze and compare the collected data with STANDISH CHAOS report and check how much this difference are there and how it is dissimilar from Pakistani software industry. However, we compare data mutually and will try to find the accurate and precise percentage from these reports for Pakistani software industry. STANDISH GROUOP [82] is a research advisory organization that focuses the performance of different software projects. This organization developed by James Johnson [82] in 1986. The organization collects data regarding software performance from different countries and produced an updated report after some time. This report is basically available in the form of book that is divided in different series. After some time, a new version or series of this book is introduced that have latest data and analyses report.

Now day, latest Standish report named "Decision latency theory" is published in 2018. However, in this research we use the analyzed data which is available in this latest CHAOS report [83]. In this report, data collects from different countries in the world that's why we include and compare this data in this research.

4.5.3.1   CHAOS Report

In this CHAOS report, the Standish group has determined the root cause of software failure, software failure factors and produced an analyzed report according to different categories. In this CHAOS report the Standish group resolute some failure factors and analyze it individually in the form of graphics. Moreover, this report produced the software failure report according to the nature of projects and analyzes the data by using three parameters. These parameters are: successful projects challenged projects and failed projects.

Table 4. 7: CHOAS report 2018

Year/Resolution	2013	2014	2015	2016	2017
Successful	31%	28%	29%	29%	33%
Challenged	50%	55%	52%	54%	48%
Failed	19%	17%	19%	17%	19%

This CHAOS report is published in 2018 and collects data in 2017 from different continent of the world. This report checks the software performance from collected data according to three parameters. These parameters are successful software, challenged software, and failed software. From 2017 data, we see that 33% successful ration is obtained while 48% is challenged software. Moreover 19% are failed software according to the data of SHOAS report.

4.5.3.2   Outcome of successful software development

In this study we analyze the data which we collect through questionnaires and determined in the following Figure 4.10. This figure shows the successful software development in Pakistani software industry.
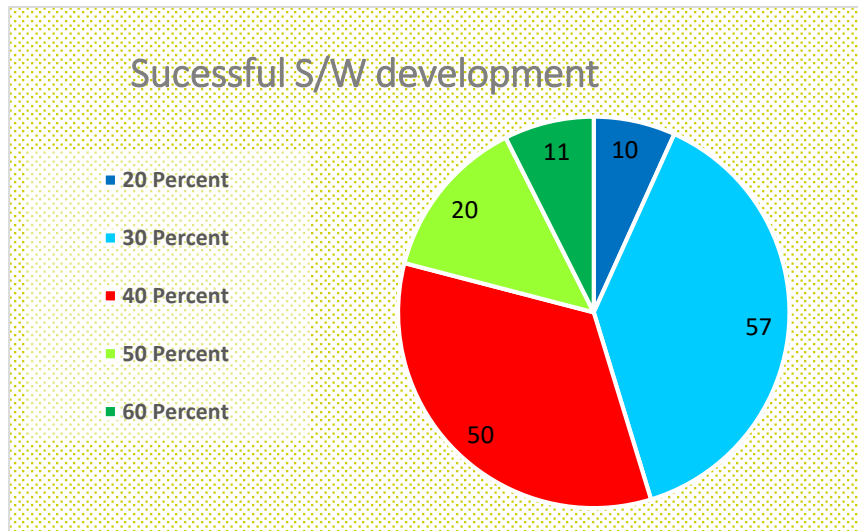
Figure 4. 10: Successful software development

In this report we can see 57 respondents say that the software failure ration is30 percent whether 50 percent respondents tell that this ratio in 40 percent. However, we considered the first option in this study because most of the responder's highlight this option.

Moreover, when we examine this ratio according to the data of interviewees, there is not much difference between questionnaires and interviews data. Figure 4.11 show the interview's data that we collect directly from experts. According to this result of this Figure 4.11, we examine that three respondents says that successful ratio is 20 percent while six respondents indicates that successful ratio is 30 percent which is highest. We observe that this ratio similar as the result of questionnaire's result. So we select that the successful ratio in Pakistani software industry is 30 percent as our produced results.
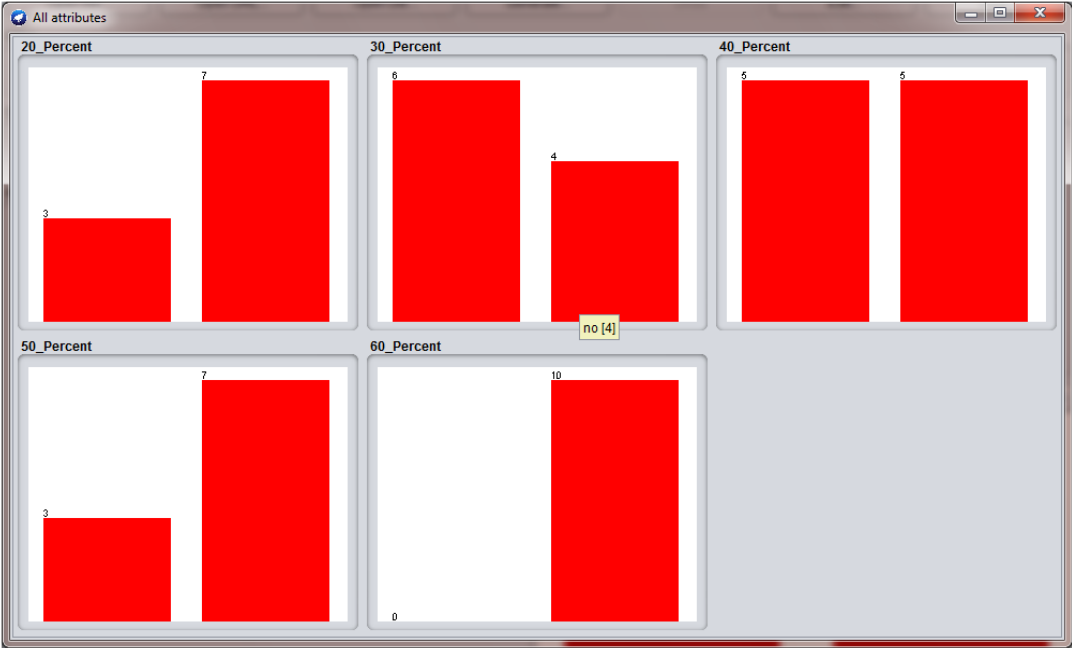
Figure 4. 11: Successful software development (Interview's results)

Moreover, we examine that 50 percent experts specifies that this ratio is 40 percent whereas 50 percent are neglect it. So we considered the second option which is sixty percent. This option will be used for further comparison with CHAOS report consequently.

4.5.3.3   Outcomes of failed software

To determine the software failure ratio in Pakistan, we also add a question in both instruments that are used for data collection from software experts. This result will be further used for the comparison purpose as the goal of this research question. The following Figure 4.12 shows the failure ratio, these results are obtained from the data that we collected from questionnaires.
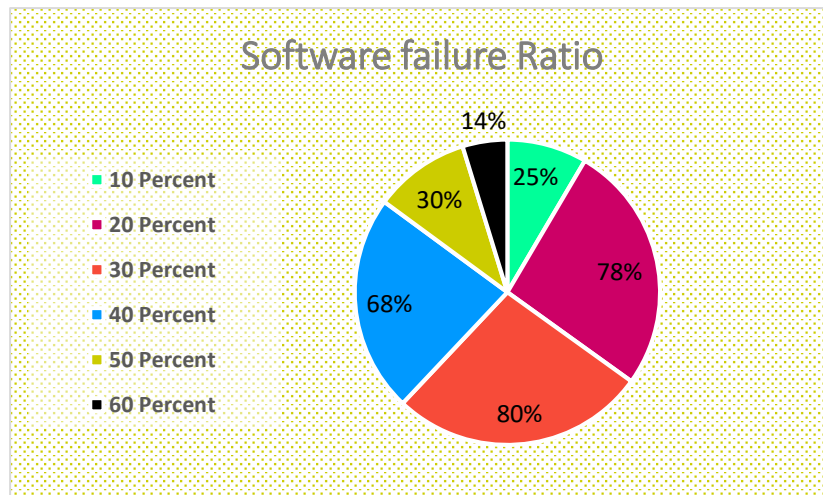
Figure 4. 12: Software failure ratio (Questionnaire outcome)

80% respondents determined that the software failure ratio in Pakistan is 30% according to the Figure 4.12. However, 78% respondent's states that this failure ratio in Pakistan is 20%, hence we deliberate the first option because most of the respondents have select that.

