Gap between Scrum Theory and Practice in Pakistan

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Thesis Approval

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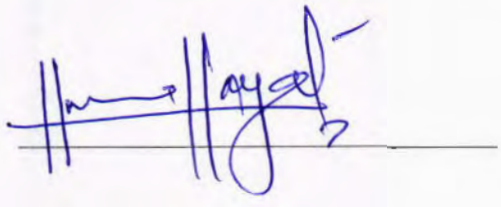

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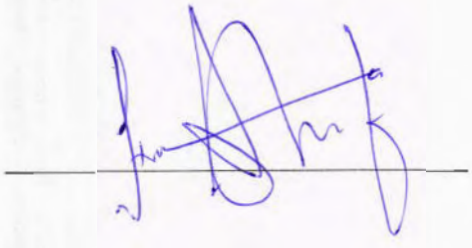

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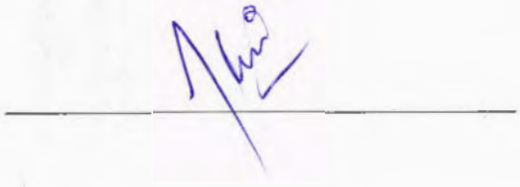

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Dedication

I dedicate my research work to

three of the best blessings of Allah SWT

My beautiful mother

My strong father

And to

My lovely Aden

Muneeba Arshad

364-FBAS/MSSE/F12

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Department of Computer Science and Software Engineering,

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As a Partial Fulfilment of the Requirement for the Award of the

Degree of

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Declaration

I hereby declare that this Thesis "Gap between Scrum Theory and Practice in Pakistan " neither as a whole nor as a part has been copied out from any source. It is further declared that I have done this research with the accompanied report entirely on the basis ofmy personal efforts, under the proficient guidance of my teachers especially my supervisor Ms. Zakia Jalil and Co-supervisor Dr. Naveed Ikram. If any part of the research is proved to be copied out from any source or found to be reproduction of any project from any of the training institute or educational institutions, I shall stand by the consequences

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Abstract

In the software engineering industry Scrum has become one of the most popular and commonly used agile methods all over the world. The use is widespread and Pakistani practitioners are also using the method these days. It provides a specific set of principles and guidelines that concisely constitute the theory of the method.

Existing work over the past decade focuses on how Scrum is practiced in the industry. However, none of these studies specifically addresses the gap between Scrum theory and practice and causes and consequences of that gap especially in the context of Pakistani software industry where Scrum is now the most commonly used agile method.

Through study of literature and observation of industry, it can be seen that there exists a gap between Scrum theory and practice. Mostly practitioners deviate from the theory as per their needs, sometimes without even clearly understanding the consequences of those deviations. These deviations might be meaningful but may cause harmful aftereffects on projects. The study of the gap reveals what deviations, if any, have been done from theory and thus expose positive or negative consequences of those deviations, eventually helping practitioner in improving their usage of the method.

Hence, the main focus of this study is to address this issue and thus help out Scrum practitioners in Pakistan by assessing their usage of the method and determining if and which improvements need to be made in the Scrum practice.

Keywords – Scrum practice, Agile, Scrum in Pakistan, Scrum deviation

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1. Introduction

Scrum [1, 2] is an agile development methodology that is applied as a wrapper with the pre-existing practices of engineering in order to develop the software in an iterative and incremental fashion. This methodology is quite flexible and simple due to which, over the years, it has become the most common method [3] used by the teams which follow an agile methodology.

In the context of software industry of Pakistan recently conducted survey [4] reveals that Scrum is the most popular agile methodology among Pakistani practitioners as well. Despite being the most commonly used agile methodology all over the world, the number of studies that focus on Scrum is comparatively small [5]. Especially in context of Pakistani software industry, only a few studies have been conducted that specifically focus on Scrum.

Scrum [1] consists of a given set of practices that constitute theory of the method. It is simple and concise and adherence is advised to reap full benefits of the method. However, Scrum is hardly ever used in accordance with the theory giving rise to the theory-practice gap.

Hence, the main focus of this research was to first find out the gap that exists between Scrum theory and practice in Pakistan. The research then proceeded towards finding out main reasons for the existence of that gap and its positive or negative consequences.

1.1 Theory and practice gap

Software development methods and processes are hardly ever applied completely in accordance with the theory without any alterations or customizations to the original principles of the method [8]. The study of the theory and practice gap reveals what aspects of the method are considered more useful by the industry practitioners and which aspects are omitted or altered. The study of this gap can be used to determine the positive and negative impacts of deviating from theory [6]. Thus it helps in assessing practice according to the theory and determining if any improvements need to be made in the current use of the method in practice.

1.2 Scrum theory

Scrum [1, 2] as it is known today was described in the year 1995 by Ken Schwaber and Jeff Sutherland. The complete Scrum theory which consists of roles, artifacts and events of Scrum is described in "The Scrum Guide – The Definitive Guide to Scrum: The Rules of the Game" [1]. The theory is concise, simple, and easy to understand and follow through. Main elements that constitute the theory are

A) Roles
B) Events
C) Artifacts

Roles in Scrum are Scrum Master, Product Owner and the Development Team. Events are Sprint planning, Daily Scrum, Sprint review and Sprint retrospective. Artifacts are Product Backlog, Sprint Backlog and the increment.

Scrum is about having individuals work together as a team in a self-organizing manner with the liability of work lying on the whole team instead of individual team members. Another aspect is cross-functionality of the team which is different from the specialist culture.

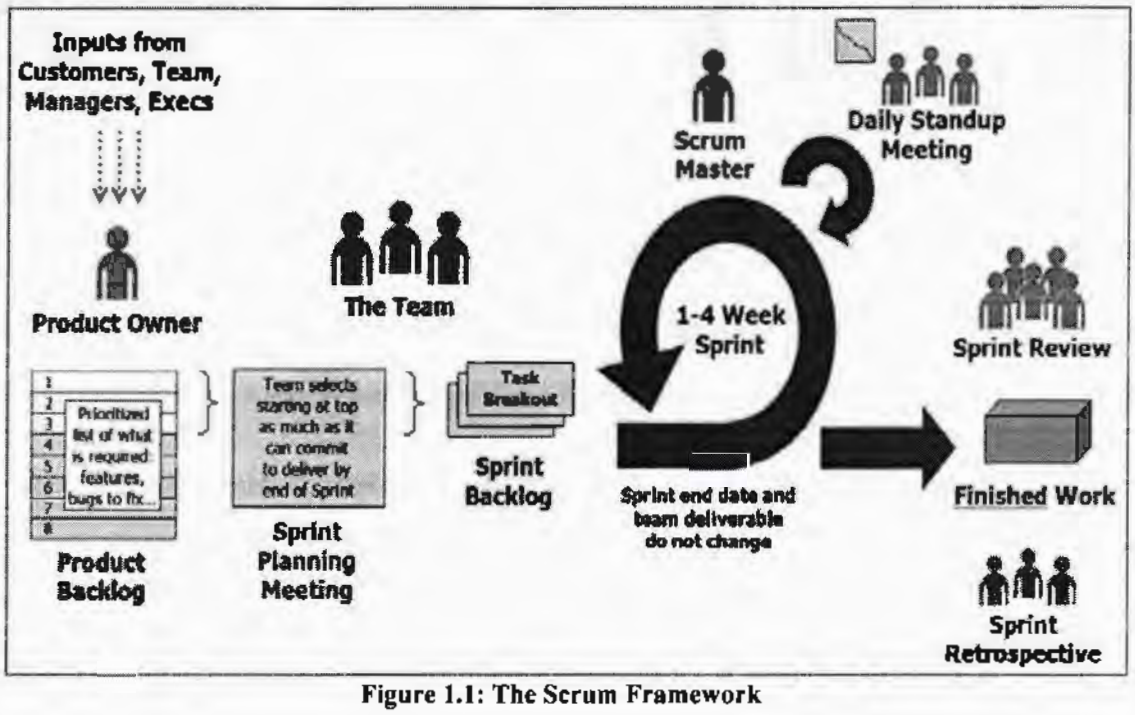


Figure 1.1: The Scrum Framework

Details of theory are provided in Appendix B.

1.3 Gap between Scrum theory and practice

Ken Schwaber, one of the founders of the Scrum process, advocates strict adherence to Scrum's core practices until Scrum works well in the organization [2]. The adaptation in Scrum practices should be based on past experiences and not one's own interpretation [2].However study of literature indicates that it is almost never used without deviations from theory in the international software industry. Deviation might lead to issues that result in project failure [7].

1.4 Motivation

Scrum is the most commonly used agile method in Pakistan but still the number of locally conducted Scrum based studies is very few and number of studies conducted on how Scrum is actually applied in the industry is "Zero". According to our knowledge, no study has been done yet assessing the practice of Scrum in local software industry and determining potential mishandling of the method and if any changes need to be made into the current practice of Scrum. In this study firstly causes consequences of deviating from Scrum practices in will be assessed. With the findings of this study a set of guidelines will be given on usage of the method in the local industry thus helping current and future practitioners of the method in Pakistan.

1.5 Research Question

Q 1) What are the causes and consequences of deviation from Scrum theory in Pakistani software industry?

1.1) What deviations from the original Scrum theory are being practiced

1.2) Why those deviations are being practiced

1.3) What are the consequences of those deviations

1.6 Research Process

Research process consisted of the eight steps (Figure 1.2). First of all literature review was performed which revealed some gaps. Based on the identified gaps research question was formed. After that Scrum theory was understood by reading The Scrum Guide [1]and Agile development with Scrum [2]. Interviews were conducted and collected data was analyzed after that. Finally solution was designed, evaluated.

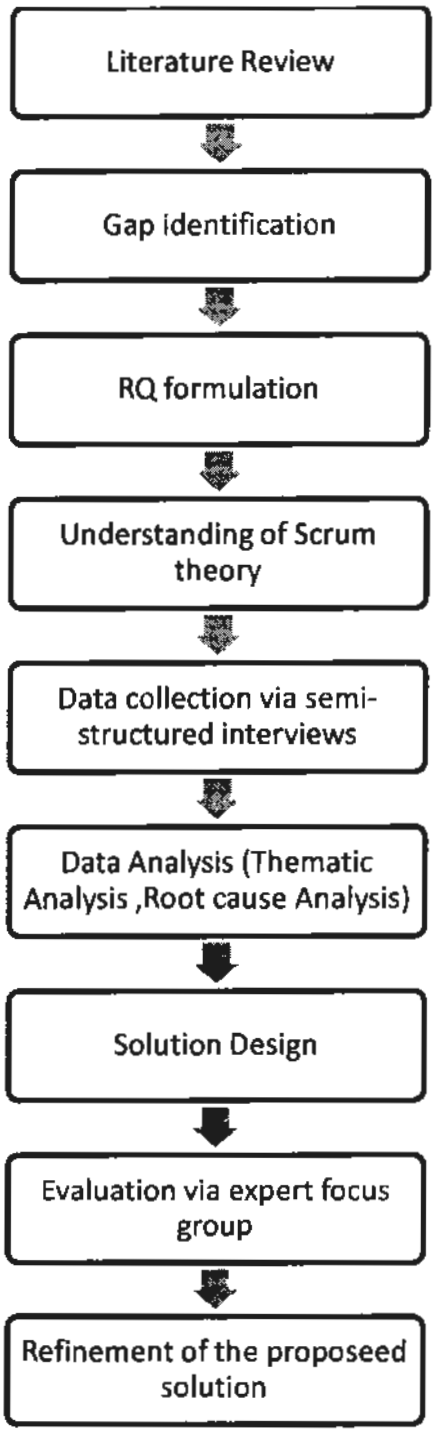


Figure 1.2: Research process

1.7 Research Objective

Main objective of the research is to propose a solution to *"the gap between Scrum theory and practice in Pakistan"* and to check how helpful the proposed solution is for the Pakistani practitioners.

1.7.1 Study Context

In order to find out answers to the identified questions, semi-structured interviews were conducted atlocal software houses in Pakistan which revealed the gap, its causes and consequences.

1.7.2 Contribution of study

A set of guidelines were designed as a result of this study that will attempt to resolve the gap between Scrum theory and practice in Pakistan.

1.8 Thesis Outline

Chapter#2: This chapter comprises of related work on Scrum theory and practice. Lack of Scrum studies have been highlighted. International trends along with local industry trends have been provided. RQs are formed in this chapter.

Chapter#3: Research methodology is described in this chapter. Interviews are primary data collection tool. Thematic network analysis and root cause analysis are described as analysis techniques. Focus Group is described as validation method.

Chapter#4: This chapter comprises steps of data analysis. Firstly deviation is identified then causes of deviation are identified. Root cause analyses is performed to identify the root causes. Consequences of deviation are also investigated.

Chapter#5: Guidelines are proposed in this chapter. Then proposed guidelines are represented in SEMAT kernel and language followed by the validation of proposed solution via a focus group of experts.

Chapter#6: Chapter 6 contains concluding remarks, summery of work, limitations and future directions.

2. Related Work

Agile movement was mainly started and transcribed by practitioners rather than researchers [17]. With the increasing usage and popularity of Agile methods, literary articles were written about them. However, the number of studies still remains scarce. The need for a detailed study on Scrum beyond the adoption stage can be felt by reviewing the literature [21, 22].

Studies after type of agile method used in the study

Agile method	Number	Percent
XP	25	76
General[a]	5	15
Scrum	1	3
Lean software development	1	3
Other[b]	1	3
Total	33	100

[a] "General" refers to studies on agility in general.
[b] "Other" refers to a company-internal agile method.

Figure 2.1: Need for Scrum studies

2.1. Studies on Scrum

Since literature revealed the need for studies on Scrum studies (Figure 2.1) research articles were read to find out the gap.

2.1.1. International Trends

Internationally, some existing studies take one specific part of Scrum and compare theory with practice [9-19]. Sverrisdottir et al. [9] have compared the perception of product owners (PO) of their roles with the role of product owner according to Scrum theory. They first described the role of PO according to Scrum theory and then conducted interviews with five product owners in five different organizations in order to get insight into the actual role of product owner. The study indicates that the understanding of product owners is rarely in perfect conformance with official Scrum method. It also reveals that Scrum is hardly ever used exclusively, rather, is used in combination with existing methodologies of the organizations. The study only focuses on role of product owner, not the whole scrum process.

A survey was conducted by Salo et al. [10] in order to show the extent of adoption of XP and Scrum in European embedded software industry. It indicates expected usefulness of these methods when there is no background experience as well as actual level of use of practices where agile methods are systematically used. Results indicate that the respondents that actually use the methods reported more positive experience of using the practices then the respondents without experience. Based on industrial evidence, the study claims that the usage of Scrum practices is more method-specific as compared to XP practices with the exception of Product Backlog. Product Backlog is most popular Scrum practice according to the study and sprint planning meeting is least popular among studied organizations. In short, the study shows that Scrum practices are mostly not used individually but as a part of Scrum method. However, the scope of study does not cover this issue in depth. Also only 27% of the companies which participated in the study actually used Scrum.

Kurapati et al. [11] conducted an online survey that shows compliance of industry with XP and Scrum practices. Survey results show that a combination of methodologies is favored as compared to using one methodology with all its practices. They have also found which agile practices and which combinations of agile and Scrum practices are used most commonly by industry practitioners. Both [9] and [10] are although empirical in nature only focus on core practices of Scrum XP and Scrum. They do not go into the depth of Scrum theory and only check for the application of few Scrum practices in inspected organizations. They do not report which practices are not applied and neither the reasons for not applying those practices.

Zieris et al. [12] compared intended way of proceeding with actual process and practices of two Polish Scrum teams. Using Scrum Guide [1] as standard, they closely observed practices of both the teams. Amendments were made into Scrum as per their observation. Some XP practices were added and some new practices were introduced. Added practices included "Pair Programming", "Test Driven Development", "The War Room", "Sync Meeting" and "Code Buddy". However they did not discuss whether these deviations from original method have any positive or negative consequences.

M. Bass [13] have conducted a case study involving 19 practitioners from seven international distributed organizations. The main purpose of this case study was to find out trends in agile process tailoring. XP practices to number of projects graph

was plotted thus showing frequency of usage of each XP practice in different projects and same was done for Scrum. The results show unexpected lack of support for XP practices and momentum for Scrum practices. Not many changes are made to Scrum process i.e. most of the practices are performed in most of the organizations whereas only selected practices of XP are followed. The study however does not reveal level of usage of these practices i.e. if a certain Scrum practice is followed, then to what extent and also what are the consequences of deviating from method.

Eloranta et al. [14] have classified deviations from Scrum into two categories namely ScrumBut and ScrumAnd. "ScrumBut" means improving core practices of Scrum i.e. making changes into core practices. In this case Scrum framework used without utilizing all the practices. Whereas, "ScrumAnd" means, blending additional practices into Scrum. They used two principles derived from Object Oriented Design to determine which one of the two categories a certain project falls under. They refer incomplete adoption of Scrum as one of reasons for low success rate of Scrum projects. They have also introduced Nokia Test [15] which determines to what extent a team claiming to use Scrum is actually using Scrum.

