The Use of SCRUM in Global Software Development: 
An Exploratory Study

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ABSTRACT

Context: The trend for Global Software Development (GSD) is increasing day by day. Some major benefits that attract organizations to develop software globally are reduced cost, reduced time to develop, improved quality, and improved resource allotment, well defined processes and improved documentation. However, there are also several challenges reported for GSD. Some of these problems have thought to be overcome by using agile practices. SCRUM is an agile methodology used to manage and control work during the project development.

Aims and Objectives: In the scope of this thesis study we investigate on several project management challenges being faced and several SCRUM practices being used by organizations in GSD projects. We also investigate the benefits achieved and challenges faced by the software organizations in implementing SCRUM practices for addressing the managerial challenges of GSD projects.

Methods: We first conducted a literature review to understand the management challenges in GSD and how SCRUM practices are being used to overcome the challenges. To further explore the current practices in industry, we conducted semi-structured interviews with six managers from six different software organizations and an online survey with 24 participants.

Results: As a result of this study, several management challenges in GSD projects, SCRUM practices being practiced, benefits and challenges being faced by the organizations in implementing SCRUM are identified by conducting interviews and surveys with experienced people who work on GSD projects which were elaborated in this paper. The maximum number of project management challenges that were not reported in the literature but were found during interviews fall under Integration management and Human Resources management. The maximum challenges that were not reported in the literature but were found during interviews fall under time management and communication management category. All the interviewees have mentioned that they are satisfied in implementing SCRUM in GSD projects.

Conclusions: From this study, we have found several new project management challenges in GSD and SCRUM practices which were not discussed in the literature. We have also found benefits and challenges of implementing SCRUM in GSD projects. All the interviewees and survey respondents have mentioned that they are satisfied and benefited by implementing SCRUM in GSD projects. It is reported that SCRUM provides better control, very adaptable and innovative. It is also reported that organizations may not benefit by implementing SCRUM in GSD projects without team commitment, customer’s involvement and not having well defined goals. There are few factors that we did not address due to time constraints such as complexity, type of project, expertise, duration of project etc. in implementing SCRUM in GSD. Conducting research on SCRUM of SCRUMS would be of great advantage. The absence of challenges and practices in few categories did not worth a general conclusion that all challenges and SCRUM practices in GSD projects have been identified. Hence we conclude that there is a need for conducting even more in-depth case studies to investigate the usage of SCRUM practices in addressing challenges of global software project management.

Keywords: SCRUM, SCRUM practices, Global Software Development, Project management challenges.
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1 INTRODUCTION

Global Software Development (GSD) shows an increasing trend [4][12][50][51][55][56]. GSD is driven by several factors such as infrastructure with improved network, architecture based on components, reducing time to delivery through “follow-the-sun” development of software [53] due to pressure on time to market [6], reducing development cost [7], the need of locating an expertise near the customer’s site [19] and the possibility of hiring skilled, competitive and experienced employees across boundaries [2][5][76],

However, development of software requires good management practices in a distributed environment [1]. A number of studies mentioned that the benefits discussed are not fulfilled in real time [56] and GSD face challenges mainly due to geographical distance, temporal distance and cultural distance.

Teamwork and communication between and among the teams and team members play a major role in globally distributed teams [1][13]. Globally distributed teams communicate with the help of several communications tools [10]. However, there are several challenges faced during GSD projects management such as differences in the terminology used by the distributed teams, socio-cultural issues [53], different backgrounds and communication and coordination issues [3].

In collocated teams, managers can monitor the performance of the team members and also can assess the advancements in the project by directly watching. Collocated teams gather regularly which results in early trust building and sharing ideas [6]. However, distributed teams lack in meetings informally hamper “tameness”, trust and knowledge exchange [54]. Due to the lack of face to face meetings, goals and practices are not shared commonly between and across the teams [77].

Cultural distance is another challenge for GSD due to perception of time, way of communication and hierarchy. Communication between people from unlike background leads to misunderstandings which hampers success rate of projects [53]. Current literature has reported various practices to overcome these issues such as meeting face-face to understand the customs and traditions of other cultured teams [53].

Time zone difference is also an issue as the teams are geographically separated [53]. Sites located far away with prominent differences in time confront major issues while communicating, compared to sites with less time difference. Feedback from other sites may delay due to different time zones [53]. Ambiguities cannot be handled adequately with the help of asynchronous tools of communication. Tools may also lead to misinterpretations [56]. Some tasks in GSD require more effort and time than when teams that are collocated [53]. There is a gradual decrease in the distributed team’s performance compared to collocated teams. GSD projects reported to fail not because of deficiency in capacity, but due to deficiency in consciousness of effects, trouble and constraints concerned to distributed work [52].
Some of these problems have thought to be overcome by using agile practices [21]. Highly uncertain projects make use of agile techniques for the effective outcome of the projects [17]. Agile software development keeps its emphasis on broad coactions between developers and customers. It is also noticed that several project managers, who work on globally distributed projects are significantly conceiving the initiation of agile methods [20] [21].

There are several agile practices such as SCRUM, Crystal Clear, Extreme Programming, Feature Driven Development, and Dynamic Systems Development Method (DSDM) available for managing GSD projects [25]. The various agile practices that are being used in the organizations help in achieving maximum profit [19]. In order to overcome problems due to physical separation, there is a need to alter the agile practices. There are several new versions of agile practices released, which are customized to gain maximum benefit in distributed projects [18].

In this thesis study, we consider the challenges and practices of GSD that are related to project management. Here, we investigate specifically SCRUM due to its wide usage in industry. SCRUM is an incremental framework to develop or manage software projects [14] [20]. Some studies stated that global development teams can effectively make use of SCRUM [8] [28]. SCRUM concentrates on daily project management activities. It concentrates on work prioritization depending on scope of business, amending the utility of deliverables, gaining revenue early.

A survey conducted earlier on agile practices [27] shows that SCRUM has a higher rate of adoption for managing projects. Use of SCRUM reported to provide high productivity [24]. Moreover, communication and cooperation between and among the teams can be improved [24]. On the other hand, there are several risks that are associated with the usage of SCRUM in GSD [9]. A framework is designed in order to help researchers in understanding the various risk factors of making use of SCRUM in GSD [9]. The training need for the distributed teams for the usage of SCRUM practices is also reported [17]. Encouraging and ensuring effective communication while using SCRUM produce productive results [22] [23] [27]. SCRUM is mainly used to control projects by easily updating documentation [26]. Organizations are reducing their investment on documentation and started investing on continuously improving the team’s performance.

Several reports have stated that many projects benefited from the use of SCRUM in GSD by communicating regularly [20]. However, it has been reported that more empirical manifest is required on the agile approaches, followed by globally distributed software projects [4] [8].
1.1 AIMS AND OBJECTIVES

The aim of our study is to investigate the use of scrum practices in GSD. The objectives of this thesis study are:

Here are the objectives of this study are following.

- To identify the management challenges in globally distributed projects,
- To investigate the SCRUM practices in GSD projects,
- To investigate the benefits and challenges faced by GSD organizations while implementing SCRUM practices to address management challenges in GSD.
2 BACKGROUND

2.1 SCRUM

Nowadays, many significant challenges are being faced by the development team in dealing with the necessities of customer. Along with the changes in requirements, adaption of modern technologies needs to face hazards with respect to the traditional approaches of developing software [15] [32].