Additionally, we also collect data from interviewee regarding software failure ratio for the sake of validation and authentication of questionnaire data. This result shows in Figure 4.13 that are produced from WEKA tool.
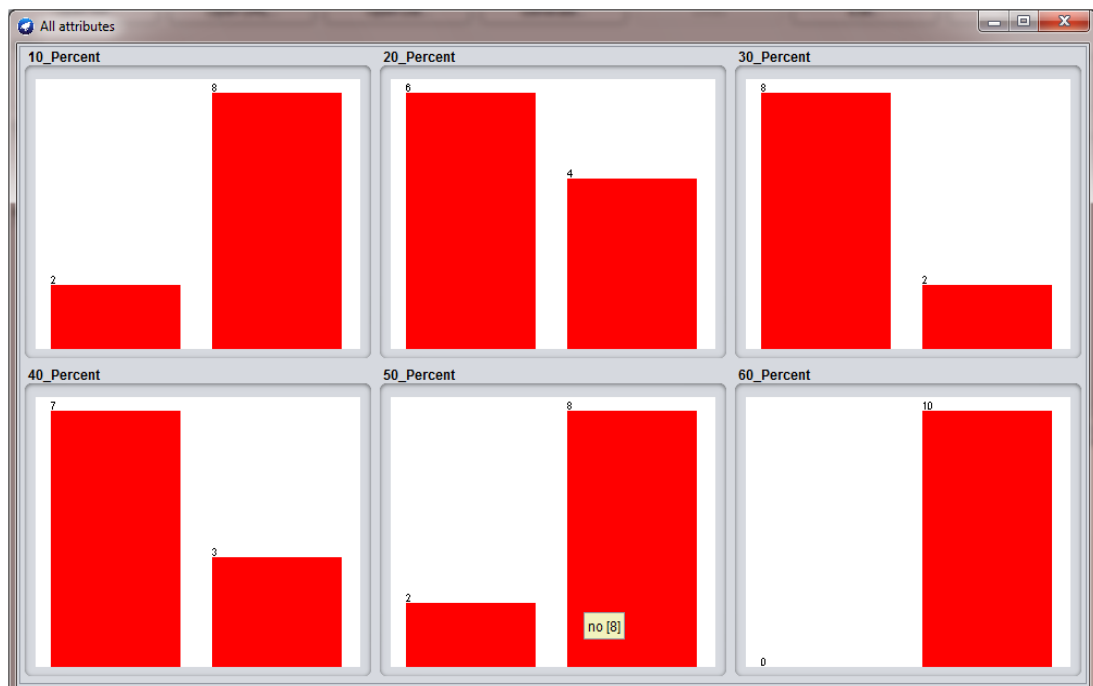
Figure 4. 13: Software failure ratio (Interview's outcome)

This outcome is produced from WEKA tool. The data which we used for WEKA is collected through interview. According to this outcome when we see the failure ratio in Pakistan, we can say that this failure ratio is 30 percent because six of interviewees recommend this option. We have divided this question into six options. These options are ten, twenty, thirty, forty, fifty and sixty percent respectively. However, when we observe each option individually, eight interviewees don't agree with ten percent failure ratio while in second option six interviewee agreed on twenty percent failure ratio out of ten. Most of the interviewees agreed with third option which is 30 percent failure ratio. We select this option for comparison with CHAOS report because majority of interviewees approved it. Moreover, the remaining options are not appropriate according to the opinion of software experts because most of the interviewees are no agreed from those options.

4.5.4 Comparisons report

As we compare the both results, following table 4.8shows the difference of software failures in Pakistan and international level failures concluded with CHOAS report. Although, when we compare the both analyzed data graphically, a very small variation is available between both data. So we can say that it not much difference between Pakistani software successful and failure ratio and CHAOS report. Additionally, when we compare both data statistically, the following statistics illustrate the whole result clearly.

Table 4. 8: Data comparison with CHAOS report

Outcomes	Successful	Failure	Remarks
CHOAS report	33%	19%	
Questionnaires results	40%	30%	
Interview findings	30%	30%	

The result of this CHOAS report is produced in 2018 and the outcomes which we collect in this research through questionnaires and interview is produced in recent year. However, this produced data is up to date which we compare with CHAOS report. CHAOS report collects data from different countries and produced an

appropriate report. In Pakistan however, we collect the data from limited area and produced results according to the respondents. When we see this record, it is not dissimilar with CHAOS report. Software failure ratio is quite different from both data. We can overcome this ratio by avoiding the failure factors which we identified in this research.

In future we can expand this survey at country level by covering most of the cities across country and then compare it with CHOAS report that data will be absolutely represent the Pakistani environment. This study is basically the subpart of a major survey which will be collect across the country in future and can overcome come the problems in Pakistani software industry. To meet the international standards, generally, we should overcome the factors which caused software fail and improve the successful factors according to the international standards. This turn may boost up the IT industry in Pakistan which is beneficial for government and at individual organizations.

4.6 Summary

This study focuses on agile based software development, its failure factors, concept of software failure and comparison with international software industry. Primary aspect of this research is to find the software failures and software failure factors in Pakistani software industry through questionnaires and interviews. This section summarizes the whole findings sequentially and represent here in graphical and statistical form. Basically this chapter enfolds the findings that we produced from questionnaires and interviews. Hence we approach almost two hundred professionals and select hundred from them. So we have more than hundred responses that respond us consequently while we collect ten interviews which is the second source of data collection from industry. The findings that we collect from questionnaires are analyzed through quantitative way and represent here in statistical and graphical form.

On the bases of work done in this study, we make categories of dual instruments according to the nature of research question. We have done this task by making three categories of both instruments as the sequence of research question. However, we select three questions in first category which asylum the both part of first research question. These questions are related to software failure, partial or absolute software failure and software failure factors. The responses of these

questions are representing in table which is statistical form of data and also represent here in graphical form accordingly. Secondly, we collect data regarding software failure factors through a question which have nine options. These options are basically the failure factors which we identified through SLR and add in both instruments. These finding are also represented here as the result of research question no 1. The third phase of the chapter is comparison of software failure and successful ratio with CHAOS report which is the core task of research questions no 2. For this purpose, we add two questions in questionnaire and interview that help us to find the successful and failure ration in Pakistani software industry. Thus we have done this task through the opinion of software experts and compare it with latest CHAOS report.

Chapter 5

GUIDELINES FOR PSI

5.1 Overview

Software development is an imperative and impressive deed in the field of information technology, computer science, software engineering and other computer's related fields [85]. However, it is essential to develop the software according to the requirement of user. Moreover, quality of software should meet the international standards and fulfill the requirements of customer succinctly and concisely. In Pakistan, generally, the software development ratio is low as compare to other Asian countries due to some perilous and critical issues which is faced by Pakistani software industry. However, Pakistani software industry (PSI) is still in progressive form and not able to meet the international standard which cause financial crises and low performance [86]. This research is entirely focused on Pakistani software industry and tries to find out the problems which are faced by PSI. In the previous chapters we try to find the software failure factors through survey and filter the rudimentary and elementary factors from discrete area in Pakistan.

In this chapter we determine the guidelines for effective and operative software development according to contemporary phenomena which will ultimately help in improving the current industry. We produced these guidelines by using the data which we collect from survey. During the survey, we add some queries related to the guidelines of software development and take responses from professionals. These responses are basically the suggestions of respondents for better and appropriate development in Pakistan.

5.2 Applicable Guideline for software development

Software risk is an expectation of problem in software development that may occur in future. The aim of this study is to overcome the risk of software by providing the appropriate guideline for software development in Pakistan. Software risk is the probability of an event, threats unwanted consequences. Product risk and project risk are two major types of software risk. In product risk, the features of software can be loss while in project risk; the whole project can be disturbed. Software risk exists in software because of irrelevant and uncertain features that may not include during the project plan. This problem occurs due to time, control or lack of information, deprived development skills, small budget problems and poor management etc. The impacts of software risk on software are; increase the software cost, software quality problem, and might be not complete the software in time.

5.2.1 Abilities for successful development

Successful development is the core area that we try to find in this study. For this purpose, we add a question in instrument where we get opinion form software experts related to the abilities of successful development. Figure 5.1 shows the opinion of software experts related to the abilities for successful development in Pakistani software industry.