Peterson et al. [16] have conducted a case study in an industrial environment to find out issues and advantages related to agile methods and compared them with state-of-art. The study shows usage of a hybrid method combining principles of various agile methods IID, XP is used by the studied organization. They have further investigated issues and advantages faced due to the usage of each practice and compared them with issues and advantages highlighted by state-of-art. The study shows that Scrum principles of iterations, time boxing, no change in started features, face-to-face interaction, requirement prioritization and frequent integration are favoured. The study however does not investigate why the agile methods were not used in the pure form or what are the pitfalls of leaving some practices. It only investigates advantages and drawbacks of practices used.

Overhage et al. [17] have investigated developer's acceptance or reluctance towards Scrum in real scenarios in depth. The study identifies eleven determinants based on theoretical and empirical findings and introduces a framework based on an extended TAM (Technology Acceptance Model) that can be used to make prediction regarding developer acceptance of Scrum as well as validation of developer acceptance level afterwards.

Ovesen et al. [18] conducted a case study of seven integrated systems development companies and used semi-structured interviews to find out team composition challenges faced by these companies when they implemented Scrum. Since integrated systems development include far more disciplines than software development hence overlapping competences are rare. Having teams with extreme cross-functionality due to so many disciplines involved leads to difficulty in sizing teams. Extreme cross-functionality further leads to issues of communication, synchronization and polarization. The study also cites team co-location and empowerment prescribed by Scrum as an issue. It is shown that companies deviate from Scrum based on their own interpretation and suitability.

2.1.2. Pakistani software industry

In relevance to Pakistani software industry Zaineb et al. [19] have recommended best practices for the restructuring of organizations that are willing to go agile in Pakistani software industry. In context of our study, their study shows variation in Scrum practices of Daily Scrum, Scrum Master role, Increment feedback, Sprint end-date and dedicated Scrum team. The study shows trend of adding inexperienced and untrained resources in Scrum teams in Pakistani software industry. Based on interviews of experienced industry practitioners, for successful implementation of agile, the study recommends training of all team members, going gradually agile by conducting pilot studies, and hiring more personnel so that each team is dedicated to one product backlog.

2.2. Literature Analysis

Table 2.1 : Gap between Scrum theory and practice

Paper ID	Main Focus	Methodologies Addressed	Region Covered	Deviation from Scrum	Causes of Deviation	Consequences
[9]	Deviations from the role of Product Owner in Scrum	Scrum	Iceland	Focuses on deviation from the role of Product Owner	Covered	Covered
[10]	Extent of adoption of XP	XP and Scrum	Europe (Belgium	Indicates method specific	Not covered	Not covered

	and Scrum in European embedded software industry		, Bulgaria Finland, France, Italy, Netherlands, Slovenia, Spain)	use of Scrum practices at surface level		
[11]	Team composition challenges faced by companies while implementing Scrum in integrated software development	Scrum	Sweden	Brief deviation covered	Not covered	Not covered
[12]	Deviation from Scrum in distributed teams	Scrum and XP	Poland	Deviation in distributed scenarios	Covered	Not covered
[13]	Find out trends in agile process tailoring	Scrum	Banglore, India, London, UK	Like [4], pitfalls not investigated	Not covered	Not covered
[14]	Investigate the malpractices from Scrum in the form of anti-patterns	Scrum	Finland	Only limited to small companies	Covered	Covered
[16]	Advantages and disadvantages of using certain Agile practices	IID, XP, Scrum	Sweden	Advantages and disadvantages of using certain Scrum practices	Covered	Covered
[17]	Developer perception of Agile methods	Scrum	Germany	The barriers in adoption to Agile	Covered	Not covered

[18]	Use of Scrum in integrated software development	Scrum	Germany	Integrated software development addressed	Covered	Covered
[19]	Best practices for organizations that practice Agile	Agile methods	Pakistan	Agile practices and Malpractices	Not Covered	Not covered

From the analysis of literature (Table 2.1), it can be seen that there exist many studies that compare core principles/practices of Scrum with how the method is actually applied in the industry. However there are limitations that can be observed in these studies. According to our knowledge, none of the currently conducted studies covers all the practices from Scrum theory and none of these studies goes into the depth of Scrum theory i.e. into the details of Scrum practices provided in the Scrum Guide. Also, post deviation identification none of the related articles propose any solution for the problem even though deviation is deemed harmful [7].

Another gap observed is that despite being the most common agile method used, we rarely see any studies on Scrum beyond the adoption stage. Especially in the context of Pakistani software industry we hardly see studies that explore Scrum process implementation at all.

Hence through this study, we tried to analyse and present a solution to the gap between Scrum theory and practice in Pakistan.

3. Research Methodology

This chapter is about research design which comprised of research aim, approach, method, phases and data collection.

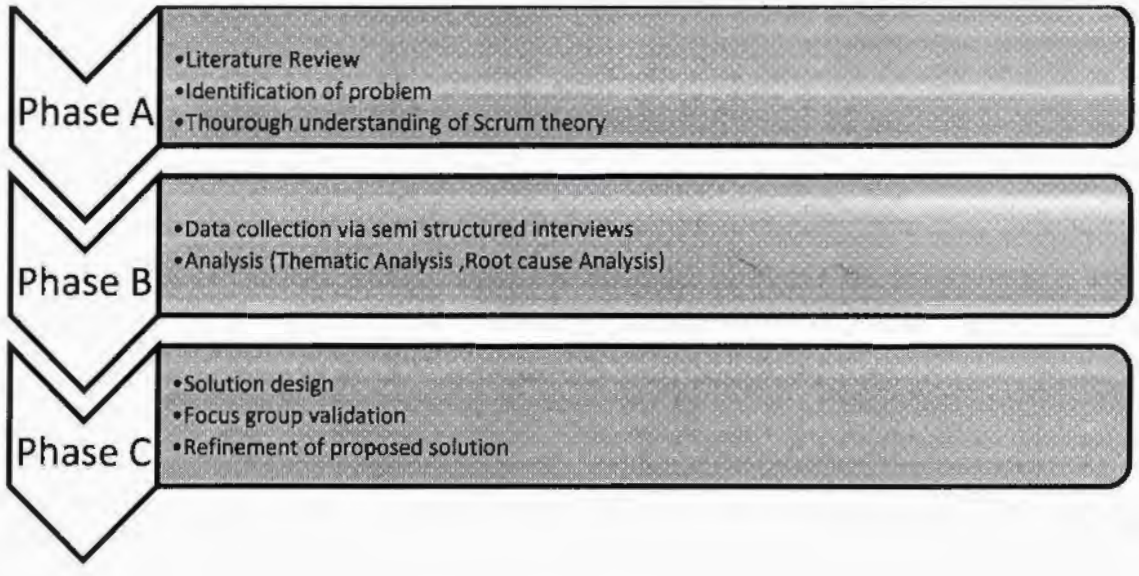


Figure 3.1: Research Design

The research has been divided into three different phases (Figure 3.1). Phases A consists of exploring related work on Scrum to reveal the gap. Semi-structured interviews were conducted on Scrum practitioners in various software houses in Pakistan in the Phase B, also analysis was performed on the collected data. Phase C comprises proposal of a solution for the industry, their validation via experts in a focus group discussion and refinement of the solution.

3.1. Research Aim

Main goal of the research was to add to existing literature on Scrum by giving a set of guidelines to help reduce the gap between Scrum theory and practice. Existing literature showed that deviation is done by the practitioners [9-19] and deviation (unless done with experience) is deemed harmful [2]. Identification of causes was mandatory to give the solution and consequences were identified to see the exact effect of deviation.

3.2. Phases of Research

Following steps were performed to identify the problem.

3.2.1. Phase A

First phase of our research is comprised of following things.

Step-1 Literature Review

Research was started with a review of literature (Figure 2.1). Different digital libraries including IEEE Xplore, ResearchGate, SpringerLink, ACM digital library were explored to identify the literature on Scrum practice. The criterion of selection was relevance to the research topic.

Step-2 Understanding of Scrum Theory

Scrum [1][2] is an agile framework in which a software is developed incrementally via short iterations lasting from one to four weeks. Introduced by Jeff Sutherland and Ken Schwaber, the framework's main emphasis is on changing the work environment and mind set of teams, making them cross-functional and self-organizing. It's not a method to develop software, rather a framework in which various methods can be employed. Consisting of roles, artifacts and events that constitute the method, it has some specified rules that bind them together. Unlike traditional methodologies e.g. waterfall, Scrum is about learning from past experiences rather than following a predetermined plan of action.

Scrum's popularity lies in its promise to deliver product with elevated quality in a short interval of time. Unlike traditional methodologies, Scrum focuses on making sure that actual needs of the customer are met by emphasizing on close collaboration with customer and repetitive evaluation of releasable software every sprint. But despite the fact that Scrum is simple and easy to understand, mastering Scrum is not easy. It requires training, skill and practice.

Scrum has its roots in *empiricism* [1] or theory of empirical process control. The emphasis of this theory is on the use of sensory experience and evidence for acquisition of knowledge and decision making. Unlike waterfall, there is no predefined set of actions and phases to develop the software in Scrum. The approach

used is iterative and incremental. All of the decisions are based on past experience of the teams. There are three pillars on which the Scrum process is based (Figure 3.2).

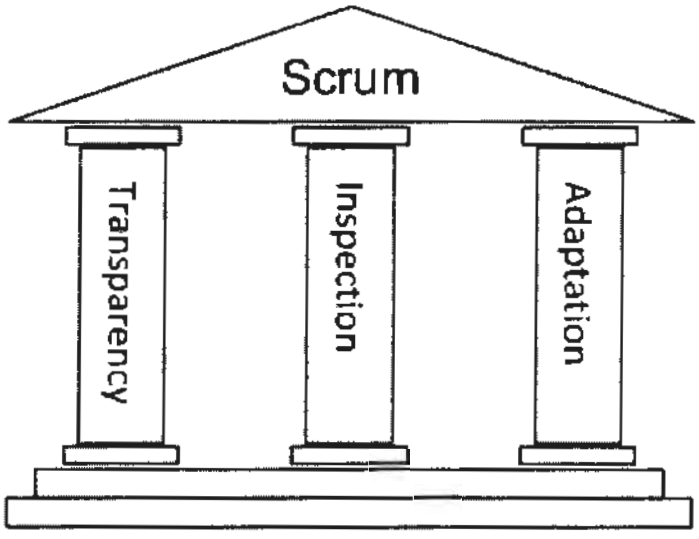


Figure3.2: Pillars of Scrum

- **Transparency**

First and foremost, Scrum requires a shared and common understanding by everyone involved in the process. Everyone involved must be able to see important aspects of the process and they must share a collective standard in order to have a common understanding of what is visible to them. Example of transparency is that everyone involved must have a mutual understanding of what "Done" means.

- **Inspection**

To prevent unwanted changes in Artifacts and goals, users of the process constantly do inspection. However, it is made sure that they do not inspect to an extent that it affects work.

- **Adaptation**

After inspection, if unwanted variances are observed then adaptation is performed accordingly. This is to make sure that the end deliverable is not unacceptable by the users.

Roles events and Artifacts are described in Appendix B.

3.2.2. Phase B-Step 1: Data collection

While conducting qualitative research, many methods exist for data collection. Among the most popular ones are semi-structured interviews [24]. This technique of data collection has various advantages. This technique ensures a deeper understanding of the context and deeper insights as compared to its counterparts. Also, use of an interview guideline ensures a common structure thus making results comparable [24]. Thus this technique was chosen as data collection method for this study.

The data collection process consisted of three phases in which first data collection tool was designed and then tested. Data was gathered and transcribed (Figure 3.3). All three phases are described in the following sections.

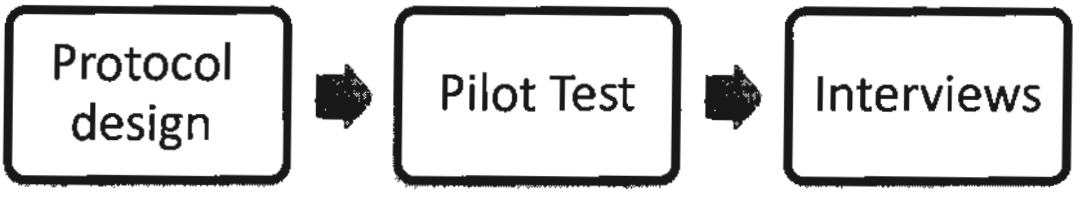


Figure 3.3:Data Collection

❖ **Protocol Design**

After reading the background material on Scrum, initially an interview protocol [24] [25] was prepared in which questions were included related to all Scrum practices (roles, events, artifacts) as described in the Scrum guide [1]. Questions from Nokia Test [15] were also included. A good interview protocol is constructed in a way that the questions asked connect with the informants [25]. Following Spikard's [25] guidelines and keeping the flow of Scrum activities in mind, interview protocol was revised again and questions were re-assembled. The final interview questionnaire consisted of three parts.

- Part A constituted of questions related to
    - The background of the interviewees
    - The organization

- Part B had questions related to inception and background of Scrum within the organization
- Part C consisted of questions related to core Scrum practices as enlisted in the Scrum guide[1].

Except for the closed ended questions related to presence of core practices, most of the questions were mainly open-ended for the purpose of extracting as much information as possible via interviews [24]. To get a better understanding of interview protocol designed for this study, interview guide is provided in AppendixC.

❖ **Pilot Test**

After forming an interview protocol, a pilot test was conducted. A pilot test [27] is a test interview conducted to reveal flaws or problems in the interview design. It helps the researcher assess the interview questionnaire so he or she can make necessary changes before the study is conducted.

Pilot test for this study was conducted with an industry practitioner with educational and research background in Agile and Scrum. The interview lasted 45 minutes. Probing questions were asked whenever needed.

Pilot test revealed a few flaws in the interview design. There was some repetitiveness and some questions needed refinement. Also some new questions were highlighted related to Scrum practices. After the pilot test, interview questionnaire was reviewed and modified accordingly and finalized. Finalized interview questionnaire consisted of 43 questions

❖ **Interviews**

Initially for the purpose of research various well-known software organizations in Pakistan that were known to use agile methods were contacted. The organizations included many well-known software houses and corporate sector organizations. Out of seven contacted organizations known to use agile, five claimed of using Scrum. Response rate was high. Five out of five contacted organizations agreed on letting us study the methodology of their organization. Size of the organizations ranged from Medium **(<250 employees)** to Large **(>250 employees)**

a) Choice of participants:

The goal was to interview Scrum Masters and Developers in the participating organizations but initial screening revealed that in many organizations individuals with the title of manager and project manager assumed Scrum Master responsibilities in the Scrum team. These individuals were also interviewed to get a better understanding of the practice. Table depicts breakdown of interviewee titles

Table 3.1: Participation according to roles

Scrum Master	8
Developer	11
Manager	1
Project Manager	2

b) Execution of interviews

Participants were interviewed over a period of 6 months. Probing questions were asked when needed to get deeper insight. To reveal causes and consequences of deviation, cross-questioning was done.

Total duration of interviews was between 30 to 35 minutes. In order to make sure that no information is lost *taping* was used to record the interviews.

Table 3.2: Participation across cities in Pakistan

Total	Lahore	Karachi	Islamabad
22	2	2	18

c) Problems faced

The study required data to be collected from all over Pakistan and participants from cities besides Islamabad were hard to get to. LinkedIn was used to reach out to people to resolve the issue and Skype was used for online interviewing.

3.2.3. Phase B-Step 2: Analysis and Result

Various methods are used for the purpose ofanalysing data within primary qualitative research. The selection of analysis method depends on technique used in primary

research [48]. Thematic network analysis [23] and root cause analysis [28] techniques were two different techniques used.

3.2.3.1.Thematic network analysis

One the most frequently used methods for analysing data is thematic network analysis [23]. This particular technique of data analysis has gained increasimg popularity over the past few years. The reason for its popularity is that it can be used with most of the qualitative research methods. Thematic network analysis is a data analysis approach deemed suitable for developing understanding and performing analysis of qualitative data gathered via interviews. In this technique of data analysis, patterns or themes are identified within the text and meaning is explored. As data for this exploratory study was gathered via Interviews, thematic network analysis technique was chosen for qualitative analysis.

Thematic network analysis is a six step process (Figure 3.4) in which first category codes from data are identified and then thematic network is developed based on themes of information identified from data. Then thematic network is then described, summarized and finally interpreted.

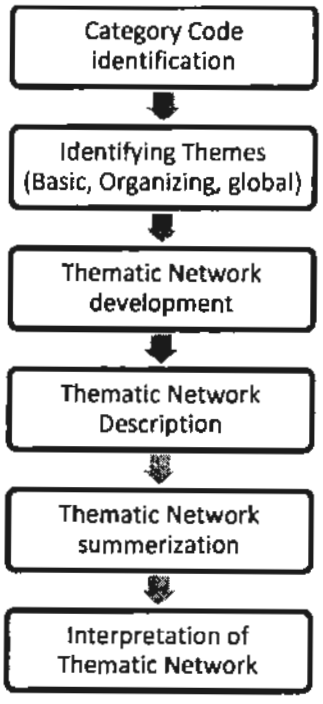


Figure 3.4: Thematic Network Analysis

Data from primary studies such as interviews consists of numerous concepts that need some refinement and restructuring to answer the research question. The first step of thematic network analysis consists of identifying category codes. A category code is a suitable name that represents a set of related concepts in interview text. The purpose of this step is group concepts into manageable chunks on basis of which a thematic network can be established. Second step is development of thematic network based on concepts in each category. Thematic network consists of themes at three levels. Lowest level theme is basic theme that groups concepts under a concept category at lowest level. A set of basic themes is further grouped into an organizing theme and finally a set of organizing themes are grouped into a global theme which is the highest level theme. This way a network of themes is developed by analysis concepts repeatedly (Figure 3.5).