Increased competition level of the software in market also raised the need for adaptable and adjustable methods of developing software with high ease of change. Due to the altering behaviour of software market, companies commenced the enforcement and adoption of wavering, altering and emerging drift of methodologies to develop software generally called as Agile development[15][32].

The main attention here is to confront the varying needs of software market and efficiently handling them [15]. Takeuchi and Nonaka granted a quick, changing and reconciling process of software development [75]. Subsequently, in 2002, Schwaber and Beedler together processed SCRUM and reported their work [15]. SCRUM, a light weighted agile methodology to develop software, small iterations are used by SCRUM. The main aim of SCRUM is to respond rapidly to modifications. It follows a substantial way of developing software than other traditional approaches as shown in Figure 1[15].

The fundamental idea behind this approach is that development of a system depends upon several uncertainties which include technical, unstable and incomplete requirements, time bound infrastructure, resources and other technologies to develop. SCRUM affords such compliances in process of development that delivers a system efficiently before deadlines to the customer.

Figure 1Process of SCRUM [15]
2.1.1 STAGES IN SCRUM PROCESS:

SCRUM methodology comprises of three phases. The following section describes the various stages in SCRUM process [15][31][32].

- **Pre Game Phase:**

  Planning, utmost design and architecture phase in a software development life cycle are covered in this phase. The necessities come from customers, marketing team and developing team. Prioritization of these requirement is accomplished and assessments are acquired which are later joined to product backlog [31]. Updating of the list is made next to respective iteration. Members are selected to commit for the project in this phase. This phase also includes planning of tasks such as managing risks controlling and choosing resources and tools [15][32].

  Designing architecture of system, depending on product back log is attained at this stage. In order to interpret the design and comment it for adjacent phases of life cycle, as eminent meetings will be conducted by the termination of pre-game phase [32].

- **Development phase:**

  Game phase is another name of this phase. Here, alterations are predicted and any unpredictable changes were also contend to admitted them, repeated cycle that include system increments are developed called sprints [15][31]. Generally, a sprint comprises about 2-4 weeks of cycle. Each sprint includes planning till implementation phase proceeding with phases of delivery.

  By end of each sprint, few deliverables that needs to be acquired unlike teams can function over unlike increments in several sprints [32]. Based on the projects nature, the total number of sprints of a system may vary.

- **Post-Game Phase:**

  This is the final stage of SCRUM, just prior to release of system. It begins once all requirements are performed. Tasks such as system quality assurance, module integrity, and integration documentation are performed in this phase [15][31].

2.1.2 SCRUM ROLES

SCRUM has several roles, they are discussed them in the below section.

- **SCRUM Master:**

  This is a role of the management whose duty is to promote development team and abolish all hurdles that induce obstruction throughout sprint. It plays a major lead in perpetuating an apparent environment for promising, cooperation and communication among members of the SCRUM team. He acts as a coordinator among customers and
members of project [15]. Usually SCRUM masters are someone with high experience in industry to perform functions easily. The tenets of SCRUM to be pursued are the team member’s duty. During the meetings of daily SCRUM are resolved and facilitated by SCRUM masters. They always aim for improvement of team member’s performance [15][32].

- **SCRUM Owner:**

  Needs of the customer are prioritized by the SCRUM owner and he assures that the project confirms to requirements of the customer and he also make sure that needs of business are being approached properly [15]. He observes if all the team members are developing accord to needs of customer. He also checks if the direction of all the efforts. SCRUM master modifies and sustain the product back log. None other than the SCRUM owner can alter the product back log. Requirements are explained by SCRUM owner to team members [31] [32]. Discuss upon the status of the project if it is done systematically. SCRUM owner handles the approval or rejection of requirements.

- **SCRUM Team:**

  They are the authentic members obliges for activities such as analysing requirements, designing the system, implementing the design and testing the developed system. There can be around three-eight people involved in the SCRUM team [15]. They organize themselves and in case of hazards they inform to SCRUM MASTER. Individual progress is updated to the rest of the team members by participating in SCRUM meetings conducted daily in reciprocate environment [15] [31].

- **Customer:**

  Activities concerning the requirements are dealt by the customer. Customer’s perspective is given high importance. Satellites of customer can also meetings conducted at sites that develop. [31]

- **Chickens:**

  These are the ones who are dedicated to work with the project by taking responsibilities officially [15].

- **Pigs:**

  These people are the one who is dedicated to work with the project by taking responsibilities officially [15].
2.1.3 SCRUM MEETINGS:

SCRUM methodology involves several meetings throughout the development [15]. The meetings in SCRUM are discussed in detail in this following section.

- **Sprint Review Meeting:**

  Process of SCRUM begins with a sprint planning meeting. This meeting is anticipated for 8 hours. In this meeting, managers and customers meet the SCRUM team. Product backlog is prepared by the product owner before start of the meeting. He demonstrates the prioritized information. Team is left for discussing their perspectives [15]. They altogether conclude the activities for the SCRUM in sprint. Capability of team, delivered items by end of the sprint and scalability of the technology are considered while meeting the decision and strategy will be prepared by the whole team for enabling the activities to be delivered before sprint terminates [15]. All the members of SCRUM team should actively participate and communicate their views. Product backlog should be shared by product owner to all members.

- **Daily SCRUM:**

  The members of the SCRUM team meet daily once in the morning in order to update the daily progress of work. The meeting is conducted for about 15 minutes. Each member of the teams should answer the three questions [15]:
  1. “What did you do yesterday?”
  2. “What will you do tomorrow”?
  3. “What obstacles are in your way”?

- **Sprint Review:**

  This meeting is conducted during the end of the sprint. The whole work done by the entire team throughout the sprint will be demonstrated. Management, customers and product owner will actively partake in meeting. Generally, it lasts for 4-5 hours duration [15]. Deliverables of the sprint are saved by each member. Only achievements of team will be discussed. Experiences of the team members are shared.

- **Sprint Retrospective Meeting:**

  Team, product owner, SCRUM master attends the meeting which lasts for three hours. Achievements in the on-going sprint will be discussed. Things that need to be improved in successive sprints were also discussed. All the answers will be noted down by the SCRUM master [15].
2.1.4 **SCRUM ARTIFACTS:**

SCRUM uses several artefacts’ for storing the information regarding the project [15]. These artefacts’ are discussed in detail below:

- **Product Backlog:**

All the recovery activities that are to be performed by team will be listed here. It is maintained by product owner. All the activities throughout the project will be included here [15]. Declaration of all required functionality tasks and prioritized. Several features related to the project being developed will be included. In order to help to product owner in assessing the precedence and time bound, expected days are also enclosed. Requirements that are both functional and non-functional will be listed out [15]. Precedence of requirements is made in an efficient way.

- **Sprint Backlog:**

It includes the tasks to be performed by the team members in the on-going sprints. Time required to finish unlike features and precedence are considered while selecting items for sprint backlog form product backlog once sprint is sealed, no modifications can be done for that sprint[15]. Procedures can be changed according to team’s willingness.

Defect tracking system, excel sheets can be used for both sprint backlog and product backlog. Development team is responsible for updating, sharing and communicating the status with product owner and SCRUM [15].

- **Burn Down Chart:**

The relation between the work left out and duration will be represented graphically [15]. Burn down charts are created by using excel sheets, whiteboards and SharePoint. Creation and maintenance of burn down chart is done by the project management. Daily it needs to be updated.