Figure 5. 1: Abilities for successful development

The fundamental abilities that are needed for successful and effective development are analyzed user need precisely; the developers have ability to work independently and within group and the developer must be responsible. These abilities are compulsory for successful development according to the opinion of software professionals. These three abilities are necessary because most of the respondents focus on these choices. Some more abilities are available such as learner attitude, utmost relationship, and background in programming and supreme communication skills. These abilities are partial because there are few respondents who emphasis these abilities consequently.

5.2.2 Project team members

A skilled and well experienced development team play a vital role during the entire development phases of software because a successful development is directly proportional with team member. Therefore, we include a question in questionnaires related what sort of individuals that should be engaged for successful development. Figure 5.2 shows a successful team that can make software in any environment. This is basically the opinion of software experts which we collect data through questionnaires.
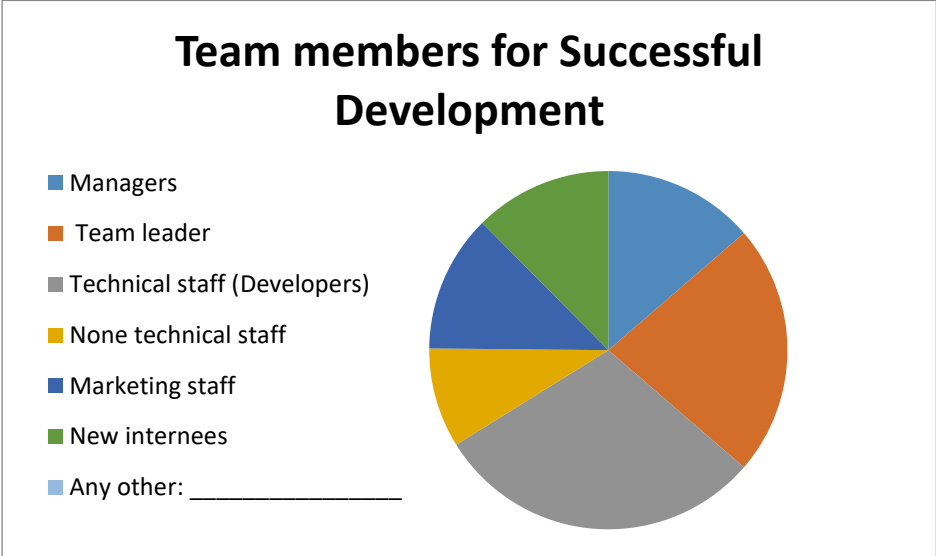

Figure 5. 2: Team members for successful development

According to the endorsement of software professionals, we observe that most of the respondents focused on technical individuals. Generally, two types of employees are available in any software industry; these are technical and non-technical individuals.

Technical persons include programmers or software developer that is the key person in any software industry. Technical individuals should have deep knowledge regarding languages which are being used for software development. Additionally, a developer should be aware about new technology that is currently used at international level. However, most of the respondents indicate technical persons so we have to work on this option for precise and effective development. Moreover, team leader and manger are also included in technical persons but the actual responsibility goes to developer according to the opinion of software experts. Finally, by electing the development team, we should be attentive by choosing the developers.

5.2.3 Knowledge required for successful development

Knowledge regarding software development and awareness about new technology is the fundamental key of accomplished and proficient organization. However, we planned to check the compulsory knowledge for successful development through getting opinion from software professionals. The following Figure 5.3 shows the level of awareness regarding software development.

Knowledge required for successful development

■ Management 50% & Technical 50%

■ Management 80% & Technical 20%

■ Management 20% & Technical 80%

■ Specify in case of other:
    _____
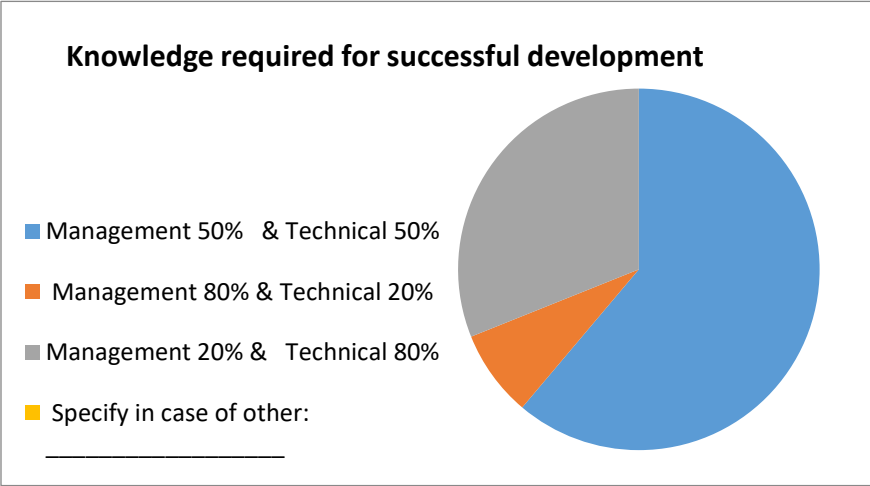
Figure 5. 3: Knowledge required for successful development

Usually, software development is quite difficult and challenging task for every organization. So there is need to develop a software from those experts who have profound knowledge related to the management of software and must have technical knowledge regarding software development. When we examine this term according to the responses of software professionals, we see that maximum respondents are agreed with both knowledge. It means that the entire team should have knowledge

94

related to the management of software and it is obligatory for each developer to acquire technical knowledge as well. Once software is being developed, its evaluation, promotion, up gradation and advertising are some additional factors which should be handle precisely and accurately through best and awesome management skills. That's why the tremendous and incredible management skills is essential for every successful development.

5.2.4 Attitude of higher management

Higher management is responsible for controlling and managing the entire organization that can play a vital role for successful development. They develop complete plan including strategies, policies, decisions and direction of development. In addition, top management can play an important and significant role in the recruitment of outside resources. Therefore, the attitude and easy approach to top management is compulsory for other staff members. For this purpose, we check the role of top management for successful development according to the opinion of software developer. Figure 5.4 illustrate the opinion of software professionals regarding top management attitude.
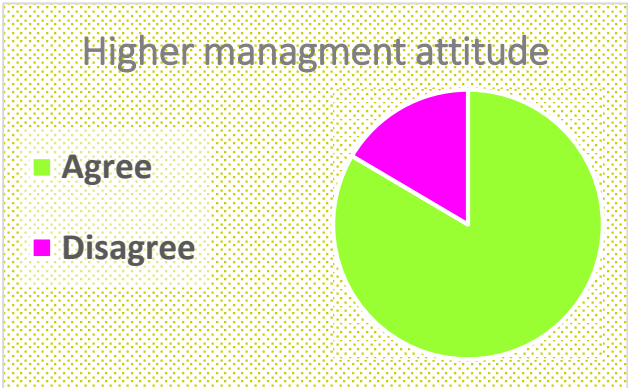
Figure 5. 4: Successful S/W depends on the attitude of higher management

Figure 5.4 demonstrate the endorsement of the attitude of top management. According to the opinion of experts we perceive majority of respondents agreed that the attitude of higher management directly impact on the development of software.

5.2.5 Software and hardware

Software is a general term which consists of various programs that are available in the form of instructions and used to operate the computers and its related devices and fulfill the other requirements. Hardware is physical part of computers

that can be touched and feel whether software is not touchable. In most general sense we can say that the software is set of instructions or programs which are written in any high-level language i.e c, c++, java, c#etc for computer to do specific task. It is a generic term used for computer programs or computer applications. Software includes nonexecutable data just like libraries, online documentation or digital media and executable data like executable code or machine language instructions. The data or information which processed by computer depends on software.

However, we can manage and protect the data or information through software. The interest level of end users can be increased by adding some attractive features in software and also can produces some positive results from employees. However, some complex software can be confused the end user due to its complexity and intricacy. Sometime the software doesn't full fill the exact requirements of user; this may impact the bad impression on user.

5.2.6 Software risk

Software risk is the possibility of problem in software that can disturb the whole software or the part of software in future. It is very important to identify and control the software risk during the development and implementation. A best software testing and analyzing approach can measure the software risk in detail which can help us to solve this issue as soon as possible. However, identification the software failure factors, detail analyses and software risk monitoring are two main elements which we deliberate to handle the risk in this study.

Estimation and scheduling, sudden growth in requirements, Productivity issue, compromising on design, procedural risks are some other important risks are available in market that can affect the software. We can overcome these risk factors by choosing the best risk management model. All kind of software can be influenced by a risk therefore an exclusive assessment process can reduce the risk in software development.