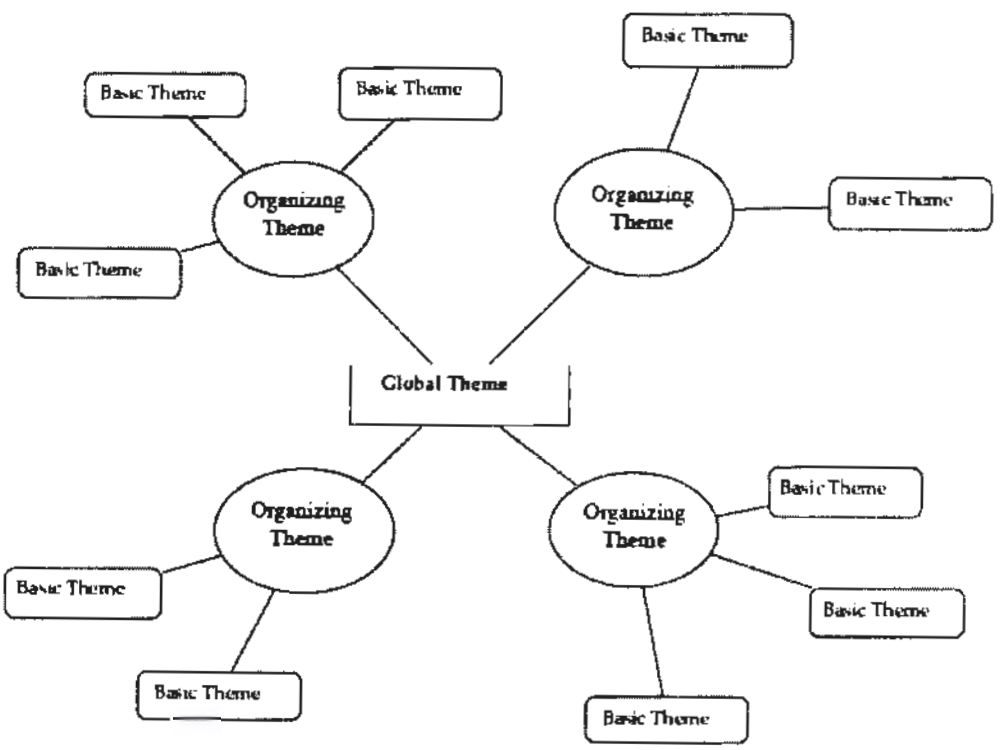


Figure3.5: Thematic network analysis

Chapter 4 has details of how thematic network analysis is used to identify

a) Deviation
b) Deviation consequences

3.2.3.2 Root Cause Analysis

Root cause analysis (RCA) [28] is a technique used to get to the underlying causes of a problem thus facilitating most effective solution. There are three fundamental things identified in order to perform RCA:

a) The problem
b) Reason for the occurrence
c) Preventive measures for the future

3.2.3.3 Data Analysis steps

Following steps were performed on the interview data in the analysis phase:

1. Deviation was identified as basic themes by using thematic network analysis
2. Causes of deviation were identified by re-analysing the data for each deviation
3. Root cause analysis was performed on the identified causes to get to the bottom of the problem
4. Consequences of deviation were identified. Again, by re-analysing the data for each deviation

The detailed analysis is provided in chapter 4.

3.2.4. Solution design

A set of guidelines was designed to target the root causes identified in the previous step. These guidelines were extracted from three main sources:

1. Literary articles based on experiences of teams using Scrum
2. Interviewed teams working successfully with Scrum
3. Literary best practices

Once designed, these guidelines were represented using SEMAT kernel and language [43].

3.2.5. Focus Group Validation

Once solution was designed, it was validated via a focus group of experts. Focus Group [17] is a research method that along with other uses can be used for evaluation of potential solutions, based on practitioner or user feedback.

3.2.5.1.Focus group guide

At first agenda was set for the focus group and guiding questions were formed. The questions were mainly related to assessment of experts on the usefulness of the solution and the language of definition. The detailed guide is provided in the Appendix E.

3.2.5.2.Choosing participants

Scrum experts in different software houses were approached for participating in the focus group. Initially 10 experts agreed to participate but in the end 8 experts actively participated in the discussion. The average experience of experts was 4.4 years.

3.2.5.3.Execution

Bulletin board format [47] of online focus group was chosen due to the facts that it wasn't possible to gather all experts under one roof for the discussion. An online forum was chosen to facilitate the discussion.

3.2.5.4.Refinement of the proposed solution

Solution was revised under the light of expert suggestion. Two changes were made in the solution.

- Organizational goal clause was made a part of the solution
- Solution was made customizable by the users

Details are provided in chapter 5.

4. Analysis and Results

After gathering the data from 22 semi-structured interviews, data was analysed in the light of research questions identified (Figure 4.1). At first interviews were analysed for deviation, then causes and consequences of those deviation were identified.

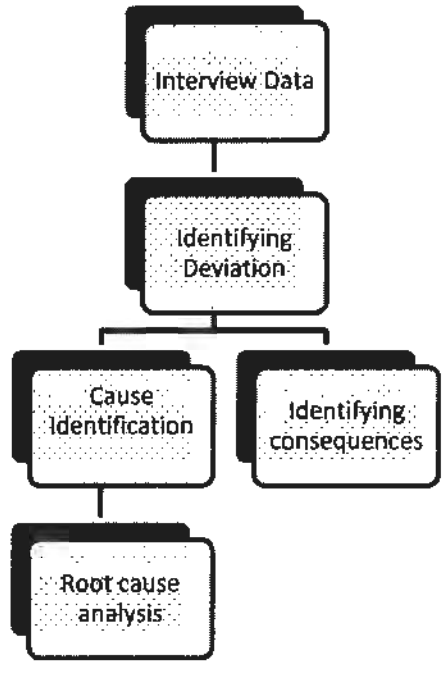


Figure4.1: Data Analysis

4.1. Deviation from Scrum theory

To identify deviation, thematic network analysis technique was used. Category codes are usually derived based on theory on which research questions are based [1]. Since the interview protocol was designed based on Scrum theory [1] [2], Scrum practices described in Scrum guide [1] were used in analysis as category codes. Based on Scrum practices in Scrum theory, data was grouped into eleven category codes: Three of these category codes representing deviation from Scrum roles of Scrum Master, product owner and development team, three representing deviations from Scrum artifacts of Product Backlog, Sprint backlog and Increment, one representing deviation from the Sprint and three representing deviations from Scrum events of Sprint Planning, Sprint Review and Daily Scrum. One category of additional practices was identified from interview data. This category represented practices added to the Scrum process of teams besides the recommended practices. Initially interviews were analyzed and 35 concepts related to the first research question were found and

arranged under eleven categories. By the application of thematic network analysis 35 concepts based on eleven concept categories were reduced to 17 basic themes. (Table 4.1)

Table 4.1: Deviation from Scrum theory

Category Code	Underlying Knowledge	Basic Themes
Deviation in Product Owner role	• No Product Owner role in the Scrum Team	• **Product Owner does not exist**
Deviation in Scrum Master role	• Scrum Master does not exist • Scrum Master is called the Manager • Scrum Master is called Project Manager • Scrum Master is doing most of Product Owner's role	• **Scrum Master does not exist** • **Scrum Master is not called the Scrum Master** • **Scrum Master is partial Product Owner**
Deviation in the Development Team	• Everyone in the Development Team does role specific tasks and are known by their respective roles e.g. QA does testing, Developer does coding • Scrum Master assigns tasks to the Development Team • Project Manager assigns and monitors of the Development Team • Product Owner divides and assigns work to the Development Team • Team lead assigns and monitors work of the Development Team • Testing team is separate from the Development Team • Testers are not part of the Development Team • Separate team for separate purposes. Requirement gathering team, Quality Assurance team and the Developer Team	• **Role specific titles for the Development Team members** • **The Development Team is not self-organizing** • **The Development Team is not cross-functional**
Deviation in Sprint	• Product Not developed in	• **Product not**

	Sprints • Progress not monitored	**developed in Sprints** • **Progress not monitored**
Deviation in sprint planning meeting	• Sprint planning meeting not held and release planning meeting held only • Scrum Master performs estimation • Team lead performs estimation • Project Manager performs estimation • Manager performs estimation	• **Sprint planning meeting not held** • **Estimation is not performed by the Development Team**
Deviation in Daily Scrum	• Not held	• **Daily Scrum Not held**
Deviation in Sprint Review	• Development Team does not participate • Release meeting held only and Review meeting is never held	• **Sprint review meeting not held**
Deviation in Sprint Retrospective	• Not held	• **Sprint Retrospective not held**
Deviation in Product Backlog	• No Product Backlog • Big Requirement documents used • Agreement document used	• **Product Backlog is not used**
Deviation in Sprint Backlog	• No Sprint Backlog	• **Sprint Backlog not used**
Deviation in Increment	• No Definition of done used by the Scrum Team	• **Definition of Done not used**

The most common deviation found through the first step of analysis was the use of "Role specific titles for Development Team members" (Table 4.2). This deviation is practiced by 18 out of 22 teams interviewed. This practice is closely followed by "Team is not self-organizing" deviation occurring in 15 out of 22 cases. Other notable

deviations observed include "Product Owner does not exist", "Definition of Done not used", "Development Team is not cross-functional".

Table4.2: Deviation from Scrum Theory-Summery

Sr.	Deviation	Frequency	Percentage
1.	Role specific titles for Development team members	18	73%
2.	Development Team is not self-organizing	15	68%
3.	Progress not monitored	13	59%
4.	Definition of Done not used	13	59%
5.	Development Team is not cross-functional	13	59%
6.	Sprint retrospective not held	11	50%
7.	Product Owner does not exist	10	45%
8.	Scrum Master is partial Product Owner	10	45%
9.	Estimation is not performed by the Development Team	8	36%
10	Sprint Review not held	8	36%
11	Product Backlog not used	7	32%
12	Sprint Backlog not used	7	32%
13	Requirements are signed off	7	32%
14	Daily Scrum not held	6	27%
15	Scrum Master is not called Scrum Master	6	27%
16	Scrum Master does not exist	2	9%
17	Product not developed in Sprints	2	9%

The thematic network analysis was only used till the second step as it served the required purpose and then causes of deviation were investigated.

4.2. The "WHY" of Deviation

Once deviations were identified, the next step was investigating into causes and consequences of those deviation. Interview data was re-analysed for that purpose.

4.2.1. Identification of deviation causes

For each deviation, causes were identified by looking at the data transcription. Follow-up questions were asked from interviewees via email when needed. (Table 4.3)

Table4.3:Causes of Deviation

Deviation	Cause
• **Product Owner does not exist**	• Role of Product Owner does not fit into the organizational structure • Assigning a dedicated resource as Product Owner for Scrum projects is not very cost effective • Not aware of the role of Product Owner in Scrum
• **Scrum Master does not exist**	• Not aware of the role of Scrum Master in Scrum
• **Scrum Master is partial Product Owner**	• Product Owner is off site so Scrum Master is performing his responsibilities. • No Product Owner so Scrum Master is doing Product Owner's duties
• **Scrum Master not called Scrum Master**	• After transition to Scrum, Manager was assigned the role of Scrum Master and did not feel the need to change his title • Multi-methodological environment. Not possible to use Scrum specific terminology as it creates confusion
• **Role specific titles for Development Team members**	• Team does not know that in the Development team in Scrum, only title for individuals is "Developer", no exceptions
• **Development Team is not self-organizing**	• According to the Team, Scrum Master is more experienced and hence assigns and manages the work of team members. Not aware of teams' self-organization in Scrum • Functional heads assign and manage work. Self-organization not known • Team does not know about self-organization. Product Owner has experience so he assigns and controls work • Not aware of Development Team self-organization. Technical leads assigns work and the team is accountable to

	them
• **Development Team is not cross-functional**	• Separate testing team as environment is multi-methodological and it is costly to break the team and assign testers to individual Scrum Teams • Tester are work at home and they are paid by product per hour. Hiring new dedicated resources will be costly • Separate team for separate purposes. Requirement gathering team, Quality Assurance team and Developer Team. Not aware that Development Team should be one cross-functional team
• **Product not developed in Sprints**	• Not aware of what Sprints are
• **Estimation is not performed by the Development Team**	• Project Manager is far more experienced and so he performs estimates. Not aware that Development Team is supposed to do estimation • Manager performs estimation as he is more experienced. Not aware that Development Team performs estimation in Scrum. • Development leads perform the estimation. When asked why does not the team perform estimation, answer was that the Development Team cannot be trusted with estimates as there is a chance that they will over-estimate. Not aware that in Scrum, Development Team is encouraged to give estimates
• **Progress not monitored**	• Some charts are auto generated but the team does not know their purpose • Team oblivious to use of progress or burn down charts • The concept is hard to comprehend hence it was dropped.
• **Daily Scrum Not held**	• It is not very cost effective as work is not always presentable at the end of the day so no point of such meeting. It is just wasting time of developers • Team does not know about Daily Scrum. No idea what that is or what is its purpose
• **Sprint Review not held**	• Product moves to staging server after development and released after testing on a pre-determined schedule. Not aware of Sprint Review
• **Sprint Retrospective not held**	• Not emphasized. It's an extra. Do not see point of it • Team does not know the concept of Sprint Retrospective

• **Product Backlog not used**	• Not a part their process. Prototyping used • Requirement documents used instead. Team does not know about product backlog
• **Sprint Backlog not used**	• PDP used in which manager assigns the tasks to team members. No special tool is used since it's the way things are from the beginning. • Team does not know about Sprint Backlog
• **Definition of Done not used**	• Not a part of the process. Team is not aware of what it is or what it is used for
• **Requirements are signed off**	• Customer requests too many alterations in the system. A sign off is taken after agreeing upon requirements and the customer pays for extra changes

4.2.2. Root cause Analysis

Once causes of deviation were identified, Root Cause Analysis (RCA) [24] was performed. RCA is used to get deeper insight into the problem at hand so that solution can be identified.

4.2.2.1.5-Why analysis

5-Why Analysis [28] technique of RCA was used as causes were identifies via interviews. 5-Why Analysis is a Six Sigma technique in which why to a cause is recurrently asked until the root cause is reached. It is usually performed up till the fifth level but it can also require more why's to reach the root cause. An Excel tool designed by Bulsuk et al. [29] was used to perform 5 why analysis (Figure 4.2).

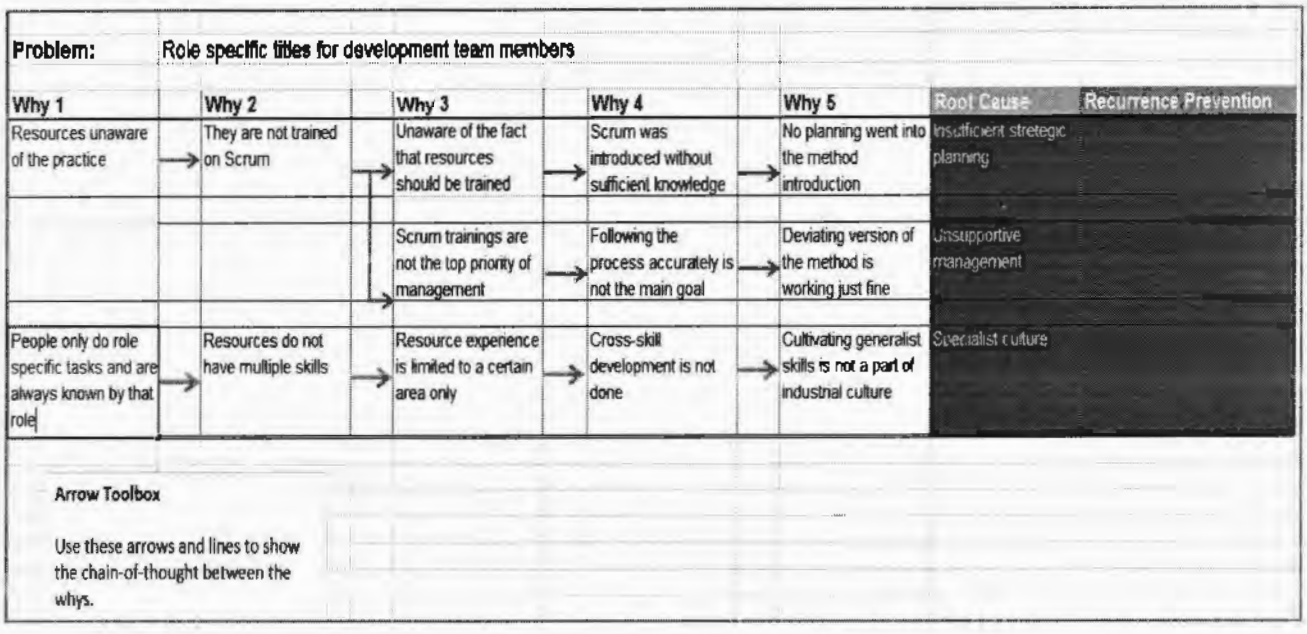


Figure4.2: 5-Why analysis

Eight root-causes of deviation were identified as a result of RCA.