  - **Horizontal Axis:** Work left out
  - **Vertical Axis:** Duration

2.1.5 **SCRUM Practices**

A practice is an activity which is repeated again and again to improve or achieve specific goals; it’s unlike the process where one has to follow a fixed sequence of steps to achieved guaranteed results. In our study we investigate about SCRUM practices currently used in the industry in accordance with their usage and effectiveness.
3 RESEARCH DESIGN

The objectives of this study are to investigate management challenges in GSD, to find SCRUM practices used in the organizations and to identify the benefits of using SCRUM and the challenges while implementing SCRUM. The research questions and the research methodology of this thesis study are described in the following sub-sections.

3.1 RESEARCH QUESTIONS

The research questions (RQ) for this thesis are as follows:

- **RQ1.** What are the project management challenges in globally distributed projects?
- **RQ2.** Which SCRUM practices are currently being used in software organizations that develop software globally?
- **RQ3.** What are the major challenges and benefits of implementing SCRUM practices in GSD?

3.2 RESEARCH METHODOLOGY

This thesis study is exploratory in nature. In our study we have used mixed methodology involving both qualitative and quantitative research [30] methods (see Figure 2). In the first phase of our study, RQ1 and RQ2 are answered by conducting a literature review on GSD and SCRUM practices used in GSD. A systematic literature review [8] was used as a basis for this study. One of the authors has gone through the references cited in these two studies and used a snow ball technique to identify the relevant papers by going through all the cited references. The data gathered from the literature was analysed using a qualitative data analysis technique; Notice, Collect and Think [74].The literature review conduct and the results are presented in Chapter 4 - Section 4.1.

In the second phase; RQ1, RQ2 and RQ3 were answered by conducting six industrial interviews indifferent software organizations located in different geographical locations in the world. The data gathered through the interviews was analysed by applying grounded theory (GT).

In the third phase, we conducted an industrial online survey [29]. The main reason behind conducting a survey is to investigate further the results obtained through literature review and interviews, and to investigate about critical “management challenges” and “SCRUM practices” which were reported both literature review and from empirical study. Similarly the most significant “SCRUM benefits” and “challenges while implementing SCRUM” were also identified. In total 24 persons from different companies with different designations participated in the survey.
Finally the outcomes from literature review, interviews and survey were refined to find answers for RQ1, RQ2 and RQ3.
4 MANAGEMENT CHALLENGES AND BEST PRACTICES IN GSD

Following section discussed management challenges and best SCRUM practices found in literature review, interviews and from survey after analyzing the data.

4.1 LITERATURE REVIEW

In our study, we have followed certain steps for conducting a literature study, in order to gather various project management challenges and SCRUM practices in GSD projects. The steps are explained in detailed as follows:

Snowball sampling: From the extended associations and through previous acquaintances snowball technique is used to obtain research and knowledge. Snowball technique [56] which is a technique for developing a research sample is used for gathering articles that reported Scrum practices in GSD projects. The major weakness of snowball sampling is that it is very hard to choose the initial paper decide on where to end.

Primary study for snowball sampling: A systematic review has been considered as the most relevant article for our study to perform snowball sampling [8]. In this article, the authors identified 20 papers relevant to their study. They gathered information from those articles to find several issues in implementing SCRUM in GSD. The authors have also extracted various SCRUM practices used in GSD [8]. These challenges and practices gathered through the systematic literature review [8] were joined together to come up with a conceptual framework [9].

Snowball sampling [56] has been performed in order to gather the most relevant studies. The authors have gone through the references cited in these two studies. In that way we have selected more relevant papers by going through all the cited references. We have used search engines to download those papers. Exclusion of articles is made by studying abstracts. If an article referred is found to be irrelevant we excluded them for our study. Several articles which were not referred in the systematic literatures considered for snowball sampling were also included in our study.

Drawback with the SLR: The SLR that is considered as most relevant for our study explored the SCRUM challenges and practices in GSD projects. It didn’t consider the management challenges in GSD. Moreover, it didn’t provide in depth empirical investigation. Through snowball sampling we have gathered 49 articles relevant to our study.

Need for gathering articles systematically: In order to cover those papers that are not covered through snowball sampling, a literature review is conducted in a systematic way. Following steps clearly mention the various sources from which the information is gathered.
Sources of information:

We have assembled the information required for conducting literature review from various sources. The several databases we have used for searching information include:

- Scopus
- Springer Link
- Elsevier Science Direct
- Compendex EI
- Wiley InterScience
- Google Scholar
- IEEE explorer
- AISC Library

The project management challenges and usage of agile methodology Scrum in the context of GSD were found from proceedings of conferences on:

- Agile
- Service computing
- Global Software Engineering
- Engineering of computer based system
- Software Engineering
- Services, sciences and management engineering
- Industrial Technology
- System Sciences
- Software metrics
- Agile development
- Software process improvement
- Future of software engineering
- Product focused software development and improvement
- Extreme programming
- Cooperation and promotion of information resource in science and technology

The project management challenges and usage of agile methodology Scrum in the context of GSD were found from Journals:

- Empirical Software engineering
- Universal knowledge management
- Information systems management

Several combinations of the following search terms were used to gather articles related to project management challenges in GSD and Scrum practices in GSD:

Global software development:

- Distributed Software Development
- Off shoring
- Globally distributed software
Software project Management:
- Project management
- Project planning
- Project initiation
- Project control

Agile Software Development and Scrum
- Agile practices
- Agile methods
- SCRUM
- SCRUM methodology
- SCRUM practices
- SCRUM challenges

Exclusion from systematically found articles: We have found 629 articles systematically with the help of above search terms from which we have used exclusion criteria by excluding editorials, comments, reviews, article posters, prefaces, news and workshops. Out of these 629 articles duplicate articles were removed and we obtained 386 articles which included proceedings of conferences and e databases. We have excluded few papers based on keywords of papers and we have found 132 papers. Later, we have studied the abstracts of 132 papers and there were few papers which were not relevant to our study. All those articles were excluded and the final selection included 64 articles.

Overall exclusion: Among these 64 articles found systematically, there are 36 articles that were common in articles found while applying snowball technique. By excluding those 36 articles from 64 we have 28 articles. We have actually gathered 49 articles through snowball sampling. So the overall papers that were uniquely found during both the extractions are 49 +28= 77 articles. Hence, the overall number of articles considered for our study is 77.

- Qualitative Data Analysis (QDA)

We mainly used qualitative research method to analyze the data. However we also perform quantitative analysis on the survey results. It is therefore a mixed methodology approach. We used "Noticing, Collecting and Thinking" process as defined by John v. Seidel [74] for QDA Data has been coded and then classified into categories according to their similarity. Figure 3 shows Noticing, collecting and Thinking model.
We performed QDA on selected data used in literature review. Data had been selected and codified according to their type and themes. Similar codes were grouped and linked. Finally we found several management challenges and practices used in GSD projects. Similarities have been observed among those were grouped into main categories.

Our research is about GSD projects. Section 1.1 discussed about a GSD and its three distance dimensions (Geographical, Temporal and Cultural). These distance dimensions caused several vital management challenges in GSD, (RQ1 of our study). These management challenges are overcome by various SCRUM practices (RQ2 of our study). These SCRUM practices have several benefits and challenges while implementing these SCRUM practices (RQ3 of our study). It is therefore the aim and objectives of our research related to project management.