5.2.7 Objective

According to the third research question, our goal is to provide the appropriate guidelines for effective and precise development in Pakistan by diminishing the risk factors in industry. However, risk management in software

projects is the basic key of successful development. It should be necessary to manage the software risk by minimizing the failure factors before the development. Software risk management protocol which is available in the form of framework or guidelines should be implemented during the development process. Most of the software risk protocols can be reduced the software failure factors and can also improve the quality and security of software.

However, the main objective of this study according to the research question is to diminish the software failure ratio in Pakistan by deceiving the applicable model or provide the guideline for improved and better development. Furthermore, it is very important to study the existing models and produced an appropriate guideline by sighted these existing models. In this section we equipped guidelines according to the opinion of software professionals. By using these guidelines, we can overcome the failure factors from Pakistani software industry and can produced quality software because these guidelines are the recommendations that are given by software experts.

5.3 Discussion

As we discuss the whole research, initially we try to find out the research gap by using the different published material and apply literature review then further apply systematic literature review on selected material. Consequently, we find research gap and convert it into research questions and produce a problem statement. Total numbers of research questions are three which we used for this research. First research question has two parts, the first one is basically the concept of software failures according to the state of art, second is software failure factors which we identified and represented in chapter 4.We accomplish the requirements of this question through conducting a detailed and comprehensive survey from software industry in Pakistan. This survey includes questionnaires and interview that we conduct from numerous resources from industry.

Secondly, our goal is to achieve the requirements of second research question which is related to the comparison of software failures and successful development with CHAOS report. For the sake of this research question we also include some questions regarding software failure and successful ratio into instrument that we used to get opinion from software experts. Moreover, we organized guidelines for

successful and superior development according to the judgment of software professionals.

5.4 Aim of research

Generally, IT sector is well established sector at international level and gain phenomenal success. Similarly, most of the countries in Asia and Europe are produced a lot of revenue from IT industry. Unfortunately, Pakistan is now undeveloped country that's why IT sector is also at embryonic position. However, the major aim of this research is improvement in IT industry that could be able to gain the extraordinary success and produce a lot of revenue.

Typically, it is survey-based research that is used to improve the Pakistani software industry which is based on agile methods. To upgrading the Pakistani s/w industry, we select limited area in Pakistan and visit the different organizations. From those organizations, furthermore we meet software professionals and collect data according to the research questions through questionnaires and interview. Moreover, the basic purpose of this data is to determine the failure factors and possible enhancements for Pakistani industry. However, this research is quite important and imperative because when we handle precisely the software failure factors then we can produce quality software that meet the international standards as well.

5.5 Goal of research

Fundamentally, the current study is divided into four categories as we mentioned in research questions. Firstly, our aim is identification of software failures which we determined according to the responses. Data related to software failures are collected from different sources and determined the concept of software failure which is mentioned in chapter no 4. Secondly, the factors related to software's failures are also identified by using the same methodology and identify some factors which can be caused software failure. These factors and its ratio are also represented in chapter no 4.

Furthermore, we propose comparison of these software failures and software failure factors with CHOAS report. CHOAS is a report which produced by an organization named Standish group. This organization collects data from different

countries and produces a report which in known as CHOAS report. In this comparison, we check that how much difference between Pakistani industry and CHOAS report. Finally, we propose guidelines for Pakistani software industry by examine the findings. These guidelines arable to minimize the software failure ratio and can produce the improved and amended development environment.

5.6 Analyses and findings

Comprehensive and inclusive guidelines are available now for precise and accurate software development in Pakistan. However, we solve the problems here which we identified during the survey. We identified failure factors like problem in initial requirements, initial planning issues, obstacle in new technology, hiring highly qualified staff, and budget problem. These factors are identified from software experts and represented consequently in previous chapter. All findings which we produced from survey are represented in statistical and graphical form in previous chapter. Moreover, there are some additional factors regarding the promotion of software that can partially affected on software. These problems could be advertisement issues, implementation problems, environment problems, computer hardware issues etc.

There is needed to make standard industry in Pakistan that should be able to fulfill the international requirements which will ultimately improve the entire fields related to computer and software. So, an appropriate and proper solution can overcome the problems software development. In addition, at domestic level development is a major challenge for any country because internet makes the entire world into a global village. So we should aware about new technology that are introduced at international level and apply it on domestic level as soon as possible. Sometimes the domestic level environment is not supported which caused major failure of software in any country.

5.7 Pros and cons

The pros and cons of software companies vary from one another, mainly depends much on type of company it is, either Service based or product development. Here are some common pros and cons in this study:Generally, this study is based on the results of instrument which we represented in previous chapter.

This study highlighted the software failure factors before the development start that can be ultimately overcome the rare problems of software development. Once these factors are highlighted before the start of software development, the entire team is alert and ready to face any type of problem concerning software development. The guidelines and recommendations that we identified in this research are eventually helping us to develop a quality and successful software.

Finally, this research covered a limited area in Pakistan therefore this study can improve the software industry in distinct area. However, we can expand this research at country level that will be ultimately improving the entire industry of Pakistan.

5.8 Summary

The main objective of this chapter is providing the guidelines for better and superior software development in Pakistani environments. These guidelines are produced from software professionals in distinct area of Pakistan. In addition, this study focused to determine the effective strategy that control the failures, plan to identify the software failures continuously, exertion for successful and quality development and develop software that meet the international standards. For this purpose, we plan to get opinion from software professionals because they can accomplish and acquire some projects in Pakistani environment. However, we evaluated the data graphically which we have collected from software experts and summarized the opinion of those experts regarding guidelines of successful development. A substantial and significant result was produced from survey which we collected from software industry. According to the results, we obtained some guidelines for successful and effective development in Pakistan. These guidelines are related to the abilities of software development team, their relationship between each other and total number of team members which will be involved in development process. These opinions are quite important for successful and impressive development. Moreover, some other guidelines are also identified in this study which is knowledge required for successful development and attitude of higher management. These points are also important that are caused successful development as well. Finally, we found stepwise results that revealed the instructions and arise some beneficial points that eventually expand the industry of Pakistan which will be auspicious for Pakistani government.

Chapter 06

RECOMMENDATION AND CONCLUSION

6.1 Overview

Software failures in IT appear obstinate issue, yet the current research shows that a comprehension and conception issues can be solve through powerful administration techniques, one can control the current circumstance. These circumstances can ultimately help us in bringing the project within the budget on time by fulfilling the entire requirements [87]. In this chapter, recommendations and conclusion will be drawn on the basis of literature review and proposed model. However, this chapter is divided into following four divisions. The first part of this chapter is recommendation; we will recommend the productive and creative recommendations for Pakistani software industry. Moreover, how the Pakistani software industry can overcome the failure factors and how this industry can achieve the international standards. So the recommendation of all these subjects will be discussed in this chapter. Furthermore, the guideline which we proposed in this study has discussed in above chapter and consequently these recommendations will eventually fruitful for Pakistani software industry.

The second part of this chapter is conclusion. This phase will hold the overall picture of entire research which we collect in this thesis. Additionally, it presents the summarized form of analyses, finding and proposed model. The last part of this research is future work. This phase addressed the contents which is not done yet and can be completed in future. These contents could be adaptations, tests and experiments which have been left due to lack of time or some other particular issues.

6.2 Recommendation

In recent year, software companies generated stable and constant incomes for country that considered being a successful organization. Hence, we endorse some recommendation according to the opinion of software professionals. These recommendations are basically generated from the postulation of software experts through questionnaires instrument. We add an additional question in questionnaire related to the recommendation for successful development in Pakistan. Some of the respondent responds this question but most of them are ignored. However, we summarized these opinions consequently and illustrate in table 6.1 individually then explain these recommendations as well. Twenty respondents reply and indorse some suggestions regarding successful software development which are represented here.