4.2.3.Root cause analysis representation

To have a more clear picture of root cause analysis RAWGraphs [30] tool was used.

4.2.3.2RAWGraphs

RAWGraphs is a data visualization tool available online. Graph of root causes was plotted against deviation by uploading data on the website resulting in a visual representation of RCA (Figure 4.3), thickness of the lines represent how frequently certain root cause occurs for a deviation.

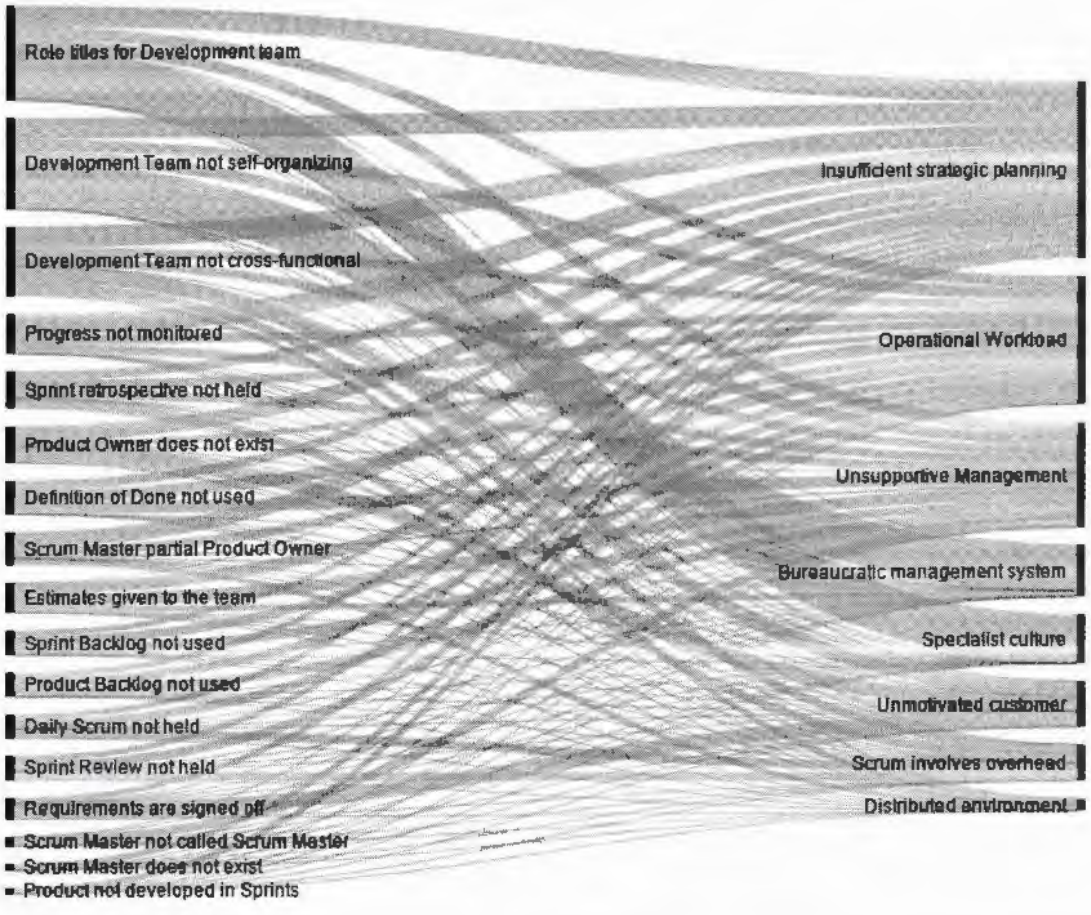


Figure4.3: RCA Visual

4.3 Consequences of deviation

When it came to identification of consequences, Thematic Network Analysis Technique was used again and this time all steps were applied. Full details of analysis are provided in **Appendix D.** Analysis revealed in four global themes

1. Positive impact reported
2. Adverse impact noted
3. Adverse impact reported
4. Impact could not be determined

Results indicated that mostly deviation resulted in negative consequences.

CHAPTER 5

5. Validation of Proposed Solution

This chapter is dedicated to the proposed solution and validation of it by experts. Solution comprises of a set of guidelines which were transferred into a tool used to represent practices and guidelines called Esswork Practice Workbench [45]. SEMAT kernel and language [43] was used to represent the solution in above mentioned tool. Solution was then validated by field experts in Scrum from Pakistani software industry.

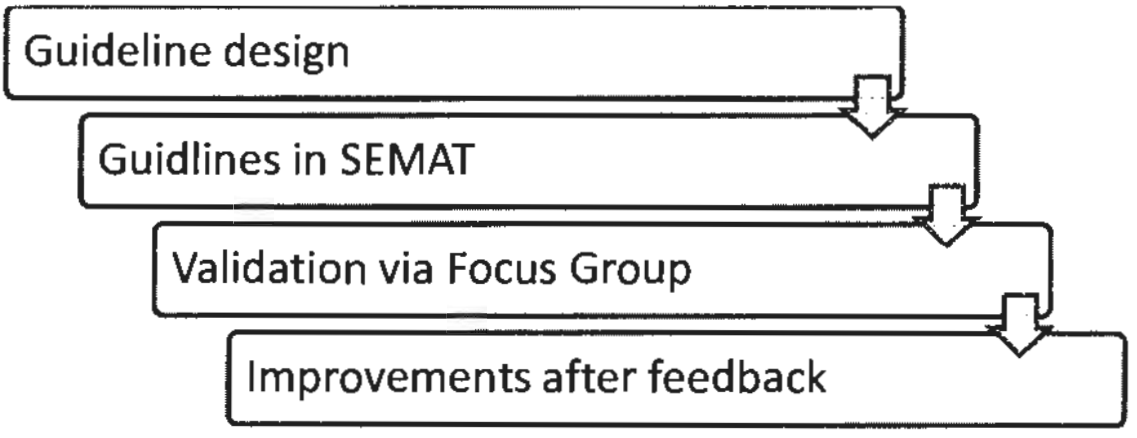


Figure 5.1: Validation steps

5.1. Proposed Guidelines

Once the analysis was complete, a set of guidelines were devised to target the identified root causes of deviation. Sources of the guidelines are as follows:

1) Literary articles based on experiences of teams using Scrum
2) Interviewed teams working successfully with Scrum
3) Literary best practices

Guidelines consisted of three phases of Scrum implementation (Figure 5.2). Idea was to design a systematic approach to help reduce deviation.

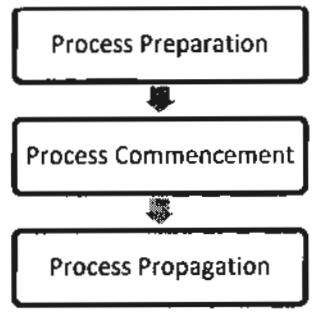


Figure 5.2: Solution Phases

5.1.1 Process preparation

- **Investing in the process:**

  Currently upper management is reluctant to spend on Scrum trainings for resources. They are not convinced that spending on the process is worth the monetary investment. Which is reflected by the fact that only 32% of the Scrum Masters from the interviewed teams have been provided trainings.

  - **Management persuasion**

    Approval by upper management is critical for any investment on processes. Hajjdiab et al. [33] have pointed out that a presentation or a meeting with the upper management introducing the methodology and also the benefits of process investment will help mitigate the issue.

  - **Reducing work pressure for dedicated Scrum adoption**

    Operational work pressure is another root cause of deviation. Resources are so dedicated to the operational work and fire fighting that they cannot be trained on the process. One solution suggested by Hajjdiab et al. [33] is investment of more time in agile adoption by reducing the workload for a set period of time. Scrum implementation cannot be rushed as it must be preceded by an organizational change. The time investment will eventually payback once the team gets functional with Scrum.

- **Strategic Planning**

  The main root cause of deviation being the lack of strategic planning prior to the adoption of the method, it is vital that environment is prepared prior to the introduction of the method. Different organizations choose to go about Scrum

in their own manner and there is no standard recipe that works for everyone. Haque et al. [34] chose to introduce Scrum incrementally in their setup. Key is to do some sort of planning prior to implementing Scrum in the organization.

- **Introducing the Play Zero**
  Ken Schwaber [39] presented a series of steps that should be undertaken prior to the commencement of Scrum in the organization. This stage called Play Zero is done at the organizational level.

  - **Play Zero Stage 1-Overview and Assessment**

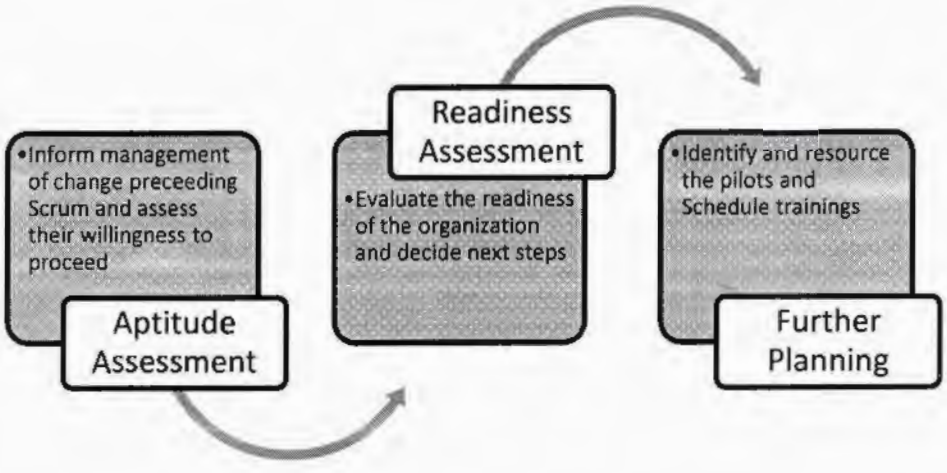


Figure5.3: Play Zero-Stage 1

Play zero's first stage (Figure 5.3) comprises of three steps of aptitude assessment, readiness assessment and further planning. In the first step management is informed of the changes that Scrum requires within the management hirarchy of the organization and assessed how much they are willing to undertake the chaneg. After the first step organzaiton's statefor Scrum is checked and the next steps are assessed accordingly. After that resources and projects are allocated fohr pilots

- **Play Zero Stage 2 - Pilot Preparation**

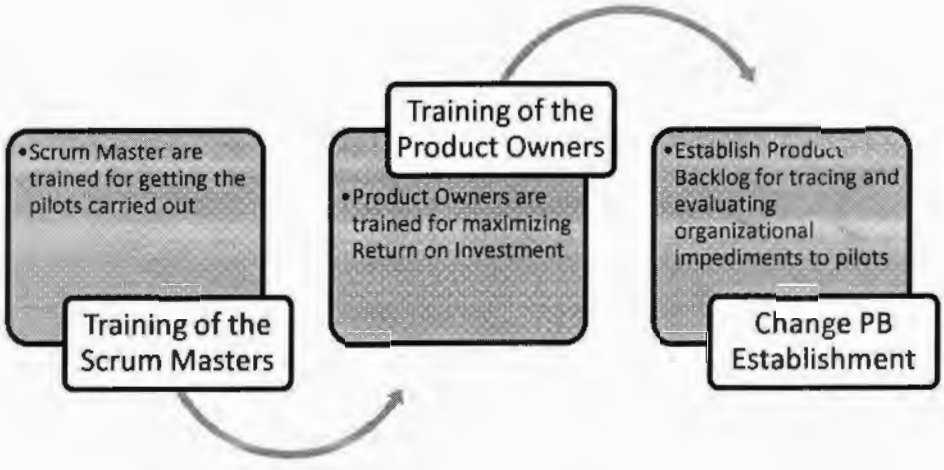


Figure5.4: Play Zero-stage 2

Stage two of play zero (Figure 5.4) also comprises of three steps. In the first step Scrum Masters are trained to carry out the pilots followed the second step which comprises training of product owners and lastly in step three product backlog for tracing and evaluation of impediments is established.

- **Customer involvement**

  50% of the teams report unwillingness and lack of customer involvement which poses issues in customer-driven projects. Most issues posed are related to ambiguous requirements and resulting rework. Team P Scrum Master states

  "When these people [customers] are not there, actually see the product after a few sprints, cause problems as they don't have the complete picture "

  Main reason being, customers just don't see the point of being constantly involved in an agile project. It requires effort and time from customer's part. As traditional methodologies don't demand this of the customer so they don't particularly support agile teams. Here are some contingencies practiced by agile teams [35] to deal with this lack of collaboration from customer's end.

  - **Selling advantages**
    Letting the customer know how agile is beneficial over traditional contracts might get the customer to change his mind about agile. Once the idea of agile clicks, they might want to get more involved.

- **Changing requirement priority**
  Due to the lack of customer involvement, sometimes the team makes assumptions about requirements thus creating features that the customer did not want. A remedial strategy is to change the priority of ambiguous features awaiting clarification and build features that have more distinct features.
- **Pay for collaboration:**
  One interesting strategy used by the teams is to assess the level at which the customer was going to be involved in the before project initiation. This allow teams to evaluate potential risks to the agility of the project due to the lack of customer involvement. If the level of involvement is low then the solution is to pay the customer for his collaboration through the duration of the project from a part of project funding.
- **Customer proxy**
  In a situation in which customer is willing to collaborate but he doesn't necessarily want to be a product owner, someone from the team is assigned the role of customer proxy. The job of customer proxy is to serve as the communication link between the team and the customer. The duties include requirement clarification, eliciting feedback etc.
- **Frequent demonstration**
  Frequent demonstration is another means to ensure at least some level of customer involvement in the project. If the customer does not clarify requirements when needed, it is a good idea to elicit his feedback by frequent demos. This way the team stays on trackand also the team knows what the customer wants exactly.

5.1.2. Process commencement

- **Conducting pilot(s)**

  Literature supports commencement of Scrum in the organization with a pilot project prior to the organization-wide implementation [33]. In the industry however, Scrum was introduced in all the teams without this crucial step. Organizations should conduct a pure Scrum project before organization-wide implementation.

- **Choosing the right pilot**
  When it comes to choosing a pilot project, there are a few things that must come under consideration [33]
  a. The pilot should span around the middle of average length of projects conducted
  b. It should be small enough to be doable by one team
  c. It should not be a critical project

- **Pilot assessment**

While conducting the pilot [39], plans are assessed and adjusted. Impediments are evaluated. After conducting the pilot project successfully, retrospective is performed to see what went right and what improvements can be made. ROI is assessed.

- **Organizational expansion**

The outcome of pilot(s) [39] is made available to everyone and based on the outcome and assessment of the outcome, development projects are started within the organization. There are some values that need to be established in the organization and the Scum Team. The culture change that Scrum requires to flourish as the process of the organization comes with time and effort.

- **From bureaucracy to autonomy**

Currently many organizations have 'command and control' management which prevents teams from achieving Scrum goals of self-organization and team empowerment. Expecting organizational culture to change overnight is not the solution. The remedy to this problem [31] [32] is team autonomy. Chung et. al [32] have presented a scenario in which a Scrum team at Yahoo managed to thrive in predominantly command and control culture. The team started off with strong agile leadership from a highly experienced Scrum Master. With the right guidance, the team achieved autonomy in decision making overtime. Their self-management helped them eliminate barriers to autonomy that came from bureaucratic system. Also the team successfully eliminated attempts to micromanagement from a subsequent Scrum Master.

- **Removal of stringency in roles:**
  One other problem that comes in the way of team autonomy is existence of role specific titles which exist in 73% of the interviewed teams. Team members end up doing role specific tasks i.e. a developer will solely do development and tester will solely do testing. Further analysis revealed that certain SDLC phases were always assigned to specific people i.e. certain people only did interface design, database design etc. A mitigation strategy could be promotion of generalists organization wide [31]. Cross-skill development would also help rid teams of specialist culture.

- **Handling distribution:**

  - **Tool support:**
    To keep everyone on the team on board, Scrum in distributed environment needs a proper tool for collaboration. Currently 75% of the distributed teams use emails to collaborate with offshore client and there is no central repository of data for transparency to prevail. Rayhan et al.[34] have described a success story of how a team enhanced Basecamp to handle this issue of distribution. Teams can use the tool that suits them the most or tailor any tool to their needs. Teams **J** and **K** who have PO residing abroad are using TFS as collaboration tool in this distributed environment successfully.
  - **Synchronizing work hours:**
    85% of the teams report having issues due to the time zone difference. Teams **J** and **K** have resolved this issue by changing the working hours according to the US time. They have the developers work at night thus removing communication gap created by time zone difference.