A standard project has 5 phases “Initiate, Planning, Executing, Monitoring & Control and closing” [57]. PMBOK [57] explained these phases as project management process groups containing 9 knowledge areas (processes) which are essential for any project. Instead of defining our own categories we used those standard 9 knowledge areas (processes) from PMBOK for categorizing of results. It is therefore both authors agreed on these categories as it covers every process area of the project management. These categories are:

1. **Integration Management**
   This is the main process area which includes activities and processes which are used to integrate various processes and elements of project management [57].

2. **Scope Management**
   It includes processes concerned with defining and controlling the project, criteria of what should be and what not to be included. It ensures that all related work is included [57].

3. **Time Management**
   These are the activities and process that deals with project deadlines [57].
4. **Cost Management**  
These are activities and processes covers planning, estimating, budgeting and controlling cost for the project to be finish within approved budget [57].

5. **Quality Management**  
These are set of activities and processes that assure if the product meets the customer needs as well as the organization needs [57].

6. **Human Resource Management**  
Activities and processes regarding rules and policies required to organize and manage the project [57].

7. **Communication Management**  
These are activities and procedures used to store information and manage the coordination and communication in the project [57].

8. **Risk Management**  
It covers activities and processes to avoid risk management in the project [57].

9. **Procurement Management**  
All activities and processes regarding purchase of product or services [57].

### 4.1.1 PROJECT MANAGEMENT CHALLENGES AND SCRUM BENEFITS FROM LITERATURE REVIEW

#### INTEGRATION MANAGEMENT

**Challenges**

- **Cultural Diversity:** An offshore partner having different cultural backgrounds has many dimensions and differences like language, attitude, communication style, it may leads towards miss understanding to other partner in different geographic area [53]. Diversity in culture could effect on globally distributed project. Due to different organizational structure, culture of responsibility sharing and complicated management level [63].

- **Technical Challenges:** In GSD projects, works are divided into distributed sites. This requires establishment of networks to communicate each other. These networks should be fast and reliable. As work is distributed and then integrated through configuration management task [53]. Organization experienced in GSD projects can faced variety of technical issues effect on project performance.
• **Regular Coordination**: Another important challenge is to manage coordination among team members across globe. Different people are working together across different sites to achieve one goal. It produces many coordination issues. [62].

• **Process Management Challenges**: During coordination between distributed sites, it became challenging to synchronize their processes between each other [53]. This coordination is highly critical at this level.

• **Contextual differences**: “Organizational differences, diversity in process maturity, inconsistency in work practices, goals and expectations” (environment) could affect the project performance [59].

• **Cross border transaction**: Organization faced challenges belong to remote site both political and legislative [59] while working in GSD project. This will effect on project performance and deadlines.

• **Multi sourcing**: An important issue is the involvement of various teams in development of a single process [60].

• **Monitor**: Continues monitoring could affect effectiveness of the team [51].

• **Managing Development**: Managing activities and procedures used in development across different sites is another important challenge for management [57]. It requires good control on practice and standards using in the organization.

• **Infrastructure Challenges**: Infrastructure issues like network and facilities could effects the performance of the project [58]. Well structure infrastructure always required to start the project.

**Practices**

• **“Team Gathering”**: To avoid problems due to culture and raise knowledge on project domain, few sprints are performed initially by gathering of SCRUM team prior to development phase at one site [21] [43] [45] [46] [47] [48]. Cultural distance can be reduced by conducting meetings quarterly with all distributed members of SCRUM team [18] [11] [34] [48]. Planning of SCRUM, retrospectives, several social activities and sprint can be performed during such gatherings [48].

• **“Proactive resource management”**: Ensure that the members of SCRUM team possess required tools and knowledge of implementing SCRUM strategies. Several tools for collaboration such as wikis, blogs, whiteboards, and team viewers are found to be really efficient during using of SCRUM strategies [18] [33] [35] [34] [36] [37] [49]. Communication and issuing outcomes of SCRUM meeting can be posted on wikis by members of distributed team [49]. Tools such as issue tracker, rally and backlog management tools found to be effective [18] [33] [35] [36] 11 [47].
SCOPE MANAGEMENT

Challenges

- **Strategic Challenges:** These challenges belong to decision making issues. First of all it is important for management to declare a project “offshore” [60] which requires detailed assessment followed by standards and plan. Next distribution of the work across globally distributed sites, expected difficulties during this distribution and their possible solutions according to resources available on respected sites [53].

Practices

- **“Mandatory participation”:** While conducting retrospective meetings, a compulsory 30-minute presentation is performed by each SCRUM team to avoid “offshore silence” [48]. Involvement in these meetings assists build on authorized disseminated team [48]. Cultural obstructions can be reduced by urging members of offshore team to furnish important data while conducting meetings if SCRUM [18].

- **“Gradual team distribution”:** Knowledge of project domain can be improved by transition of SCRUM team from one site to other site gradually [43]. This also reduced cultural barriers starting sprint at offshore involved, onshore SCRUM master who later involved with onshore team [45].

TIME MANAGEMENT

Challenges

- **Time zone differences:** In GSD projects, people work across temporal distance due to geographical location between remote sites having time differences. Following are two management challenges due to time zone differences.

  **Time Delays** “We work they sleep”. Due to geographic location and time differences between sites, time delays occur during synchronization in important processes between remote sites [59].

  **Short intervals** Due to continuously (round the clock) development on GSD sites, there is very short intervals between processes for coordination and configuration management [61].

Practices

- **Synchronised working hours:** Highly used practices by SCRUM teams to assure the feasibility of synchronous communication among sites that are distributed. This can be achieved with adjustment of working hours, extended work hours, residential working [18] [33] [34] [43] [44] [46] [47] [21] [49]. Few strategies are adapted by teams to deflect the motive of raised lapping time [34]. Three questions are answered
by team members, prior to meeting such that meetings can be made effective and small [11] [39] [42] [45].

- **“Site based local SCRUM team”** Members of local SCRUM team gather and conduct local SCRUM meetings because of reduced overlap time [34] [40] [11] [41] [48]. Inter team communication can be assured by following SCRUM of SCRUMs practice with the important members from each team. Autonomous local teams and allocation of architecture subsystems that were independent and having motivated interfaces are required in forming such team which in turn decrease communication in inter sites [34] [39] [40] [43]. Several communication lines can be established by conducting extra distributed meeting with technical lead and SCRUM master of each SCRUM team [40].

- **“Modified SCRUM practices”**: SCRUM practices are altered and extended in few cases in order to deal with challenges of communication. It is very efficient to reward the measure of SCRUM among members of local SCRUM by conducting a “mini SCRUM” every morning [47]. Emails should be responded before 12 hours in order to avoid time lag [40]. Only important SCRUM team members will go to the meeting rather than whole team to be present during late nights [37] [43]. Other practices included postings of remarks and outcomes on wikis. Mailing discussions of local meetings and onshore team will carry demo of sprint [18] [33] [35] [40] [43] [46].

➢ **COST MANAGEMENT**

**Challenges**

- **Budget Overrun**: The budget of a GSD project sometimes increases due to several factors [59]. There are variations in development cost [61] between different sites located in different regions. The management cost is also varies unexpectedly due to same [59].

**Practices**

No practices were found relevant to this category

➢ **QUALITY MANAGEMENT**

**Challenges**

- **Maintaining Quality**: Quality is the implementation of standards in all process areas. In GSD projects it became challenging for management to maintain quality aspects as work is distributed among different sites [57].