Table 6. 1: Recommends profile

Sr No	Respondent profile	Recommendation points
1	• Age: 27 year • Degree: Bachelor • Experience: 5 year	• Owner interest • Needed Technical knowledge
2	• Age: 30 year • Degree: Masters • Experience: 7 year	• Training at managerial level
3	• Age: 28 year • Degree: Masters • Experience: 7 year	• Proper initial planning required
4	• Age: 30 year • Degree: Masters • Experience: 7 year	• Budget management • Decrease scope in case of low budget
5	• Age: 30 year • Degree: Masters • Experience: 7 year	• Avoid Untidy development process
6	• Age: 35 year • Degree: MS • Experience: 9 year	• Manage risk factors then overcome it consequently
7	• Age: 25 year • Degree: Bachelor • Experience: 3 year	• Analyze at initial stage and match with international standard
8	• Age: 27 year • Degree: Masters • Experience: 5 year	• Just overcome the cultural gap and collaboration
9	• Age: 26 year • Degree: Bachelor • Experience: 5 year	• Don't compromise on quality in any case.
10	• Age: 32 year • Degree: Masters	• Awareness about the expansion of requirements

	• Experience: 8 year	
11	• Age: 33 year • Degree: Masters • Experience: 9 year	• Concisely work on confusing behavior
12	• Age: 28 year • Degree: Bachelor • Experience: 5 year	• Don't develop a software without convoluted initial planning
13	• Age: 37 year • Degree: Masters • Experience: 10 year	• Handle the political pressure and internal collision
14	• Age: 30 year • Degree: Masters • Experience: 7 year	• Inflexible nature of an organization can affect software development
15	• Age: 24 year • Degree: Masters • Experience: 3 year	• Goal of project should be achievable
16	• Age: 28 year • Degree: Masters • Experience: 5 year	• Continuously update the latest technology
17	• Age: 33year • Degree: Masters • Experience: 7 year	• Basic information related software should be collect before the development of software
18	• Age: 25 year • Degree: Masters • Experience: 5 year	• Select an appropriate method from multiple options
19	• Age: 29 year • Degree: Masters • Experience: 6 year	• Friendly environment can play a vital role in development
20	• Age: 30 year • Degree: Masters • Experience: 7 year	• Observe the failure factors before development and planned to overcome these factors

- Project owner or project manager should be involved as a part of software development team. However, a range of technical skills are needed every software project and these technical skills are compulsory for project manager especially. These technical skills could be manpower handling, initial planning, resources distribution, estimation, quality of software development and managing some hiding issues which are involve during the software development. Consequently, project manager has a most important role in software project team.

- Formal training for project manager should compulsory to deals with complex and multifaceted projects. Many projects fail due to the lack of manager skills.

- Planning is obligatory for success; every organization should precisely have done this phase through expert professionals according to its resources. A preeminent and best strategy during the planning can overcome a lot of issues related to software development.

- Budget consequences should be observed before the start of software development. Developer can decrease the scope of project in case of low budget. However, inadequacy in resources can be caused bad quality of software which is ultimately affected on organization.

- Untidy development practices are the significant wellspring of software development. These practices can fail the project at any stage of development. Some software development models are available which can conquer this issue.

- Software risk factor is another fundamental issue of software development. An effective and efficient risk management model can overcome the risk regarding the development process. Without risk management, the developer might be going wrong because they don't have knowledge to manage the risk in exact way. It is compulsory to realize the conceptual and potential risk of project. However, risk management is the basic source which is used to protect the project as whole and the entire development team should manage this factor for flourishing and successful development.

- Large scale projects are more complex and multifaceted because of its length whether small scale software projects are not much intricate. Large scale projects could be affected through over budget and low quality etc. so as to manage the large scale project, we should complete it by small parts or stages. Moreover, manager should analyze the complete project and compare it with international standard then send it for development.

- Lack of collaboration, communication and cultural gap between development team and other staff can disturb the whole development process. So, we need to educate the entire staff by training or workshop and realize them to the good relationship between each other. However, a hybrid management, effectual relationship and superb organizational structure can improve the organization and project as well.

- Quality of the software is known by the whole world that's why the level of quality never compromise at any stage. For quality measurements, we should know and compare the requirements of international customer and Pakistani customer.

- Project manager should be aware of the expansion in requirements which could be claim from customer during the development process. Requirements which finalized at earlier phase should be done within time and don't exceed from decided requirement.

- Be careful from confused behavior during the entire development process. This behavior could disorder the whole development procedure or effect on different development phases.

- Project should start with proper and appropriate planning with idealistic analyses by considerate the fatalities, timings, profits etc. without initial planning and appropriate analyses, most of the projects are over budgeted and never complete on time.

- Some large scale projects such as electronic voting system could face political pressure or some internal collision. Furthermore, some individuals or any political group will try to manipulate the project due to their personal benefit or their attached interest. However, higher management need to take care such factors because these factors caused project failure or project termination.

- The structure of an organization can play a vital role of successful software development. Most of the public software development organizations have inflexible nature that's makes a project impossible to develop on time with defined budget. Whether, private organizations can handle easily such type of problems. However, before the start of any project, the project team including technical and non-technical staff should study and understand the organizational structure.

- Objectives and goals of project should be pragmatic and achievable; otherwise it is tough to develop the software accurately.

- Lack of latest technology can amplify the probability of software failure. However, it should be compulsory to utilize latest technology and highly focus on up to dated technology. Moreover, untested technology can also

cause as software failure, so companies should use technology after test especially for large scale projects.

- Qualitative and quantitative information regarding project should be collect before the start of software development. Qualitative elements are consisting of methods, tools and skills whether quantitative elements are functionality, efforts and schedule of development. This information is very important for any type of software project.

- Multiple possibilities regarding software development should available before the start of development process. These possibilities can help us to handle the unseen situation which could be creating problem during the development of project's sub functions.

- For flourishing completion and implementation, it is very essential to communicate and collaborate among different participants such as stakeholder, users, development team etc. Entire participants have plays an important role during the completion of project.

- We should clearly define the key factors which is consists of software failure factors and focus on it consequently for successful development. To achieve the objectives of project, however it is compulsory to observe these factors and fulfill the requirements by voiding these failure factors. Furthermore, any suitable and appropriate framework according to the size of project can help us to solve this problem.

6.3 Future Work

Software project failures seems like an immovable issue, but an appropriate and precise research can overcome these issues through plainly understand the problems related to effective management and can auxiliary control the existing situation. Moreover, this will eventually help us to manage the budget and fulfill the specific requirements within specified time.

In this research we tried to find the software failure and software failure factors through survey which consists of questionnaires and interview from current market in Pakistan. Moreover, we compare the collected information for the accuracy of data and select most affected data for further research. Furthermore, we compare this selected data from CHAOS report. The purpose of this comparison is to

check the difference of software failure and software failure factors with international software market. However, at the end of this research we recommend guidelines that work for Pakistani software industry. There is enormous data written on software failure. According to this research and analyses, we can say that project software failure is an avoidable problem in Pakistanis software industry. It is also imperative that software failure provide us the chance to assume, analyze and learn from our aberration and help us to avoid them in future. However, state of the art, we should collect an appropriate research and critical analyses in future for avoiding these problems because these issues could be changing from time to time.

The definition of software could be changed according to the time, so in future we can define this term by conducting the up-to-date survey that will ultimately help the Pakistani software industry. Multiple reasons and issues regarding software failures are available in recent industry which we try to highlight and solve. However, in future we can conduct an appropriate and comprehensive survey again according to the time and compare those factors with these collected factors. This comparison report will show us the increased failure factors that are not solved yet.

In future, when the latest CHAOS report published, we could accomplish a report from Pakistani software industry and compare it with that report and analyze it according to the circumstances of state of the art.

6.4 Conclusion

Agile software development is an appropriate and precise way of development that can utilized for superior development in Pakistan. However, the implementation of this methodology is quite difficult in Pakistani environment because of some critical and crucial failure factors. So, there is need to highlight the failure factors according to the updated mechanism from updated data gradually. Software industry is quite important industry that generates lot of revenue for any country. Many countries take financial supports from this industry. In this study we take data from latest literature by using the systematic literature review and highlight some common failure factors and summarize it consequently. Moreover, these factors are further recapitulating by measuring the frequency of selected failure factors. These factors create critical problems in Pakistan during the development of software. If we want

to make the superior software industry that meets the international standard, we should resolve these factors by using the appropriate framework. This study focuses the distinct area and emphasizes the Pakistani software industry. In future we can compare these factors from other countries and produce the more appropriate results as this study. Moreover, we can expand the further research at country level through collecting the updated data which will help us to highlight the up to date failure factors. Additionally, we will produce an appropriate frame work for superior development that will help us to make the software that meets the international standard.

REFERENCES

[1]   F. Tripp, John, and Deborah J. Armstrong. "Agile methodologies: organizational adoption motives, tailoring, and performance." Journal of Computer Information Systems 58.2 (2018): 170-179.