5.1.3 Process Propagation

- **Method Assessment and retrospective**

  - **Measuring progress with Scrum**

    2013 state of Scrum recommends [36] that measuring the progress of the projects undertaken by the organization through Scrum vs other methods might help organizations realize what suits them best.

- **Exposing the impediments in Scrum's way:**
  Forte of Scrum is its ability to self-improve as a process. It exposes the impediments to its successful usage over a period of time [39]. It highlights what needs to be changed in the organization for the method to flourish. The key is to use Scrum as a process for implementation and scaling of Scrum in the organization.

  Method retrospective reveals these impediments. Advanced skill training of Scrum Masters equips them to handle these impediments in Scrum's way over time .

- **Handling the *Smells*over time**

One issue that arises over time with Scrum is that the teams start to deviate away from core of the method. As a result they start to experience the *smells* [40] which is essentially an indicator that something might be going wrong. An experienced Scrum Master promptly acts at an indication of such issues and checks what is the real cause of the problem.

- **Making continuous learning tools available**
  Onex issue is that the interviewed teams complained about Scrum involving "too much overhead". Mike Cohn [41] believes that such complains are indication of something else entirely. The team is either not used to a process, they do not understand the practice or they are doing something incorrectly.

  One reason that the team may feel overwhelmed by Scrum is that that going Scrum was a decision externally pushed upon the team [41] i.e. they were not convinced to do the method and reason for doing certain practices. As it is apparent in most interviewed cases, the teams were not introduced to the method formally. One possible remedy is to introduce the "why" of the practice to them. Knowing the reason for a certain practice will help them reap more benefits from it as they'll work with conviction. One suggested tool for this purpose is Agile Meeting Cube [42]. It is a comprehensive continuous learning tool at team's disposal. It provides teams with the "why" of Scrum events along with the a set of tools that can be used for further learning, outcome expected and a checklist to use with them.

- **Making deviation drawbacks known**

  Ken Schwaber, one of the founders of the Scrum process, advocates strict adherence to Scrum's core practices until Scrum works well in the organization. However, as observed through the course of this study, the deviations are hardly ever based on experience. This study aims to bring out hurdles to realize full benefits of the method due to deviation from theory. For them to reap full benefits of Scrum in its pure form, such studies should be made accessible to the organizations practicing the method or rather mal-practicing the method.

5.2. Guidelines-Root Cause relationship

Although guidelines were designed to be systematic, certain clauses specifically target particular root causes (Table 5.1)

Table5.1: Guidelines and targeted root causes

Guideline Clause	*Targeted Root Cause*
Management persuasion	**Unsupportive Management**
Reducing work pressure for dedicated Scrum adoption	**Operational workload**
Introducing the Play Zero	**Insufficient strategic planning**
Removal of stringency in roles	**Specialist culture**
From bureaucracy to autonomy	**Bureaucratic management system**
• *Selling Advantages* • *Customer proxy* *Frequent demonstration* • *Pay for collaboration* • *Change requirement priority*	**Unmotivated customer**
Making continuous learning tools available	**Scrum involves overhead**

• *Tool support* • *Synchronizing work hours*	**Distributed environment**

5.3. Solution in SEMAT

When it came to solution representation, we chose SEMATkernel and language [43]. SEMAT is a community of people working to standardize software engineering discipline since 2009. The idea is to truly empower practitioners by helping them share their best practices. Main output of SEMAT is a standard kernel that can be extended to represent methods and practices. SEMAT kernel can be used to represent methods and practices. SEMAT help was consulted via email to check if SEMAT could be used to represent our guidelines. Their response was affirmative as SEMAT has been used to represent method implementation guidelines in the past.

5.3.1. SEMAT kernel

SEMAT kernel comprises widely agreed upon objects called the alphas (things to work with). A standard set of alphas has been defined (Figure 5.5), however extensibility allows users to define custom alphas.

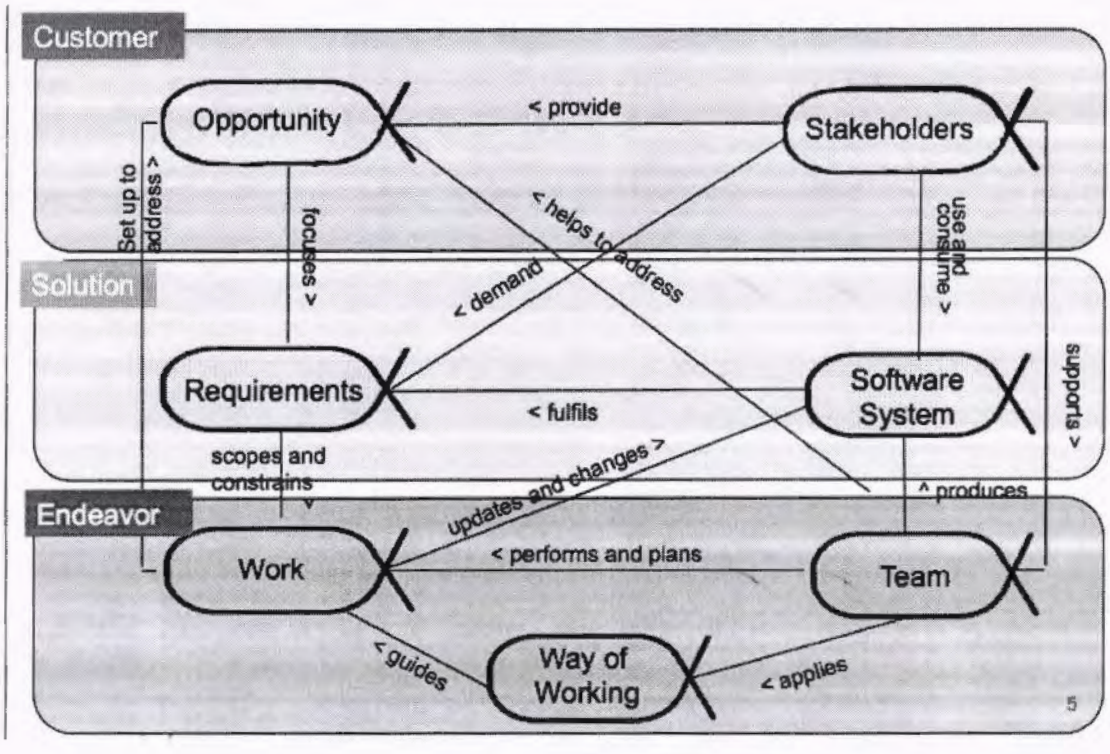


Figure 5.5:SEMAT Alphas

Associated with each alpha is a state that represents a certain scenario in the lifespan of an alpha [43]. Associated with each state is a set of checklists that must hold true for alpha to exist in a certain state. Another important concept is Activity [43] which represents things to do.

Elvesæter et al. [46] represented Scrum in SEMAT. Sprint is defined as an extension of work alpha and events are defined as activities. Scrum roles are defined as patterns.

5.3.2. Compliant Scrum

After gaining an understanding of SEMAT, guidelines were re-written in SEMAT. The solution was named Compliant Scrum for ease of reference. Guidelines were defined in SEMAT in a four step (Figure 5.6). In the first step relevant kernel alphas from the standard SEMAT kernel were identified thus outlining Compliant Scrum. Next step was to definition of compliant Scrum . After that activates were defined that constituted that contained the method to achieve the checklist of the sub-alpha.

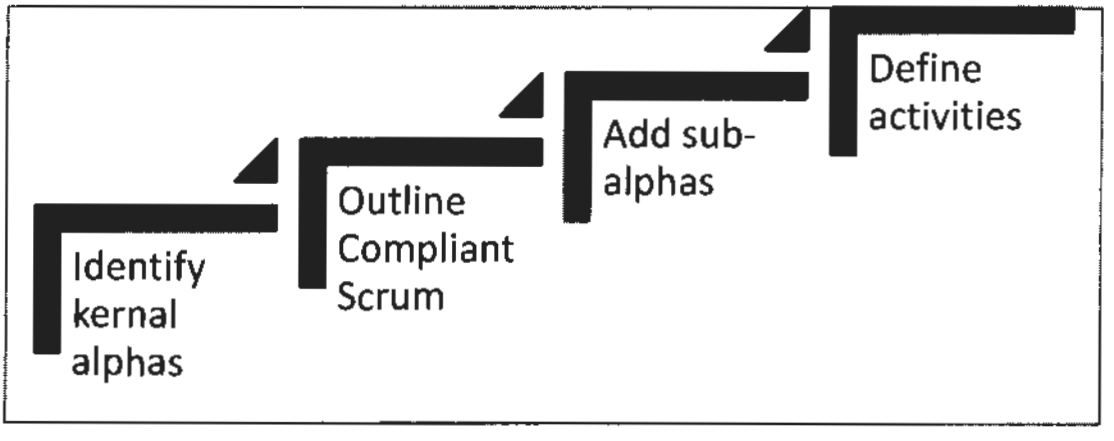


Figure 5.6: Defining Compliant Scrum

5.3.2.1 Identify relevant kernel alphas

First step was identification of alphas relevant to the solution. The alphas mentioned directly or indirectly in the guidelines were highlighted. (Figure 5.7)

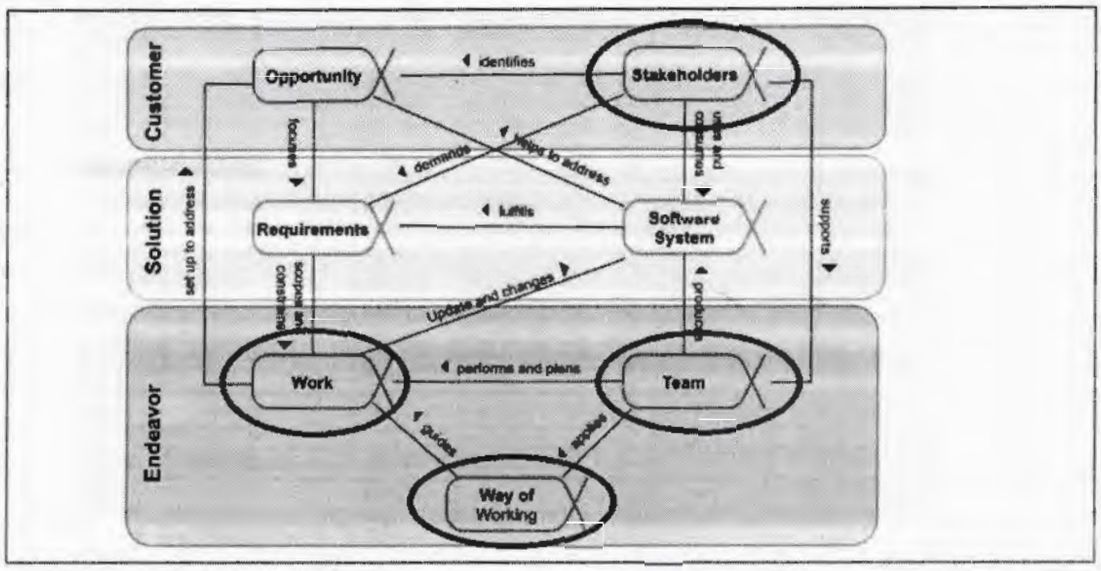


Figure 5.7: Alpha identification

5.2.2.2 Outline Compliant Scrum

Alphas that are a part of Compliant Scrum from the SEMAT kernel are Stakeholders alpha, work alpha, team alpha and way-of-working alpha (Figure 5.8).

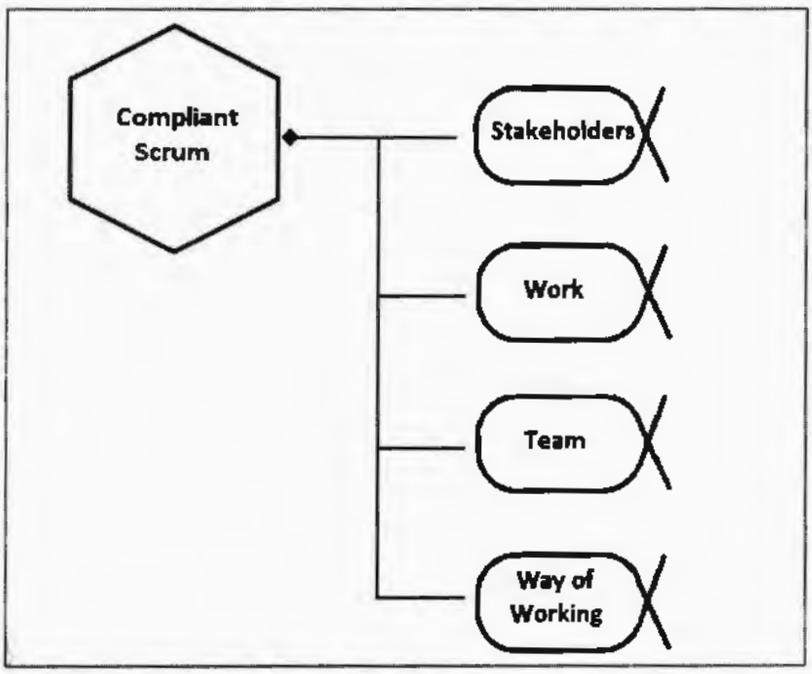
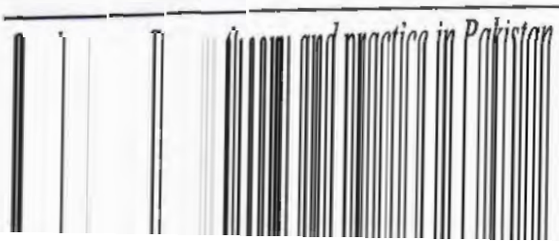


Figure5.8: Compliant Scrum outline

5.2.2.3 Add Sub-Alphas

Since the solution guides the way work is performed within the organization, Compliant Scrum was defined as a sub-alpha of Way-of-Working alpha (Figure 5.9)



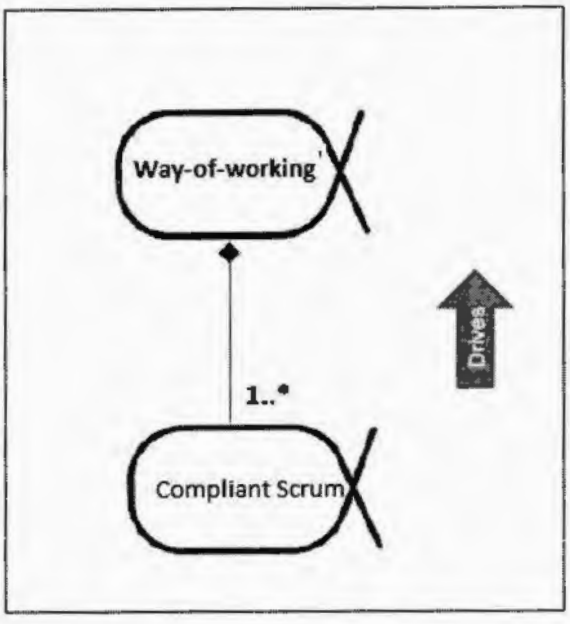


Figure 5.9: Way of Working alpha extended

Once identifying the right alpha to extend, state of the compliant scrum alpha were defined. The three states are:

- Introduced
- At work
- Working well

Checklist associated with each alpha was written in the light of guidelines (Table 5.2).

Table 5.2: Alpha state definition

Alpha State	Sub-alpha State	Checklist
Principle established **Foundation established**	**Introduced**	1. Upper management is willing to invest in the process a. Upper management are given an overview of the method b. The importance of trainings is established c. The benefits of investing in the process are established d. Resources are freed up to work dedicatedly on Scrum projects 2. An assessment is performed prior to the method commencement a. Scrum aptitude test is performed b. Organization's readiness for Scrum is assessed c. Plans are laid out for pilots, trainings and resourcing the pilot projects 3. Organization is prepared for the pilot project a. Scrum Masters are trained b. Product owner is trained

		c. Change product backlog is established 4. Strategic efforts are made to get the customer on board a. Customers are introduced to their role and importance in the agile setup b. They are made aware of Agile advantages c. In case of customer refusing to assume the role of PO, a customer proxy is established d. To ensure some level of customer involvement, working software is frequently demonstrated to them
In use **In place**	**At work**	1. Pilot(s) are undertaken a. Pilot(s) are carefully selected based on the size and criticality of the project b. Pilots are carefully monitored for impediments, adjusting plans with time c. A retrospective is performed assessing the ROI and improvements d. Organization-wide development projects are based on pilot outcome assessment 2. Development Team is autonomous a. There is no role of "Team lead" or "Project Manager" in the Scrum team b. Team members choose the work for themselves c. Team members are encouraged to estimate the work items themselves d. Collective rather than individual decision making is encouraged e. Describing the work, the team members use the term 'we' rather than 'I' f. Team members frequently communicate but they can work uninterrupted when needed 3. Development Team is multidisciplinary a. No role titles exist in the team besides "Developer" b. Cross-skill trainings are organized c. Generalists are promoted to build redundancy 4. If team members are not present on site a. Tool(s) have been established for effective team collaboration b. Time zone issue is resolved
Working well	**Working well**	1. Method assessment and retrospective is done over time a. Model(s) for measuring progress with Scrum projects are established b. Method retrospective is performed for potential impediments to it's usage 2. Knowledge is propagated a. Tools for team's continuous learning are

		established and made available b. Drawbacks of deviation from theory are known to everyone 3. Method use is monitored a. Any process related issues experienced by the team members are carefully handled b. Any deviations away from core practices are based on knowledge and experience of the teams

5.3.2.4 Define Activities

After defining alphas and states, activities were defined. Three identified activities were process preparation, process commencement and process propagation. These activities are meant to target identified alphas i.e. each activities takes a particular alpha from one state to another. These activities are closely knit with the guidelines.