**Product Quality**: Low development cost is most attractive factor in developing countries in order to compete in software market but it could effect on product quality [58].
**Process Quality:** Inability to maintain quality in processes could effect on product quality in result loosing customer satisfaction [58].

**Practices**
No practices were found relevant to this category.

➢ **HR MANAGEMENT**

**Challenges**

- **Higher Documentation overhead:** Ensuring project visibility for every stakeholder in the project is another challenge which requires detailed documentation in order ensures clarity [60].

- **Complex Hierarchy:** Complex hierarchy/structure of organization effects on the running processes caused delay in resolving problem [58].

- **Staff Management:** It is very important to empower the staff. Encourage them in order to participate actively in the team, by performing good socialization, safety and protection sensation and rewards [60].

- **Trust:** In a GSD project peoples participate in common software development on different geographic locations and backgrounds. Therefore trust is most important factor between them. One can lose trust effect due to various reasons i.e. job security, poor socialization, shifting of responsibilities etc [51] [17].

- **Trained Team members:** There is always a need of trained workforce for the project [61]. If the team is not well trained then it leads to project slippage.

- **Inexperience:** Getting experience in offshore project for organization is always challengeable. In-experience in distributed developments is major reason of failure for GSD projects [59].

- **Willingness:** Changes not always welcome in Organizations, because of their complex internal structure and ambiguous hierarchy level results delayed in scheduled [58].

**Practices**

- **“Dedicated meeting room”:** Video projector is fixed at every site to make meetings of SCRUM transparent to everyone [45]. Assures that each distributed place is allotted a distinguish room for meeting which consists of all the equipment and communication tools [18] [35].
• “Single room”: Separate room to the SCRUM team to communicate is allotted. If an individual change team, he should be able to move to these room of new team [18] [21] [35].

• “Coffee/ice cream meetings”: Culmination of a module member of team celebrates by going to ice cream shop or coffee bar. Several issues are also discussed during these meetings. This improved mutual understandings and trust among members of the team [44].

• “Visits”: Project vision can be improved by substituting visits. Cultural distance can also be cut down by frequent visiting of offshore team by product owner during development [21] [45] [46]. Maintenance of designed revolution between both onshore and offshore team improves coordination [44] [45]. Making members of the team completely realize the project vision can be made by roadmap meetings conducted by product owner [46].

• “Key documentation”: Important documentation should be maintained properly in order to increase collaboration among team during usage of SCRUM practices [21] [40] [46]. Misunderstandings can be avoided with help of use case diagrams. Several tools such as enterprise wikis, PM tools and issue tracker assert improved documentation and make project transparent [40] [46].

• “Distribution policy”: It is reported in the literature that each integrated team of SCRUM should be distributed among two sites. [40]. A study mentioned that distribution of each Scrum team was among two sites, though there are multiple sites in which the project is distributed [40].

• “SCRUM master needs to be a strong negotiator”: SCRUM master should be firm. He should be capable to prioritize requirements and force member of team to rescues on corresponded time zone because, practices of SCRUM depends on the trust and collaboration among members of the team [20].

• “Training”: Several issues related to technology are trained to SCRUM team. Value of the SCRUM and collaboration among team can be improved by giving training on SCRUM initially [40] [46].

➢ COMMUNICATION

Challenges

• Communication: It is most important challenged faced during GSD projects. Team across geographical location faced communication issues due to their location, time zone issues and socio culture backgrounds caused project delays. Organization needs a definite way to communicate plan with stakeholders; it can be formal, informal, vertical horizontal, synchronous, asynchronous, structured and unstructured [53].
• **Linguistic diversity**: It is also the most important challenge faced by GSD management. Distributed team across globe has different linguistic backgrounds. It is therefore hard for them to coordinate and communicate each other. It may leads to misunderstanding; miss-interpretation caused project delays [63].

• **Data Privacy challenges**: (both Customer and organizations) Data protection is always important. In GSD project the protection of data is more important as it communicated between different geographic locations. The customer also has concern on his data security. Failure could affect with customer relationship. So it requires a mechanism to avoid this [60].

• **Knowledge Management challenges**: Organization requires an effective way of information and "knowledge sharing mechanism" by using pre-define standards and procedures. Staff training regarding this mechanism leads to effective collaborative development. [65].

**Practices**

• **“High reliable communication bandwidth”**: An environment with fertile communication can be provided with the help of several communications tools which avoids dumb, poor and in dependable transmission [18]. Several tools are used for communication such as webcam, phone, instant messengers, video and voice conference, SMS, email, net meetings, tele-conferences [44]. Therefore suitable tools can be chosen from broad range of tools desirable for bandwidth of communication [44] [18].

• **“Reduce SCRUM meeting length”**: Challenges with asynchronous communications can be covered by cutting down length of the meeting. Duration of the meetings can be reduced by being prepared with SCRUM questions prior to the meeting. This strategy eliminates distributed meetings early mornings and during nights [20].

• **“Additional distributed meetings”**: Collaboration among team members can be improved by conducting regular meetings informally to solve several matters [18]. In these meetings they can discuss about testing, architecture design and social issues etc [44].

• **“The use of a “global” task board”**: It is useful in amending the productiveness of agile teams distributed globally. Actions to be done will be controlled by using minutes of meetings by member of all the teams. Delays and problem that were not expected aroused in some cases [44]. Formulation of tool to plan and execute sprints by globally distributing teams could be an efficient initiative. Unlike, normal teams there won’t be no architect, developer, project lead or a project manager. None of the members were assigned with similar responsibilities. Responsibilities dealt early [44]. Hence, a belief of group possession and port switching amended several acquisitions of member in a team.
RISK MANAGEMENT

Challenges

- **Risk Management challenges**: Almost every project involves risks and for GSD projects it is most critical because work synchronization across geographical boundaries and facing threats of risks more than a non GSD project. Managing risks in a GSD project becomes difficult for management [64].

Practices

No practices were found relevant to this category.

PROCUREMENT MANAGEMENT

No management challenges and practices were found relevant to this category.

4.2 INTERVIEWS

The interview is used to collect historical data from the respondent memories and also gathering the data that cannot be collected quantitatively [16][67]. Interview can be classified into three types. Those are structured interview, unstructured interview and semi-structured interview. In structured interview, the interviewer tends to prepare clear and specific questions (Yes-No form). Unstructured interview is an open-ended asked question as possible. The interviewee conversation is source of both questions and answers. Semi-structured interview is a combination of both structured and unstructured interviews (open-ended and specific questions) [68].

4.2.1 DATA COLLECTION

The desired populations for industrial study were the IT companies having GSD experience and using SCRUM inside their organization. The potential respondents were contacted by emails. Both authors used their business contacts with known experience in GSD, also both authors used internet search engines for companies that are currently involved in distributed software projects. The companies that were identified were contacted accordingly. We conducted six semi-structured interviews in six different companies. In which, we have conducted two face-to-face (one-on-one, in person) interviews and remaining four were video-conferencing interviews. All interviews were than transcribed to avoid interpretations.
4.2.2 INTERVIEW PARTICIPANTS

- **ORGANIZATION 1:**
  **XYZ ORGANIZATION, AUSTRALIA**
  XYZ was founded in 2001. It is one of the major business processes outsourcing companies in finance and accounting domains. It has three developing sites at Australia, US and India. This organization requested us not to reveal the organization name.