[2]   Turk, Dan, Robert France, and Bernhard Rumpe. "Assumptions underlying agile software development processes." arXiv preprint arXiv:1409.6610 (2014).

[3]   Jan, Samina, and Ali Javed. "SCXTREME Framework: A Customized Approach of Process Improvements in Agile Blend with CMMI Practices in Pakistan." IJCNIS 5, no. 3 (2013): 69-78.

[4]   Moe, Nils Brede, Aybüke Aurum, and Tore Dybå. "Challenges of shared decision-making: A multiple case study of agile software development." Information and Software Technology54, no. 8 (2012): 853-865.

[5]   Almeida, Fernando. "Challenges in migration from waterfall to agile environments." World Journal of Computer Application and Technology 5.3 (2017): 39-49.

[6]   Moe, Nils Brede, Torgeir Dingsøyr, and Tore Dybå. "Overcoming barriers to self-management in software teams."IEEE software 26, no. 6 (2009).

[7]   Martini, Antonio, Lars Pareto, and Jan Bosch. "Communication factors for speed and reuse in large-scale agile software development." In Proceedings of the 17th international software product line conference, pp. 42-51. ACM, 2013.

[8]   Jahan, Muhammad Shah, Muhammad Talha Riaz, and Muhammad Abbas. "Software Testing Practices in IT Industry of Pakistan." Proceedings of the 6th Conference on the Engineering of Computer Based Systems. ACM, 2019.

[9]   Faiza Anwer1, Shabib Aftab2, Syed Shah Muhammad Shah3 and Usman Waheed4 "Comparative Analysis of Two Popular Agile Process Models: Extreme Programming and Scrum. International Journal of Computer Science and Telecommunications [Volume 8, Issue 2, March   2017]

[10]   Mateen, Ahmed, Madiha Tabassum, and Akmal Rehan. "Combining agile with traditional V model for enhancement of maturity in software Development." arXiv preprint arXiv:1702.00126 (2017).

[11]   Batarseh, Feras A., and Avelino J. Gonzalez. "Predicting failures in agile software development through data analytics." Software Quality Journal 26.1 (2018): 49-66.

[12]   Vijayasarathy, L. R., & Butler, C. W. (2015). Choice of software development methodologies: Do organizational, project, and team characteristics matter?. IEEE software, 33(5), 86-94.

[13]   Lei, Howard, et al. "A statistical analysis of the effects of Scrum and Kanban on software development projects." Robotics and Computer-Integrated Manufacturing 43 (2017): 59-67.

[14]   Zahid, A., Haider, M.W., Farooq, M.S., Abid, A. and Ali, A., 2018. A Critical Analysis of Software Failure Causes From Project Management Perspectives. VFAST Transactions on Software Engineering, 13(3), pp.113-119.

[15]   Inayat I, Salim SS, Marczak S, Daneva M, Shamshirband S. A systematic literature review on agile requirements engineering practices and challenges. Computers in human behavior. 2015 Oct 1;51:915-29.

[16]   Bukhari, Syed Faisal Ahmed, and Hira Khan. "A comparative study on usage of traditional and agile software development methodologies in software industry of Asia." In Proceedings of the International Conference on Software Engineering Research and Practice (SERP), p. 1. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2014.

[17]   Abrahamsson, Pekka, et al. "Agile software development methods: Review and analysis." arXiv preprint arXiv:1709.08439 (2017).

[18]   Anwer, Faiza, et al. "Comparative analysis of two popular agile process models: extreme programming and scrum." International Journal of Computer Science and Telecommunications 8.2 (2017): 1-7.

[19]   Budoya, Christian Misobi, Mussa M. Kissaka, and Joel S. Mtebe. "Instructional Design Enabled Agile Method Using ADDIE Model and Feature Driven Development Process." International Journal of Education and Development using Information and Communication Technology 15.1 (2019): n1.

[20]   Zafar, Iqra, Aiman Khan Nazir, and Muhammad Abbas. "The impact of agile methodology (DSDM) on software project management." Circulation in

Computer Science: International Conference on Engineering, Computing & Information Technology (ICECIT 2017). 2017.

[21]   Laanti, Maarit. "Agile transformation model for large software development organizations." In Proceedings of the XP2017 Scientific Workshops, p. 19. ACM, 2017.

[22]   Aziz, T., S. SAEED, and I. ALSMADI. "Supporting Agile Methodologies in Practice: A Study of Pakistani Software Industry." Sindh University Research Journal-SURJ (Science Series) 47, no. 1 (2016).

[23]   Butt, Farrukh Latif, Rabiya AS Zainab, Shahid Nazir Bhatti, and Atika T. Aneesa Rida. "Optimized Order of Software Testing Techniques in Agile Process-A Systematic Approach."International Journal of Computer Science and Information Security 14, no. 12 (2016): 509.

[24]   Sultana, Saadia, Yasir Hafeez Motla, Sohail Asghar, Muhammad Jamal, and Romana Azad. "A hybrid model by integrating agile practices for pakistani software industry." InElectronics, Communications and Computers (CONIELECOMP), 2014 International Conference on, pp. 256-262. IEEE, 2014.

[25]   Ali, Muhammad Asim. "Survey on the state of agile practices implementation in Pakistan." International Journal of Information and Communication Technology Research 2.4 (2012).

[26]   Biehl, Markus. "Implementing global information systems: Success factors and failure points." Communications of the ACM 50.1 (2007): 52-58.

[27]   Ghafoor, Fawad, Ibrar Ali Shah, and Nasir Rashid. "Issues in Adopting Agile Methodologies in Global and Local Software Development: A Systematic Literature Review Protocol with Preliminary Results." International Journal of Computer Applications 160, no. 7 (2017).

[28]   Awar, Khush Bakhat, M. Shujah Islam Sameem, and Yasir Hafeez. "A model for applying Agile practices in Distributed environment: A case of local software industry." InCommunication, Computing and Digital Systems (C-CODE), International Conference on, pp. 228-232. IEEE, 2017.

[29]   Richter, Ingo, Florian Raith, and Michael Weber. "Problems in agile global software engineering projects especially within traditionally organised corporations:[An exploratory semi-structured interview study]."

In Proceedings of the Ninth International C* Conference on Computer Science & Software Engineering, pp. 33-43. ACM, 2016.

[30] Mc Hugh, Martin, Fergal McCaffery, and Valentine Casey. "Barriers to using agile software development practices within the medical device industry." (2017).

[31] Sohaib, Osama, and Khalid Khan. "Integrating usability engineering and agile software development: A literature review." In Computer design and applications (ICCDA), 2010 international conference on, vol. 2, pp. V2-32. IEEE, 2010.

[32] Sarfraz, Muhammad, Maria Ramzan, Akhter Rasheed, and Fateh Ali. "Agile Practicing and Outsourcing." IJCSIS International journal of computer science and information security 14, no. 6 (2016): 641-648.

[33] Lopes, Socrates Veridiano Faria, and Plinio Thomaz Aquino Junior. "Architectural Design Group Decision-Making in Agile Projects." In Software Architecture Workshops (ICSAW), 2017 IEEE International Conference on, pp. 210-215. IEEE, 2017.

[34] Jaffar, Rafid Nabil, Alaa Abd Al Muhsen Hussain, and Wisam Chiad. "A new model for study of quality attributes to components based development approach." Periodicals of Engineering and Natural Sciences 7.3 (2019): 1177-1185.

[35] Iqbal, Javed, Mazni Omar, and Azman Yasin. "The Impact of Agile Methodologies and Cost Management Success Factors: An Empirical Study." Baghdad Science Journal 16.20/6/2019 (2019): 496-503.

[36] Tabassum, Atika, Shahid Nazir Bhatti, Aneesa Rida Asghar, Iqra Manzoor, and Imtiaz Alam. "Optimized Quality Model for Agile Development: Extreme Programming (XP) as a Case Scenario." INTERNATIONAL JOURNAL OF ADVANCED COMPUTER SCIENCE AND APPLICATIONS 8, no. 4 (2017): 392-400.

[37] Hoda, Rashina, Norsaremah Salleh, John Grundy, and Hui Mien Tee. "Systematic literature reviews in agile software development: A tertiary study." Information and Software Technology 85 (2017): 60-70.

[38] Keele, Staffs. Guidelines for performing systematic literature reviews in software engineering. Vol. 5. Technical report, Ver. 2.3 EBSE Technical Report. EBSE, 2007.