❖ **Process preparation**

Process-Preparation activity consists of steps essential to set the ground for Scrum. The purpose is to make sure that the organization is Scrum-Ready

- This activity is complete when ***Deviation-free Scrum is introduced***
- **Introduction:**
  - Process-Preparation activity consists of steps essential to set the ground for Scrum. The purpose is to make sure that the organization is Scrum-Ready
  - This activity has three phases.

Phase 1. A two day working session

This session is conducted by an external Scrum expert. It has the following agendas

a. Getting management to invest in the process:

- An overview of the method is given
- Importance of trainings is established
- Benefits of investing in the process are established
- Upper management is convinced to free up resources to work dedicatedly on Scrum projects. They are made aware of long term benefits of such investment.

b. Strategically planning Scrum rollout:

- Scrum aptitude test is performed in which management is exposed to the type of change preceding Scrum and their willingness to proceed is assessed
- Organization's readiness for Scrum is assessed
- Pilots are identified and resourced and trainings are scheduled

Phase 2: Preparing organization for pilots:

- Scrum Masters are trained to run the pilots in a two day workshop
- In a one day workshop Product Owners are trained to get maximum ROI using Scrum
- A change product backlog is established. The purpose of this backlog is to capture the impediments that come up during pilot projects. Later on this backlog is used to derive change within the organization.

Phase 3: Strategic efforts to get the customer involved:

- Sessions are held with the customer to get them to participate in the process.
- They are introduced to their role and importance of their presence in the agile setup.
- In case the customers refuse to be a part of agile setup, a customer proxy is appointed which serves the purpose of requirement clarification and eliciting feedback.
- To ensure some level of customer involvement, working software is frequently demonstrated to the customer.
-

❖ **Process commencement**

Process commencement activity makes sure that Scrum is rolled in a deviation free manner

- This activity is complete when ***Deviation-free Scrum is at work***
- **Introduction:**
  - Process commencement activity makes sure that Scrum is introduced in a deviation free manner
  - This activity has three phases

    Phase 1: Conducting Scrum pilots

    When it comes to choosing a pilot project, there are a few things that must come under consideration

a. The pilot should span around the middle of average length of projects conducted
b. It should be small enough to be doable by one team
c. It should not be a critical project

Phase 2: Pilot assessment and retrospective:

- After conducting the pilot project successfully, retrospective is performed to see what went right and what improvements can be made. ROI is assessed.

Phase 3: Scrum Expansion

- Based on the pilots, Scrum projects are initiated throughout the organization
- The Development Team must be ***self-organized*** and ***cross-functional***
- To achieve self-organization, the team must have autonomy in decision making over time which is acquired with the assistance of a highly skilled Scrum Master.
- To achieve cross-functionality, the organization must
  - Promote generalist culture
  - Organize cross-skill trainings
  - Eliminate all the titles except "Developer"

❖ **Process propagation**

Process propagation activity consists of steps taken to make sure that Scrum stays deviation-free in the organization and continues to thrive

- This activity is complete when***Deviation-free Scrum is working well***
- **Introduction:**
  - Process propagation activity consists of steps taken to make sure that Scrum stays deviation-free in the organization and continues to thrive
  - This activity has two phases

    Phase 1: Assess and retrospect method usage

    - Once Scrum is rolled out in the organization, it is evaluated using models
    - The purpose is to make sure that Scrum is working well in the organization
    - Retrospective of the Scrum process is performed over time to reveal impediments that come in Scrum's way over time.

    Phase 2: Expand Scrum knowledge to prevent deviation

section consisted of three question about technical, organizational and personal barriers. In the fourth section, experts were asked suggested improvements.

Figure 5.10: Guiding questions for the focus group

5.4.2. Participants

After writing the guiding questions for focus group, experts were approached via LinkenIn. Response rate was initially low but later on many experts agreed to be a part of the discussion. Experts were sent invitation to join the discussion along with a detailed video explanation of the solution. Out of 8 experts who actively participated in the discussion, seven had mostly positive feedback.

Table 5.3: Focus group participants

Expert	Experience	Position/Title
Expert A	8 years	Agile guide//Scrum Master
Expert B	6 years	Agile guide/Scrum Master
Expert C	5 years	Scrum coach/Scrum Master
Expert D	4 years	Agile Frameworks Expert
Expert E	3.6 years	Scrum Master
Expert F	3 years	Scrum Master
Expert G	2.8 years	Scrum Master
Expert H	2.5 years	Scrum Master

The discussion was conducted in a bulletin board format [47]. Experts left commentsagreeing or disagreeing with each other. Discussion lasted for seven days. Moderator asked probing questions and tried to drive the discussion towards consensus.

5.4.3. Barriers to solution adoption:

5.4.3.1.Technical barriers

The solution was commended by majority of experts as technically applicable without any major barriers. Owing to the fact thatEsswork Practice workbench comes with very comprehensive help module, technical barriers raised over time are easily resolvable.

5.4.3.2.Organizational barriers

Out of all the topics, expert focus was very much on organizational barriers.

- **Investment trade-off:**

  A point was raised that solution will pose a tradeoff between investing into business goals and the solution. Organizations have a limited operational budget that is dedicated to meeting customer expectations and other goals which will make it secondarily important. Solution is going to be up against these competing priorities.

- **Motivation behind use:**

Organizations need a strong motivation to use this solution as it requires time and cost investment. If they think that current process is yielding required results than they wont certainly go the 9 yards to implement the solution. The mentality that drives deviation might prevent solution implementation.

5.4.3.3.Personal barriers

Expert G raised a point that solution implementation requires just not a behavioural change. As it requires following strict patterns so concept of commitment must be introduced which is hard. Again the competing goal here is personal performance.

The background of users was also raised as a barrier to implementation. Everyone using the solution might not have same technical background which might require different trainings.

5.4.4. Strengths of the solution

Here are the aspects of the solution commended by experts.

- The guidelines were very clear and would definitely be effective according to the experts.
- The solution was deemed concise, straightforward and easily manageable
- Precision in reducing identified deviation was acclaimed
- The chosen approach SEMAT was deemed systematic to implement guidelines and processes
- Comprehension was deemed easy and simple. When presented to the correct audience, solution will be immediately clear according to the experts

5.4.5. Expert suggestions

Experts suggested raising awareness with respect to Scrum and linking the solution to organizational goals. On the point of organizational goal they said if the organization (decision making management group) is driven to this because "everyone else is doing it" then, they are not actually motivated to go the whole-9-yards with anything that can improve their business processes.

Other improvement suggested was customization of the solution by the users in the future. The reason being extensibility in the future for helping out peer teams by reducing future deviation. Organizations need to experiment and observe how solutions influence their workflows according to the experts.

5.5. Improvements in solution

Solution was revised in the light of expert insight. Here are the improvements made.

5.5.1. Inclusion of organizational goal clause

Expert suggestion was convincing the upper management to plan out implementation by linking it to the organizational goal. Phase 1 of process preparation activity was modified to include this suggestion.

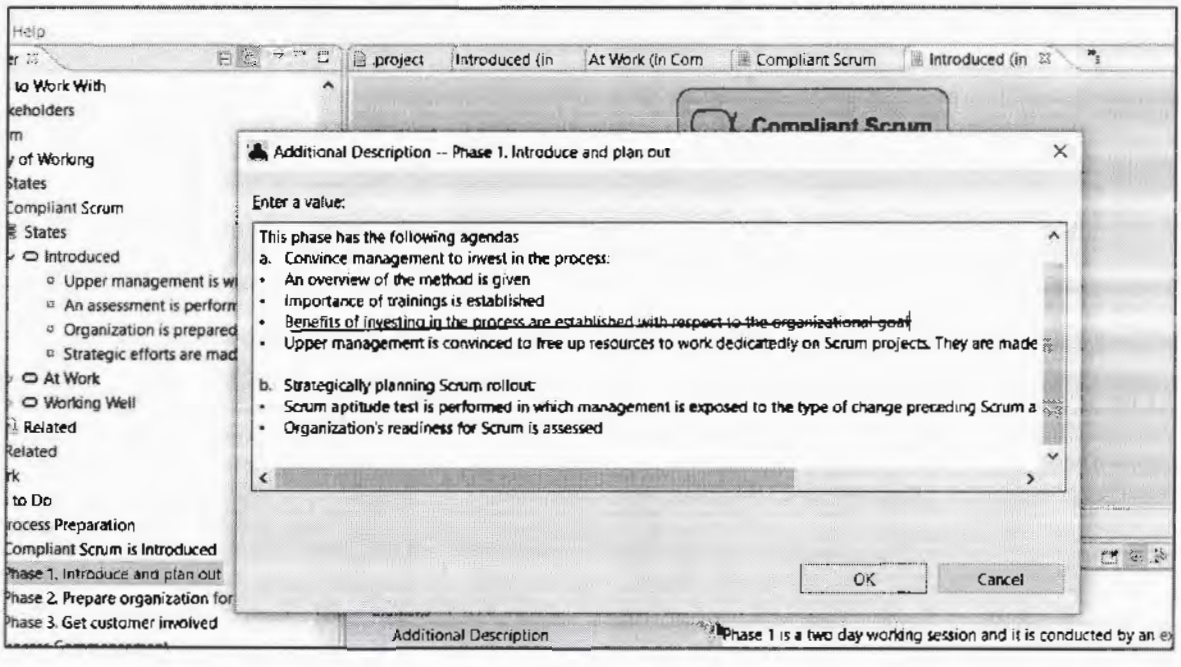


Figure5.11. Including organizational goal

5.5.2. Solution customization

To enable extensibility of the solution by future teams, holding of SEMAT Esswork training sessions was made a part of the solution (Process propagation->Phase 3:Create knowledge base)

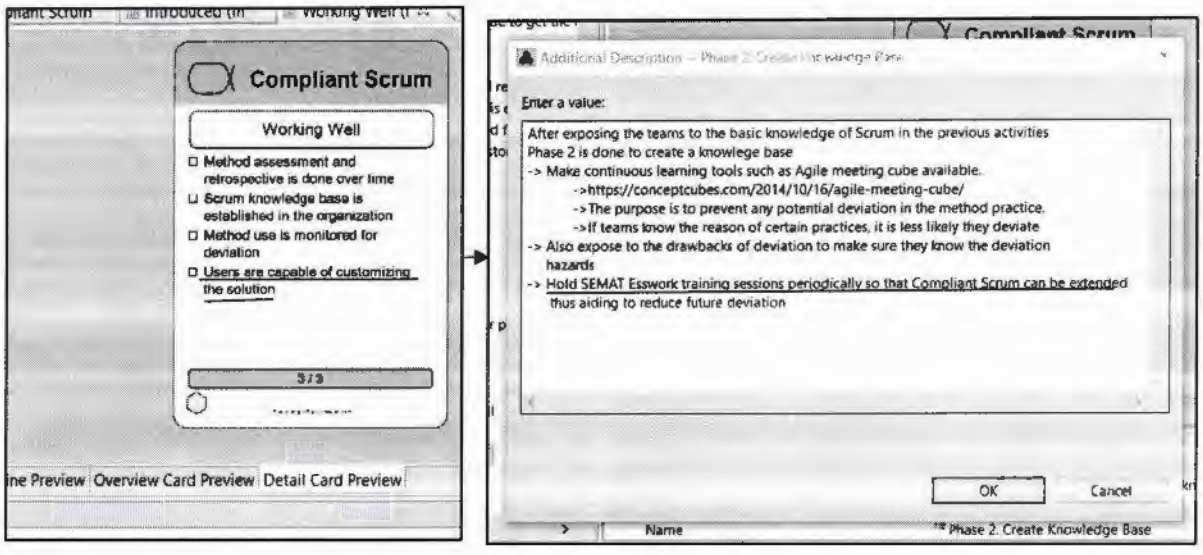


Figure5.12: Solution customization

5.6. Summary of Findings

All in all, solution did click to the experts. As with any Scrum adoption, obstructions at personal and organizational level do hinder the application of solution, these barriers however are addressed to some extent by the proposed solution. The focus group provided some rich data concerning problems faced by the industry today. These findings were inline with the interviews.

Chapter 6: Conclusion

6. Conclusion

Scrum is one of the most popular methods used in the software world of today still number of studies on Scrum practice is very low. Despite the recommendation that theory should not be tinkered with, we see deviation in the industry which is preventing the practitioners to reap full benefits of the method.

The study provides a set of guidelines to help fill this gap. The guidelines are based on methods of teams who manoeuvred their way out of deviation despite unfavourable circumstances. The guidelines are written as a practice in SEMAT kernel and language so that the practitioners can use it with ease, add to it, basically make the most out of it in the future.

6.1. Contribution

The work aims to contribute the following:

- Detailed description of Scrum after studying literature on the method.
- Gap between Scrum theory and practice in the industry.
- Causes of the said gap.
- A set of guidelines to resolve the gap so that practitioners can make the most out of the method.
- The solution written in SEMAT kernel and language and then transferred to esswork.
- Validation of the proposed solution via a focus group to elicit in-depth expert feedback on the guidelines.
- Improvements in the proposed solution after expert feedback.
- Proposed solution is available on YouTube along with the detail of problem and analysis.

  https://www.youtube.com/watch?v=55jaAiNqQ7U&t=391s

6.2. Limitation

Due to the limited time for interviews and validation, industry implementation wasn't made a part of the scope. If the solution is used by some of the software houses, that might be very helpful. However, this might take a lot of time. Since it was a one person research with limited time and resources, all aspects of the solution validation weren't possible to cover and focus group was chosen.

Owing to the fact that it was difficult to get in touch with the software houses outside Islamabad via personal contacts, only a couple interviews were conducted in the other cities of Pakistan. However since the findings were inline with the collected data,seemingly this did notaffect the accuracy of results.

Also since it was hard to gather all the experts under one roof due to their availability and geographic difference, online format of focus group discussion was used which comes with a few limitations such as facilitating a flow in discussion. This this problem was overcome by requesting the participants to drop in comments whenever a lack of activity was felt.

6.3. Recommendation

In future, solution should be implemented in the industry. This will reveal if anything is lacking and might end up adding some new things to the solution. Even the experts in the focus group said they wanted to see the solution in action.

Also trial version of Esswork availablefor research purposes was used which comes with a limited set of features. However, the complete version is sold to the interested organizations with variety of features. This version allows publication of practices as browsable web-sites which will allow accessibility across organizational borders allowing extensibility and improvement.

6.4. Summary of work

Research started off with a study of literature on Scrum practice (chapter 2) which revealed a) lack of studies on Scrum b) gap between Scrum theory and practice. Study further revealed that this gap is not recommended as it might result in unfavourable consequences as a result practitioners might not be able to reap full benefits of the method. Interviews were conducted across various software houses in Pakistan and

data revealed the deviation practiced. Causes were also investigated via these interviews. Root causes were identified via analysis. Once root causes were identified, we set off to design guidelines. Again, literature was consulted here. Past experiences of teams which devised strategies to accurately implement the method despite unfavourable circumstances were used to devise the guidelines along with peer teams implementing Scrum accurately in Pakistan. Once the guidelines were devised, they were written in SEMAT kernel and language for ease of understanding and applicability. For validation purpose, a focus group of experts was conducted which resulted in mostly favourable response. A few alterations were made in the solution in the light of expert recommendations.

References

[1] K. Schwaber and J. Sutherland, "The Scrum Guide – The Definitive Guide to Scrum: The Rules of the Game," http://www.scrum.org/Scrum- Guides, October 2011, last access: 2014-06-14.

[2] K. Schwaber and M. Beedle, Agile Software Development with SCRUM. Upper Saddle River, NJ: Prentice-Hall, 2002.

[3] Version One, "Fourth Annual Survey 2009 The State of Agile Development",2009, http://www.versionone.com/pdf/2009_state_of_agile_development_survey_results.pdf.

[4] Jan, Samina, and Ali Javed. "SCXTREME Framework: A Customized Approach of Process Improvements in Agile Blend with CMMI Practices in Pakistan." International Journal of Information Technology & Computer Science 5, no. 3 (2013).

[5] Overhage, Sven, et al. "What makes IT personnel adopt scrum? A framework of drivers and inhibitors to developer acceptance." 2011 44th Hawaii International Conference on System Sciences (HICSS). IEEE, 2011.

[6] Sverrisdottir, Hrafnhildur Sif, Helgi Thor Ingason, and HaukurIngiJonasson. "The role of the product owner in Scrum-comparison between theory and practices." 27th IPMA World Congress, Dubrovnik, Croatia. 2013.

[7] Eloranta, Veli-Pekka, et al. "Scrum Anti-Patterns--An Empirical Study." Software Engineering Conference (APSEC, 2013 20th Asia-Pacific. Vol. 1. IEEE, 2013.