  *Interviewee 1*: He is working as a SCRUM master for globally distributed projects. Since four years he is working with the organization since eight years. His current project is to develop online banking software for a reputed bank.

- **ORGANIZATION 2:**
  **SOFT HOUSE, SWEDEN**
  It is Scandinavia’s popular software development provider. Their major focus is on mobile clients, service systems and outsourcing. They provide courses in SCRUM master and product owner certifications.

  *Interviewee 2*: He is working as a product owner and also been a SCRUM master. Current project is to develop accounting software for their client. Working in the organization since 4 years and working on GSD using agile methodologies since 3 years. Current project has 20 members in the team from Sweden, Denmark and Pakistan.

- **ORGANIZATION 3:**
  **BIZINTECH TECHNO SOLUTIONS, INDIA**
  Bizintech Techno solutions is a software service providing organization. It was established in the year 1896, currently around 300 clients all over the world. It has experts in all domains to provide for his projects for the HR- payroll, CRM, asset management and distributed systems.

  *Interviewee 3*: He is the technical general management of Bizintech. He is having 6 years of experience in using agile methodologies. He is having 8 years of experience in working with distributed projects. Current project is product development for computer based maintenance management (CMMS). Team size is 9. Focus developer, two testers an 2 marketing team member and one business analyst, 6 in India and 3 in Indonesia.

- **ORGANIZATION 4:**
  **ABC TECHNOLOGIES, INDIA**
  Infosys offers integration of systems, custom based development of software, verification and maintenance services. It is one of the India’s leading off shoring outsourcing companies. They offer services with higher quality and reduced risk of acceptance. Their main aim is to provide maximum customer satisfaction. It has branches in several countries.
Interviewee 4: His role in the organization is product owner. He is working in globally distributed projects using SCRUM since 5 years. His current project is revenues based cycle management system. The team size is 15-20 Indian developers including leads and architect and 8 functional designs from India and United States.

- ORGANIZATION 5:
  NOKIA, FINLAND
Nokia is one of the world’s leading organizations in communication and internal industries. They produce mobile devices, televisions, laptops, games. Their major focus is on providing internet solution and equipment’s.

Interviewee 5: His role in organization is project manager. He has been working in organization since four years in globally distributed environment using SCRUM. The case project is a mobile application development project. The developers are from Finland, UK and India.

- ORGANIZATION 6:
  VOPIUM, DANMARK
VOPIUM (http://vopium.com) is a software-based provider of free and low-cost international mobile communication via VoIP and Wi-Fi technology. Vopium offers a free application that can be downloaded directly to mobile phones to enable cheap international mobile phone calls, (SMS) text messaging, and Instant Messaging saving up to 90 percent on traditional international mobile and landline calls. Vopium automatically integrates with the user’s contact book. The software works independently of a SIM card or subscriber’s mobile network operator. Additional features include synchronization, web SMS, call back, and just dial.

Interviewee 6: He is CTO in that organization, He has 15 years of experience in globally distributed development projects and he attached with this organization since last 4 years. They are continuously working their product VOPIUM. Their Team size is around 70 and consisting of multicultural environment prevailing in 4 offices including Copenhagen, Luxemburg, and Lahore. The case project is to maintain and continuously develop product line and related web sites

4.2.3 DATA ANALYSIS
To analyze interview transcripts, we used Grounded Theory (GT) defined by Glaser and Strauss [38] [73]. GT is a qualitative systematic research methodology in which a theory is generated from data by a bottom up approach [38] [73]. Data is coded and categorized and again categorized and analyzed to generate a theory. It also provides constant comparison between collected data continuously. By this approach theory developed from collected data instead of applying theory on the data.
Although GT introduced by Glaser and Straus but both define different method of using grounded theory on data" [73]. Glaser emphasizes the individual researcher's creativity within a clear frame of stages [73] While Strauss approach concerns with validation criteria with systematic approach [73]; we also perform GT according to Strauss approach which consists on series of steps including Open Coding, Axial Coding and Selective Coding. Successful execution of these will generates a good theory as the result.

We used NVIVO 8 to systematically store records of all codes. It helps to apply and save code to any piece of data, sub-code, categorize, write memos and finally analyze the data. Each and every piece of information was added in the database; they were also tagged and linked to ease the traceability.

Data analysis was done by performing predefined procedure of GT by applying open, axial, and selective coding techniques/theoretical sampling. [60]. All the data was then thoroughly analyzed and codes were re-checked to ensure validity. The transcribed interviews were used as an input for GT. Finally outcomes of GT help to answer all the RQ1, RQ2 & RQ3.

**STEP1: OPEN CODING**

The first step is to apply code on each and every piece of collected data. This was performed by conceptualized line by line thorough study, in order to ensure everything is coded. Therefore each piece of data has been reviewed, analyzed and then tagged with proper keyword (code). These codes were re-checked to ensure validation. Finally there were 217 codes defined in total.

These codes were categorized into groups according to their similarity. There were total 30 classes of similar codes. Again similar classes were re-grouped and limited to 9 generalized categories.

In the following examples, we explained how open coding has been performed on interview transcripts.

**Text 1:** "While developing software globally, there are members from distinct cultures. Due to differences in cultural and language backgrounds, there arose cultural and linguistic issues?"

This statement addresses the core issue of cultural differences in GSD context. Therefore this statement coded as “Cultural Diversity” and the threat which caused this issue is therefore coded as “socio culture issues”. One memo was also noted regarding details about code and link to same code.

**Text 2:** “He said that daily SCRUM meetings are conducted to have synchronous communication”
This statement holds information about SCRUM practice used in the organization. Hence coded as “Daily SCRUM”, also a benefit link to this statement is coded as “synchronous communication”. Similarly memos were created and linked with these codes.

**Step 2: AXIAL CODING**

Second step is to relate codes (categories and their properties) with each other. It has been observed that many codes and categories are interrelated. As our research is related to GSD project management, for which a literature review has been performed in section 4.1 to find answers for RQ1 and RQ2, results from literature review were analyzed and arranged into categories in section 4.1. Similarly Interviews were conducted to explore industrial SCRUM experience regarding GSD context to find RQ1 and RQ2. In addition to find SCRUM benefits and challenges facing while SCRUM implementation (RQ3). It is therefore these categories have been used again to categorize the results obtained through interviews. They are used to classify the results during axial coding.

These codes were mostly related to management challenges and SCRUM practices. For each category there were challenges addressing the GSD related issues for management and SCRUM practices used in GSD context. Codes related to benefits of using SCRUM in GSD project and organizations experiences of “challenges faced during SCRUM implementation” were also explored. Table 1 shows distribution of codes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Challenges</td>
<td>79</td>
</tr>
<tr>
<td>SCRUM Practices</td>
<td>52</td>
</tr>
<tr>
<td>SCRUM Benefits</td>
<td>35</td>
</tr>
<tr>
<td>Challenges faced while SCRUM Implementation</td>
<td>51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>217</strong></td>
</tr>
</tbody>
</table>

Table 1 Code results

**Step 3: SELECTIVE CODING**

Third step is selective coding which involves integration between categories [73]. A category has been chosen as core category and then related to other categories accordingly. This was done by systematically validating relationship between each category. “Integration Management” has been adopted as core category as it contains high frequency of codes and found well to connect with other categories. We decided not to include unclear statement if they do not relate to any category to ensure validity of data.