[39] Khan, Muhammad Ishfaq, Muzaffar Ali Qureshi, and Qaisar Abbas. "Agile methodology in software development (SMEs) of Pakistan software industry for successful software projects (CMM framework)." In Educational and Network Technology (ICENT), 2010 International Conference on, pp. 576-580. IEEE, 2010

[40] Iqbal, Javed, Mazni Omar, and Azman Yasin. "Empirical Study of Agile Methodologies and Quality Management Success Factors in Pakistani Software Companies." Proceedings of Knowledge Management of International Conference (KMICe). Vol. 2018. 2018.

[41] Tanvir, Sara, Hanny Tufail, and Aimal Khan. "A Study on Uncertainties in Software Project Management in Pakistan." (2018).

[42] Zafar, Atique Ahmad, et al. "Taxonomy of factors causing integration failure during global software development." IEEE Access 6 (2018): 22228-22239.

[43] Gondal, Hafiz Ali Hamza, et al. "Preeminent risk factor affecting software development." 2018 International Conference on Advancements in Computational Sciences (ICACS). IEEE, 2018.

[44] Saleem, Nazish, Sanjay Mathrani, and Nazim Taskin. "Investigating Critical Success Factors of Project Management in Global Software Development: A Work in Progress." (2019).

[45] Mughal, M., A. Bahaudin, and N. Salleh. "Behavioral factors for IT project success in Pakistan: Moderating effect of leadership styles." Management Science Letters 9.7 (2019): 987-996.

[46] Rashid, Junaid, Toqeer Mahmood, and Muhamad Wasif Nisar. "A Study on Software Metrics and its Impact on Software Quality." arXiv preprint arXiv:1905.12922 (2019).

[47] Renz, Susan M., Jane M. Carrington, and Terry A. Badger. "Two strategies for qualitative content analysis: An intramethod approach to triangulation." Qualitative health research 28.5 (2018): 824-831.

[48] Morse, Janice M. Mixed method design: Principles and procedures. Routledge, 2016.

[49] Bowen, Phillip W., Richard Rose, and Andrew Pilkington. "Mixed methods-theory and practice. Sequential, explanatory approach." International Journal of Quantitative and Qualitative Research Methods 5.2 (2017): 10-27.

[50]   Creswell, John W., and Vicki L. Plano Clark. Designing and conducting mixed methods research. Sage publications, 2017.

[51]   Dewasiri, N. J., Y. K. B. Weerakoon, and A. A. Azeez. "Mixed methods in finance research: The rationale and research designs." International Journal of Qualitative Methods 17.1 (2018): 1609406918801730.

[52]   Warfa, Abdi-Rizak M. "Mixed-methods design in biology education research: Approach and uses." CBE—Life Sciences Education 15.4 (2016): rm5.

[53]   Herrera, Natalia Romero. "In-situ and mixed-design interventions." Living Labs. Springer, Cham, 2017. 157-167.

[54]   Petree, Gary Lee. "Connecting the Servicemembers Opportunity Colleges (SOC) Program and the Campus Environment at a SOC Program Institution: A Mixed Methods Study with a Transformative Design." (2017).

[55]   Heale, Roberta, and Dorothy Forbes. "Understanding triangulation in research." Evidence-Based Nursing 16.4 (2013): 98-98.

[56]   Carter, Nancy, et al. "The use of triangulation in qualitative research." Oncology nursing forum. Vol. 41. No. 5. 2014.

[57]   Morse, Janice M. Mixed method design: Principles and procedures. Routledge, 2016.

[58]   Thomas, Juliet Anne. "Using unstructured diaries for primary data collection." Nurse researcher 22.5 (2015).

[59]   Minton, Elizabeth, et al. "Comparing data collection alternatives: Amazon Mturk, college students, and secondary data analysis." AMA Winter Educators' Conference Proceedings. Vol. 24. 2013.

[60]   De Bruijne, Marika, and Arnaud Wijnant. "Improving response rates and questionnaire design for mobile web surveys." Public Opinion Quarterly 78.4 (2014): 951-962.

[61]   Warshaw, Paul R., and Fred D. Davis. "The accuracy of behavioral intention versus behavioral expectation for predicting behavioral goals." The Journal of psychology 119.6 (1985): 599-602.

[62]   Leung, Wai-Ching. "How to design a questionnaire." BMJ 322.Suppl S6 (2001): 0106187.

[63]   Friborg, Oddgeir, and Jan H. Rosenvinge. "A comparison of open-ended and closed questions in the prediction of mental health." Quality & Quantity 47.3 (2013): 1397-1411.

[64]   Krosnick, Jon A. "Questionnaire design." The Palgrave handbook of survey research. Palgrave Macmillan, Cham, 2018. 439-455.

[65]   Brace, Ian. Questionnaire design: How to plan, structure and write survey material for effective market research. Kogan Page Publishers, 2018.

[66]   Matarazzo, Joseph D., and Arthur N. Wiens. The interview: Research on its anatomy and structure. Transaction Publishers, 2017.

[67]   King, Nigel, Christine Horrocks, and Joanna Brooks. Interviews in qualitative research. SAGE Publications Limited, 2018.

[68]   McIntosh, Michele J., and Janice M. Morse. "Situating and constructing diversity in semi-structured interviews." Global qualitative nursing research 2 (2015): 2333393615597674.

[69]   Rogers, Richard. "Structured interviews and dissimulation." (2018).

[70]   Dikko, Maryam. "Establishing construct validity and reliability: Pilot testing of a qualitative interview for research in Takaful (Islamic insurance)." The Qualitative Report 21.3 (2016): 521-528.

[71]   Sullivan, S. John, et al. "'What's happening?'A content analysis of concussion-related traffic on Twitter." Br J Sports Med 46.4 (2012): 258-263.

[72]   Chan, Zenobia CY, Yuen-ling Fung, and Wai-tong Chien. "Bracketing in phenomenology: Only undertaken in the data collection and analysis process." The qualitative report 18.30 (2013): 1-9.

[73]   Sgier, Lea. "Qualitative data analysis." An Initiat. Gebert Ruf Stift (2012): 19-21.

[74]   Elo, Satu, et al. "Qualitative content analysis: A focus on trustworthiness." SAGE open 4.1 (2014): 2158244014522633.

[75]   Suri, Harsh. "Purposeful sampling in qualitative research synthesis." Qualitative research journal 11.2 (2011): 63-75.

[76]   Tesch, Renata. Qualitative research: Analysis types and software. Routledge, 2013.

[77]   Downs, Roger M., and David Stea, eds. Image and environment: Cognitive mapping and spatial behavior. Transaction Publishers, 2017.

[78]   D'Este, Pablo, Frederick Guy, and Simona Iammarino. "Shaping the formation of university–industry research collaborations: what type of proximity does really matter?." Journal of economic geography 13.4 (2012): 537-558.

[79]   Riff, Daniel, et al. Analyzing media messages: Using quantitative content analysis in research. Routledge, 2019.

[80]   Glaser, Barney G., and Anselm L. Strauss. Discovery of grounded theory: Strategies for qualitative research. Routledge, 2017.

[81]   Wilson, Virginia. "Research methods: triangulation." Evidence based library and information practice 9.1 (2014): 74-75.

[82]   https://www.standishgroup.com › news

[83]   https://www.projectsmart.co.uk/white-papers/chaos-report.pdf.

[84]   Kitchenham, Barbara, and Shari Lawrence Pfleeger. "Principles of survey research: part 5: populations and samples." ACM SIGSOFT Software Engineering Notes 27.5 (2002): 17-20.

[85]   Kumar, Rajeev, Suhel Ahmad Khan, and Raees Ahmad Khan. "Durable security in software development: needs and importance." CSI Communications 10 (2015): 34-36.

[86]   Shahzad, Fakhar, GuoYi Xiu, and Muhammad Shahbaz. "Organizational culture and innovation performance in Pakistan's software industry." Technology in Society 51 (2017): 66-73.

[87]   Rana, Deepak Singh, Shiv Ashish Dhondiyal, and Sushil Kumar Chamoli. "Software defined networking (SDN) challenges, issues and solution." Int J Comput Sci Eng 7.1 (2019): 884-889.

APPENDIX A

Questionnaires

Introduction

Self introduction are included at the front page of this questionnaires. This introduction is as following:

Dear Sir/Madam,

I am student of MSCS at National University of Modern Language Islamabad (NUML) and conducting research on "Software Failure reduction in Pakistani software industry (PSI) working on agile method". The purpose of this research is to identify the failure factors from Pakistani software industry and propose a framework for precise development. You are requested to kindly provide your response on the following questionnaire.