[8] Kalus, Georg, and Marco Kuhrmann. "Criteria for software process tailoring: a systematic review", Proceedings of the 2013 International Conference on Software and System Process. ACM, 2013.

[9] Sverrisdottir, Hrafnhildur Sif, Helgi Thor Ingason, and HaukurIngiJonasson. "The role of the product owner in Scrum-comparison between theory and practices." 27th IPMA World Congress, Dubrovnik, Croatia. 2013.

[10] Salo, Outi, and PekkaAbrahamsson. "Agile methods in European embedded software development organisations: a survey on the actual use and usefulness of Extreme Programming and Scrum." Software, IET 2.1 (2008): 58-64.

[11] Kurapati, Narendra, Venkata Sarath Chandra Manyam, and Kai Petersen. "Agile software development practice adoption survey." Agile Processes in Software Engineering and Extreme Programming. Springer Berlin Heidelberg, 2012. 16-30.

[12] Zieris, Franz, and Stephan Salinger. "Doing Scrum Rather Than Being Agile: A Case Study on Actual Nearshoring Practices." 2013 IEEE 8th International Conference on Global Software Engineering (ICGSE), IEEE, 2013.

[13] Bass, Julian M. "Influences on agile practice tailoring in enterprise software development." AGILE India (AGILE INDIA), 2012. IEEE, 2012.

[14] Eloranta, Veli-Pekka,. "Scrum Anti-Patterns--An Empirical Study." Software Engineering Conference (APSEC, 2013 20th Asia-Pacific. Vol. 1. IEEE, 2013.

[15] Fernandes, J.M. and Almeida, M., 2010, September. Classification and comparison of agile methods. In Quality of Information and Communications Technology (QUATIC), 2010 Seventh International Conference on the (pp. 391-396). IEEE.

[16] Petersen, Kai, and ClaesWohlin. "A comparison of issues and advantages in agile and incremental development between state of the art and an industrial case." Journal of systems and software 82, no. 9 (2009): 1479-1490.

[17] Overhage, S. and Schlauderer, S., 2012, January. Investigating the long-term acceptance of agile methodologies: An empirical study of developer perceptions in scrum projects. In System science (hicss), 2012 45th hawaii international conference on (pp. 5452-5461). IEEE.

[18] Ovesen, Nis. "Pragmatic Team Compositions in Scrum-Based Development Projects." The 20th International Conference on Engineering Design. 2015.

[19] Zaineb, Ghazia, Bassam Shaikh, and Ali Ahsan. "Recommended cultural and business practices for project based software organization of Pakistan for supporting restructuring of functional organization for implementing agile based development framework in software projects." In Information Management, Innovation Management and Industrial Engineering (ICIII), 2012 International Conference on, vol. 1, pp. 16-20. IEEE, 2012.

[20] Sutherland, Jeff, ScrumBut Test aka The Nokia Test. Available at http://jeffsutherland.com/scrumbutttest.pdf (2010)

[21] Abrahamsson, P., Conboy, K. and Wang, X., 2009. 'Lots done, more to do': the current state of agile systems development research.

[22] Dybå, Tore, and TorgeirDingsøyr. "Empirical studies of agile software development: A systematic review." Information and software technology 50, no. 9 (2008): 833-859.

[23] Gill, Asif, Deborah Bunker, and Philip Seltsikas. "Moving Forward: Emerging Themes in Financial Services Technologies' Adoption." Communications of the Association for Information Systems 36, no. 1 (2015): 12.

[24] Jacob, Stacy A., and S. Paige Furgerson. "Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research." The Qualitative Report 17, no. 42 (2012): 1-10.

[25] Spickard, Jim. "How to construct an interview protocol." Retrieved January 31 (2005): 2009.

[26] Dybå, Tore, Rafael Prikladnicki, Kari Rönkkö, Carolyn Seaman, and Jonathan Sillito. "Qualitative research in software engineering." Empirical Software Engineering 16, no. 4 (2011): 425-429.

[27] Kvale, Steinar. Doing interviews. Sage, 2008

[28] Williams, P.M., 2001. Techniques for root cause analysis. Proceedings (Baylor University. Medical Center), 14(2), p.154.

[29] http://www.bulsuk.com/2009/07/5-why-analysis-using-table.html

[30] http://rawgraphs.io/

[31] Moe NB, Dingsøyr T, Dybå T. Overcoming barriers to self-management in software teams. IEEE software. 2009 Nov;26(6).

[32] Chung MW, Drummond B. Agile at yahoo! from the trenches. InAgile Conference, 2009. AGILE'09. 2009 Aug 24 (pp. 113-118). IEEE.

[33] Hajjdiab H, Taleb AS. Agile adoption experience: A case study in the UAE. InSoftware Engineering and Service Science (ICSESS), 2011 IEEE 2nd International Conference on 2011 Jul 15 (pp. 31-34). IEEE.

[34] Rayhan SH, Haque N. Incremental adoption of Scrum for successful delivery of an IT project in a remote setup. InAgile, 2008. AGILE'08. Conference 2008 Aug 4 (pp. 351-355). IEEE.

[35] Hoda R, Noble J, Marshall S. The impact of inadequate customer collaboration on self-organizing Agile teams. Information and Software Technology. 2011 May 31;53(5):521-34.

[36] Ramesh B, Cao L, Mohan K, Xu P. Can distributed software development be agile?. Communications of the ACM. 2006 Oct 1;49(10):41-6.

[37] Alliance S. The state of scrum: benchmarks and guidelines. Orlando, FL: Kim, D. 2013.

[38] Jansen S, Vlaanderen K, van Vliet R, Bredewoud H, Kwekkeboom H. From agility to productivity.

[39] Leffingwell D, Smits H. A CIO's playbook for adopting the scrum method of achieving software agility. Technical report, Rally Software Development Corporation and Ken Schwaber-Scrum Alliance; 2005.

[40] https://www.mountaingoatsoftware.com/articles/toward-a-catalog-of-scrum-smells

[41] https://www.scrumalliance.org/community/articles/2006/march/scrum-shouldn-t-be-a-burden

[42] https://www.scrum.org/resources/blog/scrum-myths-scrum-meeting-heavy

[43] Jacobson, I., Ng, P.W., McMahon, P., Spence, I. and Lidman, S., 2012. The essence of software engineering: the SEMAT kernel. Queue, 10(10), p.40.

[44] Krueger, R.A. and Casey, M.A., 2014. Focus groups: A practical guide for applied research. Sage publications.

[45] https://www.ivarjacobson.com/esswork-practice-workbench

[46] Elvesæter, Brian. "Extending the Kernel with Practices to Create Methods." (2013).

[47] Bader, G.E. and Rossi, C.A., 1998. Focus groups: A step-by-step guide. Bader Group.

[48] Merriam, Sharan B. Qualitative research in practice: Examples for discussion and analysis. Jossey-Bass Inc Pub, 2002.

Appendix-A

Acronyms and Abbreviations	
Term	**Description**
PO	Product owner
SM	Scrum master
PB	Product backlog
DOD	Definition of Done
PB	Product Backlog
SB	Sprint Backlog

Appendix-B

The Scrum Team	
Product Owner	In a Scrum team, Product Owner (PO) is the role responsible for translation of product specifications into the final product while ensuring that maximum value is delivered. Official accountable person for the Scrum project is Product Owner. For a Scrum project to succeed, a Product Owner's decisions should be respected by the team and everyone in the organization. Product Owner creates and maintains the Product Backlog for a Scrum project. From the start till the end of the project, solely the Product Owner decides what goes in and out of the Product Backlog and what changes are made to the Product Backlog items. Product Owner makes sure that the team understands the Product Backlog content to the level needed. He estimates the Product Backlog items with the help of the team. Product Backlog prioritization reflects decisions of a Product Owner and making sure that it is visible to everyone is Product Owner's responsibility. Scrum advocates one Product Owner per product to eliminate conflicting set of requirements for the Scrum team to work from. Product Owner is the solitary product representative; he can be from the development organization, from customer end or both at the same time in case of in-house product development. In any case, in Scrum, Product Owner is the person responsible for the project and for a Scrum to succeed, Product Owner's role must be given critical importance in the Scrum team and organization as a whole.
The Development Team	In Scrum, the Development Team is a group of three to nine people who are responsible for converting product specifications into the working product increment at the end of the sprint. The Development Team in Scrum is self-organizing. The "manager is the boss" culture does not apply in Scrum. No one tells the team what it has to do or how it should be done, rather the team members work together in synergy towards a common goal. The Scrum team must not be interrupted by anyone outside the team. The power to make team decisions lies only with the team. A second must-have property for the Scrum Development Team is cross-functionality [1][2]. The Development Team must include individuals with all the required expertise to meet the team goal. The Development Team must not be dependent on others outside the team to help the team in achieving its goal. Team must do all of its work on its own. In a Scrum Development Team, individuals don't assume any titles. Regardless of their respective expertise, Development Team members are supposed to address every task required by the team to meet its goal. It means that a tester cannot refuse to code or a coder cannot refuse to test if her team

	needs her to do so. This ego-less and state-less culture motivates individuals to do their best. Their loyalties are not with themselves, rather with their team and with the project. This sense of commitment in individuals results in productivity gains. Scrum Development Team size is ideally seven plus minus two. A team as small as of three people can be a Scrum team, still benefit but interactions are limited by the small team size. Productivity gains in Scrum are derived by interactions among individuals. On the other side, having a large team of eight people and more doesn't work as well. A large team produces too much complexity to be handled using an empirical process. However, if the project is large, the solution in Scrum is having multiple Scrum teams and holding a "Scrum of Scrums" meeting for them. A "Scrum of Scrums" meeting can be described as Daily Scrum of Scrum Masters from different Scrum teams working on the same project. Through this meeting, teams can share their progress with each other. The Development Team must be equipped with top tools and technologies in an open work environment. A team of experts with mediocre tools will not be very productive unless it is armed with the best possible tools. Open work environment facilitates communication and interaction among the team members. Using separate confined spaces for the team members is discouraged in Scrum as it is a hurdle to team communication. Provide the best possible tools to a team in an open working environment and see the productivity shoot. If properly applied, Scrum can bring out the best in individuals. Scrum stimulates the team members to grow as a team as they work out their internal differences and draw on their strengths to achieve a common goal.
The Scrum Master	Scrum Master is the individual who is responsible for making sure that Scrum's practices are adhered by everyone involved. He works with both the Scrum team and the management to make Scrum work. He is responsible for making Scrum a success in the organization . Scrum Master is the driving force behind all other Scrum practices. Unlike the role of manager in a traditional organizational setup, Scrum master is the servant-leader to the Development Team, Product Owner and organization at large despite being a management role. For the Development Team, he is their Scrum coach, he makes sure that everyone in the team understands the core of Scrum. He removes impediments in team's progress. Facilitates Scrum events for the team and makes sure that team has a suitable work environment for self-organization to flourish. He helps the management and customers in institution of a Product Owner for the project. He helps the Product Owner understand empirical project planning and effective backlog management. He cultivates Scrum culture in the organization at large. His services are not only limited to the organization, he also helps employees and stakeholders in understanding and enacting Scrum.

	Certain qualities are associated with the persona of a Scrum Master. Determination and focus along with quick decision making power is required by a Scrum Master to keep the team at its highest productivity level. Anything that comes in the way of his team's progress, Scrum Master is responsible for effectively removing it. Most importantly a Scrum Master should be an individual who knows the essence of Scrum and agility. Without a knowledgeable individual with the right personality traits and mind set, Scrum cannot function and flourish within the organization.
Scrum Events	
The Sprint	In Scrum, software is developed via short length iterations known as sprints. Prescribed length for a sprint is less than a month preferably 2 to 4 weeks. It is recommended that the goal of a sprint i.e. the functionality that the team commits to deliver in a sprint should not be changed and the quality goals set by the team should not be decreased. However scope may be renegotiated among development team and Product Owner as more is learned. Ideally by the end of the sprint, an increment of potentially shippable functionality is delivered to the customer.
Sprint Planning	Sprint Planning is the meeting in which The Development Team, Product Owner, users, customers, management decide what is to be done during the next Sprint. The meeting consists of two sub meetings. In the first meeting it is decided what functionality is to be developed during the coming sprint. This decision is based on the Development Team's past progress as a team which is tracked via the use of burn-down-charts Once the functionality to be developed during the next sprint is agreed upon by everyone involved, the team figures out a way in through which the functionality can be converted into product increment. Inputs to sprint planning meeting are past performance of the team and its capabilities, Product Backlog and last increment of the product. Sprint planning is a meeting conducted before the start of every sprint. This meeting takes place in two parts. In the first part the product owner along with the team decides what is to be delivered in the coming sprint. The "what is to be delivered" is called the sprint goal; Scrum prescribes using velocity of previous sprints in order to choose goal for next sprint thus ensuring empiricism. In the second part of sprint planning meeting, the team decides on how to implement the items selected for the sprint. The meeting is carried out for a maximum of eight hours for one month sprint and if the duration of sprint is shorter, meeting is shorter as well. Scrum puts emphasis on letting the development team decide what they can deliver in the coming sprint thus empowering the team.
Daily Scrum	In Scrum, the team meets every day to discuss the status of the project in a meeting called Daily Scrum. Daily Scrum is time-boxed and duration is

	maximum 15 minutes. Main purpose of this meeting, like other periodic meetings in Scrum framework is to inspect and adapt. Only the team members actively participate in this meeting. The team gathers in one place and each team member answers three questions: What have you done since the last meeting? What will you do between now and the next Scrum? What got in your way of doing work? Scrum emphasizes allows only the team members to speak during the meeting. Anyone besides the team is allowed to be present but they are now allowed to participate. The reason is justified by this joke: "A chicken and a pig are together when the chicken says, "Let's start a restaurant!" The pig thinks it over and says. "What would we call this restaurant?" The chicken says, "Ham n' Eggs!" The pig says, "No, thanks, I'd be committed, but you'd only be involved!" " The Daily Scrum meeting solves the "the chicken and the pig" problem effectively. Only people who are working on the project are playing role of the pig as they are committed, everyone else is only involved. Hence, only team members are allowed to talk during the meeting. Anyone besides the team is not allowed to give an input. Like other Scrum events, Scrum Master facilitates the Daily Scrum. He as always makes sure that the tram is not disrupted and is performing at its maximum productivity level. He makes sure that the meeting stays within time limit and the meeting place is adequate and undisruptive. A good Scrum Master does everything in his power to make Daily Scrum a success. All the team members answer three questions describing what they did since yesterday, what they'll do between now and the next Scrum and what is coming in their way of doing work. The first two answers ensure decision transparency. The decision making power is delegated to the team members. They can do whatever they want to convert product backlog item into functionality. Indecision is raised as an impediment. Quick decision making on part of the Development Team and Scrum Master is a Daily Scrum essential. The third answer informs the Scrum Master of the impediments that the team members are facing. The Scrum Master then makes it his top priority to remove the impediments thus ensuring that nothing comes in the way of team's productivity. Daily Scrum should not be extended beyond time limit. Attempting to solve problems in this meeting stretches the meeting beyond time limit. Daily Scrum is very beneficial since it stimulates quick decision making in the team, it increases communication among team members and removes impediments.
Sprint review	Sprint review meeting is held at the end of each sprint. During this meeting, the increment of functionality developed during sprint is inspected. The attendees include product owner, Scrum Master and the team. The done work is presented in this meeting. It is evaluated by the product owner and compared with the acceptance criteria set at the beginning of the sprint. Sprint Review is the major inspection and adaptation event in a sprint. Sometimes it also involves the end-user of the system in which case direct feedback is elicited.

Sprint Retrospective	One of the four key Scrum events, sprint retrospective is aimed at helping the Scrum teams inspect their performance and adapt accordingly. During this time-boxed event, Scrum team with the help of Scrum Master examines how preceding sprint went and categorizes the good and bad practices. Also a plan is set for improving on what didn't work during the previous sprint. Main questions asked are: 1. What went right during the previous sprint in terms of people, process and tools? 2. What went wrong? 3. What are the suggested improvements?
Scrum Artifacts	
Product Backlog	Product backlog is the single repository of requirements. At point during the development, Product Backlog represents the software being developed. The accountability of product backlog lies with the product owner who maintains it. The Product Backlog Items (PBI) have a number of attributes including, priority, detail, order and estimate. As features become clear, Product Backlog is expanded and refined over time. The estimation is solely the responsibility of the Development Team member. Other bodies such as the Product Owner might aid the team in reaching an estimate but they cannot influence it

Table : The Product Backlog

Priority	Item	Details	Initia size estim
1	As a receptionist, I want to add patients into the ward	...	5
2	As a receptionist, I want to remove patients form the ward	...	2
3	Check and enhance the speed of data processing	...	13
4	Speed up the validation process (Check wiki)	...	20
5	Upgrade to Win 2003 server	...	13

Sprint Backlog	The work chosen by the Development Team for a sprint is moved from Product backlog to the Sprint backlog. It consists of features that the Development Team plans on developing during the coming Sprint. Since features become more clear as they are developed during the Sprint, team keeps changing up the Sprint Backlog. It provides visibility to teams work during the sprint. The Sprint Backlog represents the features that are part of the increment of

<table>
<tr><td></td><td>functionality releasable at the end of the Sprint. The sole ownership of Sprint Backlog is by the Development Team
Table: Sprint Backlog
<table>
<tr><th>Backlog item</th><th>Task</th><th>Owner</th><th>Initial Time Estimate</th></tr>
<tr><td rowspan="5">Enable all users to add patients to the ward</td><td>Configure the system</td><td>Liam</td><td>4 hours</td></tr>
<tr><td>Test the system for performance</td><td>Song</td><td>2 Hours</td></tr>
<tr><td>Create login module</td><td>Trever</td><td>3 Hours</td></tr>
<tr><td>Complete signup module</td><td>Trever</td><td>4 Hours</td></tr>
<tr><td>Implement connectivity</td><td>Liam</td><td>3 Hours</td></tr>
</table></td></tr>
<tr><td>Increment</td><td>The items developed during the Sprint constitute the increment. An important thing to remember here is that the increment must be releasable. Regardless of the fact that it is released or not, the increment must be “done”.</td></tr>
</table>

Appendix-C

General Questions	
1.	Name of Interviewee?
2.	Name of the organization?
3.	Role of interviewee in the organization?
4.	For how long have you been using Scrum? Personal and organizational experience?