It is noted that we explored 26 management challenges and 19 SCRUM practices during literature review (Section 4.1). After analyzing Interviews we found few more management challenges and SCRUM practices along with SCRUM benefits and challenges faced by management during implementation of SCRUM, which helped us to answer RQ3.

Finally from categories, we have 35 Management challenges, 23 SCRUM practice and 12 SCRUM benefits. In addition we found 22 challenges faced during SCRUM implementation
in GSD project. Figure 4 represents relationship Management Challenges, SCRUM practices, SCRUM benefits, SCRUM implementation with categories accordingly.

![Relationship Diagram](image)

Figure 4 Relationship diagram

The outcomes from the interviews are arranged in knowledge areas of management described in section 4.1. Each of them directly or indirectly influenced by one or more management challenges, similarly SCRUM practices were also involved in each category. It is not easy for management to overcome these challenges in GSD context; any decision will affect one or many areas performance and may cause project failure. Study also identified SCRUM benefits and challenges while implementing SCRUM in the organization. Using suitable SCRUM practices will benefit and may help to improve project performance and quality. Chapter 4 explained each management challenge, SCRUM practice and SCRUM practice according to each category.

### 4.2.4 RESULTS FROM INTERVIEWS

This section includes managements challenges found and SCRUM practices used in GSD projects.

> **INTEGRATION MANAGEMENT**

**Challenges**

- “Complex procedures are confusing”:
  Experienced people can understand the complex procedures but not some with less
expertise. For members’ with less expertise, it takes too long to understand those procedures which in turn delay the project.

- **“Convincing the stakeholder on Agile is difficult”:** The organizations always face difficulties in convincing the stakeholders to shift to agile from the traditional ways of developing software. It is always hard to convince a person who works on the projects front end alone.

- **“Poor technical expertise fail resolving conflicts”:** Due to poor technical expertise, the team would not be able to effectively minimize the conflicts and cannot realize the relation among variables related to organization and behavior.

- **“Poor feedback reduce team commitment”:** Team commitment and willingness to coordinate reduces, if the SCRUM master doesn’t support and is not committed. The most general problem is that the high level management does not provide feedback regularly about performance and daily activities included in the project.

- **“Poor coordination reduces trust and team does not share common goals”:** Interviewees have told that teams with improper coordination will never come out with defined roles and duties. They also had experienced several conflicts in delivering the projects on time. Ideas are not properly shared and it reduces trust among the teams.

- **“Lack of test automation leads to poor validation of product developed”:** It is often hard to persuade the testing team that none of the tools can be used for load testing and automated function testing.

- **“Conflicts arise due to new processes & emerging technologies”:** Emerging technologies and changing processes are also a big challenge. Due to emerging trends, needs of customers often change and team members lack interest in the product.

- **“Dependency among modules leads to project delay”:** Determining and controlling dependencies among the modules is a biggest challenge. Problems due to coordination exist, whenever they fail to find the interdependencies between the teams. One of the interviews told that, they were building banking software with 2 important modules being developed at Denmark branch, 1 module being developed at Mexico and another module being developed at London. Module being developed by Mexican team is dependent on the module that has to be developed by London. Denmark team has completed their work. London team had delay in finishing their module and the Mexican team has to wait for the London team to finish and it delayed the overall project delivery.
• “Hiding status results in project delay”:
  It is very hard to continue the team members do not share what they are up to. At times, the members of the team struck up at some point and they do not continue with the work, which finally leads to project failure.

• “Large number of developing sites makes integration difficult”:
  Collaborating among too many developing sites is very hard. Distribution of task would be difficult. Integrating the work will be very major issue which leads to project failure.

Practices

• “Prioritizing the objectives avoids schedule slippage”
  Ensuring the prioritization of the objectives based on the customers need is made. Objectives are classified into high level and low level objectives. Firstly, high level objectives are worked out and. Alternatives ways of doing things is planned. This prioritization helps in avoiding slippage of planned schedule. Organization objectives can be reached.

• “Customer and end user involvement”
  Customer and end users are encouraged to frequently review the work and provide feedback. Customers and end users should regularly keep updated on status and progress of the projects. When they find something missing from what they expected, they can inform immediately as changes made late increase rework. It overcomes challenges with change management and also reduces rework.

• “Avoid dependencies in user stories”
  In current era, with changing market trends, users change the requirements often. If change occurs, late in the project, rework will be increased. Stories of different user are prioritized in different ways. End users are to be kept in mind while writing user stories to avoid dependencies. Existence of dependencies delays the delivery of important functionality.

• “Regular status updates helps the team understand where they stand”
  From interviews it is also found that, updates need to be conveyed to all the stakeholders. Status meetings need to be conducted regularly where customers and stake holders are encouraged to participate and share their feedback. In case of absence minutes of meeting is shared with them.

• “Limited team size, number of developing sites and distributed SCRUM teams improves coordination”
  Size of the team need to be kept always limited. Larger the team size, higher the risk. If number of SCRUM teams is large then SCRUM of SCRUM is implemented. In case if the size is too large, then SCRUM of SCRUM of SCRUMs is implemented. A SCRUM master is allotted for each SCRUM at each location. If the numbers of developing sites are too large, see to that there should not be more than two SCRUMs.
SCOPE MANAGEMENT

Challenges

- “Poor standards reduce quality of the product”: Having poor standards is a major challenge in distributed environment. If standards are not clear, then quality of the software reduces.

- “Poor planning leads to project failure”: Success of the whole project depends on proper planning. If the plan is improper, there exist several conflicts among all the members of the team involved in the project regarding expectations. Once the project is in progress and getting complex, it is more difficult to have a clear idea of things to be done to have a successful project. So it is clear that improper planning leads to rework.

- “Decision making is difficult in innovative world”: It is difficult to make decisions in a distributed environment. It is always difficult to find out what the problem exactly is. Members of the team in distributed environment Members of the team in a distributed environment have different organizational structures and work environments due to which all the members don’t necessarily think in an innovative way that in turn leads to incorrect decisions.

- “Lack of Shared goals leads to failure of business goals”: The members of the team always lack common goals. Each member of the team performs in his perspective without having mutual understanding. This lack of shared goals leads to assumptions. Others opinions are never considered due to lack of shared goals which in turn leads failure of business goals.

- “Poor customer satisfaction result in mistrust”: When a product is being developed, customer requirements need to be kept in mind. There is no meaning in developing software that doesn’t meet customer needs. Customer will lose trust and good will in that organization.

Practices

- “Assuring the justification of decisions improves progress of the project” Decisions need to be made with proper care as it has impact on the whole project. There should be a clear justification on making a decision made which helps in performing the current actions rather than the performing actions correctly. It improves the progress of organization objectives.
TIME MANAGEMENT

Challenges

- “Short deadlines reduce team performance”:
  Due to shorter deadlines, team members are pressurized and could not work effectively. This gradually reduces the team’s performance and always leads to project failure.

- “Time zone issues reduce knowledge sharing”:
  For few projects with different time zones, one team sleeps while the other works. It is very difficult for them to share their opinions. If they need to inform something they need to wait until the next working day by that time the other time would be ready to leave.