In this questionnaire you will be asked to provide your feedback on related to software development, Role in development team, related to failure projects, Successful and failure ratio, Abilities for successful development and your opinion related to the failure factors during software development etc. I assure you that your responses will be kept in high confidence and will not be shared with anyone. Only aggregate results will be made public without indicating name of any respondent. Access to the research data will be restricted to the investigator and the research supervisors. All research outcomes will be published for research report.

Thank you,

Muhammad Nadeem Raza

Student of MS in computer Science

University of Modern Language Islamabad (NUML)

nadeem.meri@gmail.com

Questions

Following questions are added in this questionnnaires. These questions are includes according to defined sequence.

Q 1: What is your age?
- ☐ 18-24 years old
- ☐ 25-34 years old
- ☐ 35-44 years old
- ☐ 45-54 years old
- ☐ 55-64 years old
- ☐ 65-74 years old

Q 2:   What is the highest degree or level of school you have completed?
- ☐ Intermediate degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional degree
- ☐ Doctorate degree

Q 3: Specify the area of s/w development
- ☐ Web developer
- ☐ Desktop developer
- ☐ Mobile developer
- ☐ Graphics developer
- ☐ Game developer
- ☐ Big data developer
- ☐ Server side

Q 4: Your experience in software development is:
- ☐ 2 to 5 years
- ☐ 5 to 7 years
- ☐ 7 to 10 years
- ☐ 10 to 15 years
- ☐ 15 to 20 years
- ☐ 20 to 30 years
- ☐ More than 30 years

Q 5: In this organization, which methods are being used for software development?
- ☐ Agile Methodology
- ☐ System Development Life cycle (SDLC)
- ☐ Both (agile and SDLC)
- ☐ Mix Method
- ☐ Other

Q 6:   What kind of services your organizations provide in agile based software development?
- ☐ Short term software with specified time span
- ☐ Long term software over the year

☐ Provides both services, depends to the nature of project
☐ Specify in case of other: _____

Q 7: Have you ever remained the part of software development projects?

☐ Yes, I am the part of agile based software development as technical person

☐ Yes, I am the part of agile based software development as nontechnical person

☐ No, I am not the part of agile based software development, but I know most of the techniques used in agile environment.

☐ No, I am not the part of development team.

Q 8: What is your role in development team?

☐ take holder (Investor)
☐ Project Manager
☐ Manager
☐ Team leader
☐ Software Developer
☐ Quality controller
☐ Any other: _____

Q 9: How many agile based software projects you developed in last 10 year (As a team member)?

☐ 1 to 05 Projects
☐ 5 to 10 Projects
☐ 10 to 15 Projects
☐ 15 to 20 Projects
☐ 20 or more then
☐ Other:_____

Q 10: How would you express the software project failure?

☐ Software accomplishes the specified requirements but not timely delivered to customer.

☐ Software fulfill the specified requirements but there is lack of quality

☐ Over budgeted software projects considered as failure projects

☐ Software projects were not according to the requirement and fulfill some additional requirements which are not included in agreement.

☐ Software meets the requirements at the time of testing but contained problem at the time of implementation.

Q 11: In your opinion, what is partial or absolute software failure?

☐ Projects does not deliver timely
☐ Don't meet the user requirements
☐ Project completes with additional budget
☐ Project fail due to security and quality issues
☐ Mentioned if other: _____

Q 12: What was the ratio of failure projects in which you were involved?

☐ 0 to 5 %

119

- ☐ 5 to 10 %
- ☐ 10 to 20 %
- ☐ 20 to 40 %
- ☐ 40 to 60 %
- ☐ 60 to 8

Q 13: What is the impact of failures projects on organization?
- ☐ Fiscal loss
- ☐ Time loss
- ☐ Performance issue
- ☐ Loss of investor confidence
- ☐ Bad publicity
- ☐ Considered as cheap organization
- ☐ Employment difficulties
- ☐ Loss the trust
- ☐ Survive issues in mark

Q 14: According to your opinion, which factors can disturb the software project completely or partially in agile based development?
- ☐ Management problem
- ☐ Initial planning issues
- ☐ Communication gap between team members
- ☐ Lack of knowledge about new technology
- ☐ Low budget
- ☐ Not fully support from top Management
- ☐ Absence of stack holder
- ☐ Inexperienced staff
- ☐ Counterfeit organizational structure
- ☐ Other: _____

Q 15: Please specify the software project's successful ratio in agile based development
- ☐ 10 to 20 percent
- ☐ 20 to 40 percent
- ☐ 40 to 60 percent
- ☐ 60 to 80 Percent
- ☐ 80 to 100 percent

Q 16: What are the fundamental abilities needed for prosperous software development?
- ☐ Learner attitude
- ☐ Responsibility
- ☐ Utmost relationships
- ☐ Ability to Work Independently and Within Groups
- ☐ Analyze user needs
- ☐ Analytical thinking
- ☐ Background in programming
- ☐ Supreme communication skill

Q 17: What sort of individuals can have engaged in software project team
- ☐ Managers
- ☐ Team leader

- ☐ Technical staff (Developers)
- ☐ None technical staff
- ☐ Marketing staff
- ☐ New internees
- ☐ Any other: _____

Q 18:   The attitude of higher management can play a vital role in the success of software project

- ☐ Agree
- ☐ Disagree

Q 19:   Technical knowledge needed for software project manager

- ☐ Management 50%   & Technical 50%
- ☐ Management 80% & Technical 20%
- ☐ Management 20% &   Technical 80%
- ☐ Specify in case of other: _____

Q 20:   Improvement in agile based development can impressive change in Pakistani software industry

- ☐ Agree
- ☐ Disagree

Q 21:   For rapid and superior development, agile methodology is better than traditional method

- ☐ Agree
- ☐ Disagree

Q 22:   How we can improve agile based development in Pakistan (any suggestion)

Interview

Sr No	Interviewer inside purpose	Questions (Language/English)	Supplementary questions possibilities/explanations	To be noted in interviewer sheet	Comment
I. Introduction phase					
	Catch interviewee's consideration and encourage the respondent in the interview.	Hello, I am M Nadeem Raza, can you please allow me to discuss my research project with you and seek your valuable feedback? I am interviewing software professionals to learn about the state of art in agile based software failures. I saw that some failure factors can disrupt the development process, so I want to ask you some severe questions about that. It will take minimum time and obviously, your answers will be preserved secretly. You would be of incredible help.			
	Request for approval to audiotape (optional)	Great! Would it be alright for you whether I record your answers?			

II. Questioning phase					
1	Take the idea from interviewee regarding to the concept of software failures. E.g. (What is software failures according to interviewee's point of view)	Thanks, Let's start, according to your point of view, what is software failure? Or how would you explain the concept of software failures.	- What is project software failure including short term and long-term software? - What is partial and absolute software failures - Software failures could be software delivery status, quality of software, budget problems, fulfill extra requirement, implementation problems to client, and overtime in development processes, not match requirements, security problems and Finlay identify the software failures ration in Pakistani software development industry.		
2	Identify the software failure factors	Secondly, According to your opinion, which factors can disrupt the software project completely or partially in agile based development.	- Common failure factors in development industry. - Fundamental failure factors in Pakistani agile based industry. - Software failure factors could be management problems, initial planning, communications gap between management developer and customer, unawareness about new technology, low budget, unsupported management, absence of stack holder, inexperience staff members, and counterfeit organizational structure - Software successful ration in Pakistan.		
3	Detect the factors for successful software development	How we can improve the development of software in Pakistan. Please identify some factors for successful development.	- What is successful development - Some compulsory factors needed for successful and effective development - Kindly describe some additional factors which can improve and upgrade the software industry in Pakistan. - Which methodology is better for development in Pakistani environment? (Traditional methods or agile techniques). - Effectual factors could be responsibility,		

			learner attitude, utmost relationship among staff, developers have ability to work individually and within the group, background in programming, best communication skills, how much experiences needed, staff evaluation (manager, team leader, developers, marketing staff or new internees).		
III. Demographics/ Other info Part					
	Age	This was actually the last question. Could you tell me please, how old you are?			
	Education	Finally, I want to know your highest degree.	Master's degree, Bachelor degree or some professional certificates in IT		
Iv. Concluding					
		Thanks for your collaboration, have a great day!			