Scrum Background Questions	
1.	Organization's motivation behind Scrum and how did it start?
2.	What kind of trainings did the Scrum teams receive?
3.	Have there been internal Scrum trainings and what material was used in those trainings?
4.	Is it used at project level or organization level?
5.	Did the company face any issues in the beginning of Scrum adoption as per your knowledge? And how did you overcome them?
6.	Explain Structure/Management hierarchy of your organization?
7.	Has the management been actively helping in the adoption of Scrum process?
8.	Describe your customer support towards Scrum and do you have open and closed communication with the customer?

Scrum Practice Questions	
1.	What roles are there in Scrum teams of your organization?
Follow up	Are there any roles besides PO, SM and Dev team member? • Yes • No
Follow up	If Yes, describe them?
2.	Does the team know who the product owner is?
Follow up	What does product owner do in a Scrum team?
Follow up	For a single Scrum project, is PO one person or do multiple people take the responsibility?
3.	Is product owner from customer end or proxy?

Follow up	If from customer end, yes describe his involvement with the team?
Follow up	If proxy,when why?
Follow up	Can you think of any issues that come up because of PO being customer proxy?
4.	Is PO present on site? • Yes • No
Follow up	If, No, describe any issues that are faced because of PO not being present on site?
5.	How does PO communicate with the customer?
Follow up	What if any, are the communication problems faced with the customer?
6.	Describe PO's involvement with the development team?
Follow up	What if any, are the communication problems faced between the PO and the development team?
7.	Is there a Scrum Master for each Scrum team? • Yes • No
Follow up	If yes, Whatare his duties?
Follow up	What did the Scrum Masters do before they were assigned the role?
Follow up	Did the Scrum Masters in your organization receive any prior training?
8.	Can the iteration start before specification is complete?
9.	Is there a product backlog ordered by the business value? • Yes • No
Follow up	If Yes, who manages product backlog?
Follow up	Who (and how) creates the estimates for the product backlog items?
10.	Is product developed in sprints?
Follow up	Do your sprints start and end on planned dates?
Follow up	What is the length of a sprint?
Follow up	Are more requirements added to sprint backlog during sprint?
11.	Are planning meetings ever/always held?
Follow up	What is the duration?
Follow up	Who participates?
Follow up	What happens in these meetings?

12.	Are changes ever made to sprint goal during sprint? • Yes • No
Follow up	If yes, describe those changes?
Follow up	How does that effect team work and sprint goal?
13.	Are meetings held every day?
Follow up	Who participates?
Follow up	What is the duration?
Follow up	How willingly do team members participate?
Follow up	What happens in those meetings?
Follow up	Describe hurdles, if any are faced?
14.	Have you defined "done" criteria for sprint backlog items? • Yes • No
Follow up	If yes, What it is in your project?
15.	In what kind of environment teams work?
Follow up	Is a single team located so that the members can hear and see each other?
16.	Does the team have outside people disrupting the work of the team during the sprints? • Yes • No
Follow up	If yes, who they typically are?
Follow up	How does it affect the sprint goal?
17.	Does the team have overlapping expertise?
Follow up	Are there specific roles in the Scrum team (tester, QA, Coder)?
18.	Does sprint team acquire services of any other team? • Yes • No
Follow up	If yes, which team and why?
Follow up	Does it pose any issues?
19.	Who decides how much work the team does in a sprint?
Follow up	Who assigns responsibilities?

20.	Do you use burn-down charts? • Yes • No
Follow up	If yes, who updates it and when?
Follow up	What is the unit used in the burn-down charts?
21.	How do you handle testing in Scrum projects?
Follow up	Do you have experienced more problems in testing than before using Scrum?
22.	Is the software increment completely tested and working at the end of an iteration?
Follow up	Is it delivered to the customer?
Follow up	Describe feedback process?
23.	Are review meetings held after each sprint? • Yes • No
Follow up	If yes, who participates?
Follow up	What is the duration?
Follow up	Describe customer and user involvement in these meetings?
24.	Do you organize retrospectives after iterations? • Yes • No
Follow up	If yes, what is their impact?
25.	Do you have had need to distribute the development or a Scrum team?
Follow up	What kind of experiences you have on this?
26.	Is Scrum of Scrum meeting held? • Yes • No
Follow up	If yes, describe these meetings?

Scrum usage Questions	
1.	Describe benefits that you have experienced after taking Scrum in use? What has been the most rewarding thing after taking Scrum in use?
Follow up	What has been the most rewarding thing after taking Scrum in use?
2.	Describe drawbacks of using Scrum?
Follow up	What has been the worst thing that has happened after taking Scrum in use?

3.	Are Scrum and agile methods in general compatible with your current organization culture?
4.	How has communication changed after taking Scrum in use?

Appendix-D

❖ **Consequences of deviation-Basic Themes**

Deviation	Consequence	Basic Theme
• **Product Owner does not exist**	• Requirements are ambiguous and no one is available for clarification • Client never satisfied with what is developed • Too much rework due to changing requirements from client's end after increment is delivered • Team showed feelings of frustration towards the client • Ambiguous requirements and no one is available for clarification	• **Ambiguous requirements and client unavailable for clarification** • **Client never satisfied with what is developed** • **Extensive rework after delivery** • **Development Team frustrated with the customer**
• **Scrum Master is partial Product Owner**	• Team is not coached on Scrum • Scrum Master does not make sure that Scrum is understood and enacted in the organization • Scrum Master does not perform other duties associated with his role • Could not be determined	• **Scrum Master not able to perform his duties as Scrum Master** • **Could not be determined**
• **Scrum Master does not exist**	• Scrum events not held • Scrum roles do not exist • Scrum artifacts not used	• **Scrum practices not followed by the Scrum Team**
• **Scrum Master not called Scrum Master**	• No role found which performs duties of Scrum Master	• **Duties of Scrum Master not performed by any role**
• **Role specific titles for Development**	• Team members do not have T-shaped skills	• **T-shaped skills not found in the Development Team**

Team members	• Team members do not help each other across disciplines	**members** • **Lack of cooperation among Development Team members**
• **Development Team is not self-organizing**	• Development Team members not able to perform best of their capabilities • Reduced motivation in the Development team • Could not be determined	• **Development Team members not able to perform the best of their capabilities** • **Reduced motivation in the Development Team** • **Consequences could not be determined**
• **Development Team is not cross-functional**	• Increment not releasable at the end of the Sprint • Testing cycle is too long causing rework	• **Increment not releasable at the end of Sprint** • **Rework due to long testing cycle**
• **Product not developed in Sprints**	• High number of change requests post-production	• **Extensive change requests post-production**
• **Estimation is not performed by the Development Team**	• Development Team members feel burdened as features are underestimated • Estimates are mostly wrong • Could not be determined	• **Development Team feels burdened** • **Inaccurate estimates** • **Consequences could not be determined**
• **Progress not monitored**	• Could not be determined • Estimation is never performed correctly	• **Estimation is never correct** • **Consequences could not be determined**
• **Daily Scrum Not held**	• Could not be determined • Communication gap among team members • Lack of cooperation among team members	• **Consequences could not be determined** • **Lack of communication among Development Team members** • **Lack of cooperation among Team members**
• **Sprint Review not held**	• Rework due to late feedback	• **Rework due to late feedback**

	• Could not be determined	• **Consequences could not be determined**
• **Sprint Retrospective not held**	• No improvements made over time with regards to people, process and tools	• **No improvements over time with regards to people, process and tools**
• **Product Backlog not used**	• Hard to trace issues, requirements and changes over time • Could not be determined	• **Lack of visibility as the Project evolves over time** • **Could not be determined**
• **Sprint Backlog not used**	• Work progress not visible as Sprint progresses • Could not be determined	• **Work progress not visible as Sprint progresses** • **Impact undetermined**
• **Definition of Done not used**	• Inconsistent quality based on developer experience and interpretation of what complete means • Could not be determined	• **Inconsistent quality of features** • **Consequences could not be determined**
• **Requirements are signed off**	• Could not be determined	• **Consequences could not be determined**
• **A small team assigned for hot-fixes**	• Team is not interfered during sprint unless there is a show-stopper bug reported	• **Team completely un-interfered during Sprint due to a hot-fix team**
• **Additional role of Project Manager**	• Development Team is not self-organizing	• **Development Team is not self-organizing due to additional role of Project Manager**
• **Team lead for tbe Development Team**	• Team is not self-organizing as the additional role of Team Lead assigns and monitors the work of the Development Team	• **Development Team is not self-organizing due to additional role of Team Lead**

❖ **Consequences of deviation-Organizing ang global themes**

Basic Theme	Organizing theme	Global theme
• Team completely un-interfered during Sprint due to a hot-fix team (2)	• **Positive impact reported**	• Positive Consequences

• Scrum Master does not perform his duties as Scrum Master (10) • Scrum not followed (2) • No improvements made over time (11) • Development Team is not self-organizing due to additional role of Project Manager (2) • Development Team is not self-organizing due to additional role of Team Lead (12)	• **Adverse impact noted**	• Negative Consequences
• Ambiguous requirements and client not available for clarification (11) • Client not satisfied with what is developed (11) • Extensive rework due to ever-changing requirements after delivery (11) • Development Team frustrated with the customer (11) • Development Team members not able to perform the best of their capabilities (6) • Reduced motivation in the Development Team (9) • Rework due to late feedback (6) • No improvements over time with regards to people, process and tools (11) • Lack of visibility as the Project evolves over time (5) • Work progress not visible as Sprint progresses (5) • Inconsistent quality of features (8) • Lack of communication	• **Adverse impact reported**	• Negative Consequences

among Development Team members (4) • Lack of cooperation among Team members (4)		
• Consequences could not be determined (28)	• **Impact could not be determined**	• Consequences Undetermined

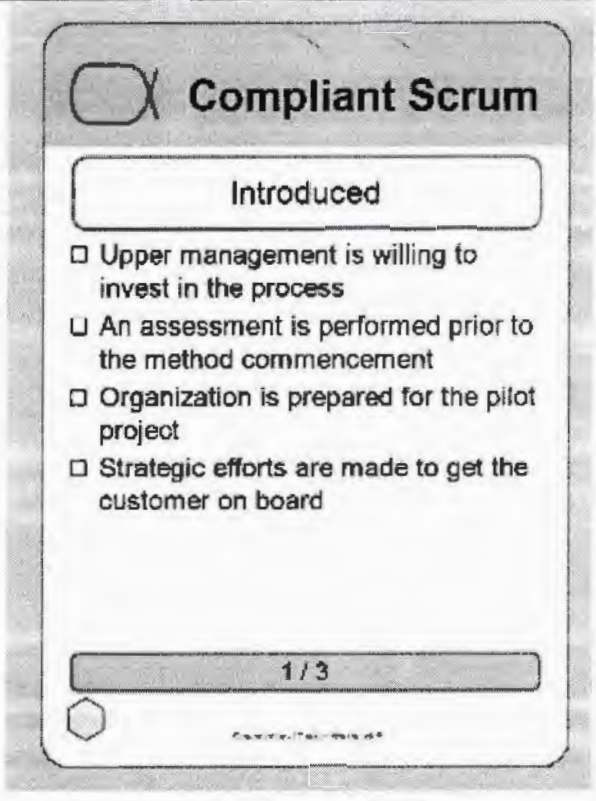
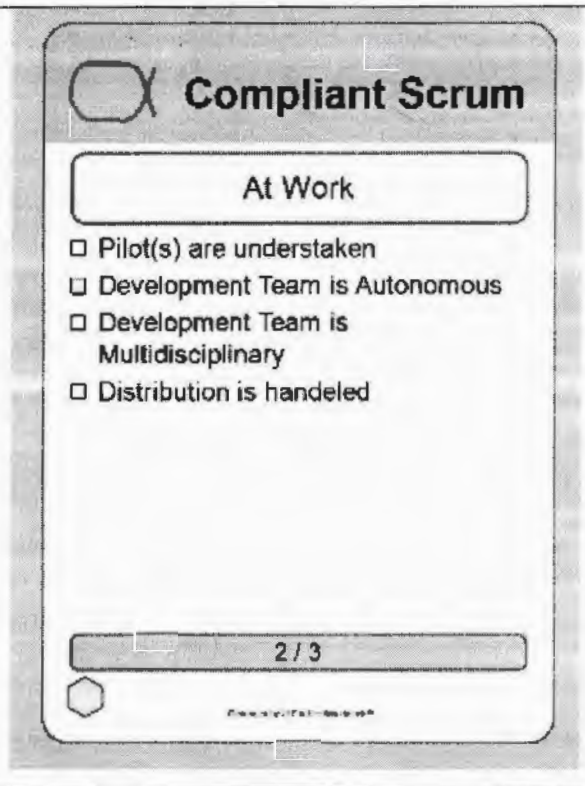
❖ **Consequences of Deviation-Results:**

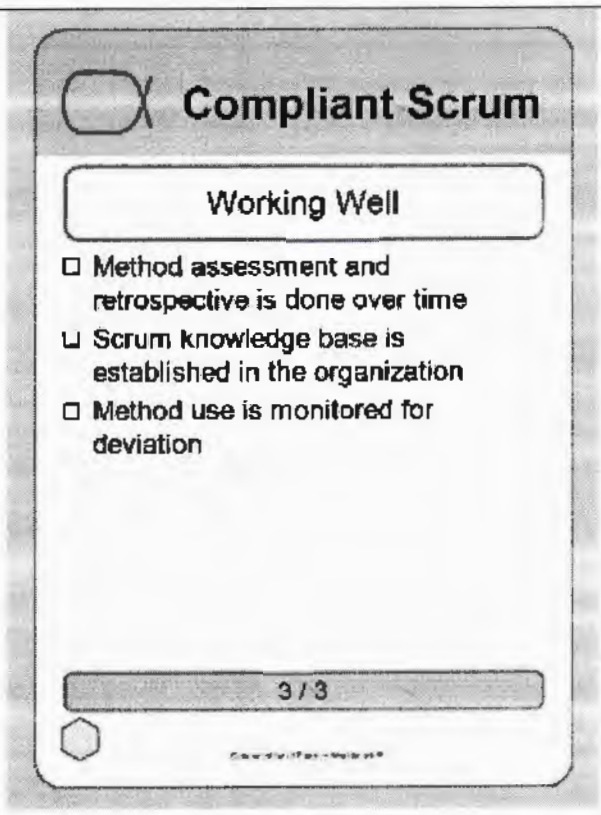
	Deviation Consequence	**Frequency**
1.	Positive impact reported	2
2.	Adverse impact noted	37
3.	Adverse impact reported	94
4.	Impact could not be determined	28

Appendix-E

1.	**What is the reason behind the decision to use focus groups?** We are trying to elicit feedback of experts on the proposed solution (Compliant Scrum) defined using SEMAT. Focus group will facilitate discussion among the participants thus will help explore consensus on the feedback.
2.	**What is the general issue?** Expert feedback on Compliant Scrum
3.	**What are the specific issue?** • Usefulness of the solution (to fill the gap) • Perceptions of efficacy of the solution (how effective the solution is to fill the gap) • Format/presentation of the solution (language of definition SEMAT) • Content/language of the solution (Is it well defined in that language) • Barriers/solutions to implementation
4.	**What goals do you hope to meet using a focus group?** • Elicit expert feedback on Compliant Scrum • Get expert feedback on the language of definition (SEMAT) • Explore degree of consensus on the usability of the proposed solution
5.	**What purpose will the information serve?** • Validate the proposed solution • Effectiveness of the proposed solution for the problem at hand • Effectiveness in the language of definition
6.	**From whom do you want to collect information?** Experts in Scrum from Pakistani software industry who are equipped with knowledge to validate efficacy of the proposed solution.

Appendix-F

Alpha State	Alpha State Cards
Introduced	
At Work	

Working Well	
Activity	**Activity Cards**
Process Preparation