- “Long meetings leads to disinterest of team members to participate”:
  Members of the team lose interest when the meetings are prolonged for a long time and they don’t communicate properly. Meetings are usually extended than expected and members of team do not share what is actually needed

 Practices

- “Using planning poker avoids anchoring while making estimations”
  Estimation is one of the greatest challenges being faced. Planning poker is the most efficient way recommended by all the interviewees for estimating the effort and budget. Card deck is given to each person who is involved in estimation and asked to pick one card. Second person should not see the card. When turning of cards is done, discussion on various estimates is done by keeping a tile imit. This process is repeated till estimates are met. It overcomes problem of anchoring. It is fun and everyone is involved.

- “Consider user stories when an experienced person is making estimates”
  When an experienced person make estimates he always over estimate things in which he is an expert and ignore things he is not familiar with. This challenge is overcome by using user stories while planning, if required. Mean average is also best methods the organizations referred about through which estimations there are sustainable and agreeable are met. Important thing is that any tool can be used by them. But objective should always be kept in mind.

- “Time zones of all development sites need to be kept in mind while planning for the meeting so that there won’t be any overlap”
  Times of daily SCRUM meetings are adjusted in such a way that all the time zones are met. All the team members can meet irrespective of their timing zone. It helps in making all members of team involved. It overcomes challenges with time zone difference.
“Two step estimation method to make sustainable estimates”

Estimation is found to be a greatest challenge in globally distributed projects. In SCRUM, there is nothing called Gantt chart and the traditional waterfall life cycle model. The easiest way used by the majority of the interviewees is the two step approach:
Step 1: on the first day, each team member is asked to make estimation of all stories as points.
Step 2: on the second day, each team member is asked to list out their tasks and the time they require to finish each task. Individual opinion need to be taken rather than discussing with other members. Once all the members finish writing, collect the paper in which tasks and estimates of each person is gathered. Sum up all of them and the final estimate can be calculated.

Local daily SCRUM meetings avoids asynchronous communication

All the distributed teams’ will conduct daily meetings at their local location to discuss the three SCRUM questions. It makes communication more synchronous.

“Reduce meeting duration to stop discussing solutions for problems”

All the meetings are fixed for a time. If the time is exceeding the discussion is stopped. Only problems are discussed but not solutions.

➤ COST MANAGEMENT

Challenges
“Incorrect estimations results in project failure”:
It is always a major challenge while estimating the effort and budget of the project, before completing requirements of business, deadline and budget of the project need to be estimated. If these estimations are wrong, project will be initiated with poor resources. This will be realized only at the end of the project and leads to project failure.

Practices
No results were found for this category.

➤ QUALITY MANAGEMENT

Challenges: No results were reported relevant for this category.

Practices: No results reported relevant for this category.

➤ HR MANAGEMENT
Challenges

- **“Complex hierarchy results in poor decision making”:**
  There are several problems with the hierarchy in the organization. It is hard to overcome the disputes that arise among the team members. When a problem occurs, there is no possibility of lower level team members to discuss with senior level management. Making decisions will be difficult due to egoistic issues among the different levels of hierarchy.

- **“Management pressure leads to mistrust and reduce confidence”:**
  Members of the team always lose their confidence levels due to the upper level management pressure on them. Due to overloaded stress, they cannot work effectively which in turn reduces quality of the software.

- **“Low visibility leads to coordination issues”:**
  When there is no visibility of the process, members of the team face difficulties in knowing the status of the other teams work. Coordination among the members reduces and important information will be missed.

- **“Work synchronization leads to poor task distribution”:**
  Synchronization of work is a challenge. They said there is need for rework due to poor collaboration among the team members and between the teams at same time.

- **“Lack of trust leads to project failure”:**
  The most important challenge in managing globally distributed projects is lack of trust. The interviewees have told that the lack of trust is due to reduced personal communication and poor language skills.

- **“Poor work environment leads to task slippage”:**
  When the work environment is not good enough, then the implementation of ideas cannot be fulfilled. Unavailability of resources leads to skipping of tasks. It will reduce the enthusiasm of the project members to work.

- **“In proper training result in project failure and team members of team lose confidence”:**
  Due to lack of training on the domain and usage of agile practices, projects lead to failure. It is very difficult to convince members of the team to go agile without training them on basics of agile practices.

- **“Lack of willingness leads to poor quality”:**
  A very major problem the organizations are facing is when the members of the team lack interest. They never cooperate with each other and they don’t share their opinions, reduces quality.
Practices

- “Provide training to new employees in usage of SCRUM practices”: All the employees recruited newly need to be trained on the applying SCRUM practices. They should be taught to think agile. If they are not aware of the SCRUM practices used by organizations, the whole project affects. Rest of the team members should help the new employee to understand the practices.

- “Sharing common goals helps in doing project right on time”: Goals are shared with all the team members and they are asked if they understood the document. If there is any ambiguity in requirements or phrases, it is explained to the members of whole team to have shared common goals and vision. It also helps to have improved organization goals rather than business goals.

- “Encouraging team involvement in meetings”: All the members of the team are encouraged to involve in the meeting such that any issues can be discussed clearly. All the team members are invited to attend the meetings and share their experiences, views and issues being faced by them. It helps improving team coordination.

➢ COMMUNICATION MANAGEMENT

Challenges

- “Linguistic issues results in misinterpreting things”: Language is a very important challenge especially in teams from different backgrounds. They cannot understand each other’s language properly. Misinterpretation of the requirements occurs due to language issues.

- “Lack of communication leads to project failure”: Informal communication between team members is reduced gradually. Feedback is delayed due to lack of communication. Misunderstandings arise due to linguistic issues. Cultural issues due to geographical distance are also increased.

- “Incomplete requirements results in misinterpretations”: An incomplete requirement is a great challenge. When the requirements are incomplete misinterpretation of requirements occur much more than in-house development due to linguistic issues and project does not meet customer needs and leads to incomplete product. Assumption of the requirements happens, which may lead to development of a wrong product.

- “Socio cultural issues leads to misinterpretations”: Other important challenge being faced by the organization is due to socio cultural issues. Success of the project is gradually decreased due to the dissimilarities in cultural background of the team members.
• “Low band width result in decreased transfer rate”: All the systems run slowly and transfer rate decreases. They also say that if the bandwidth is slow, distributed teams could not communicate properly which leads to delay in the progress of the project.

• “Lack of information sharing delays project delivery”: Sharing information among teams is a challenge because the teams do not share their status and their opinions which lead to complexity of the project. Due to complexity, project development will take too long than expected.

• “Data security issues reduce trust on employees due to high attrition rate”: Data security issues are a major challenge being faced by the organizations. If an employee leaves the organization in the middle of the project, the confidential information may be leaked to other competition organizations.

Practices

• “Regular information sharing keeps all the participants involved in the project” It has been told that information should be shared by all the members of the team. A check list is an efficient way to see if the status and documents are regularly updated to members of the teams. This regular information sharing and updating keeps all the team members involved in the project

• “Email on the important points need to be discussed is sent prior to meetings” An email with answers to what has been done yesterday what need to be done and any issues being faced are distributed to all the participants of the meeting priority to the meeting. This reduces linguistic challenges and also helps in reducing length of the meeting.

• “Record minutes of meetings to avoid loss of data” It is recommended to record the minutes of meetings, on activities that were discussed during the meeting. This helps to ensure such that no information is ignored or forgot in future. This recorded data is to be saved and sent to all the members of the team.

• “Motivate team in using video communication” Video conference is conducted among all the development sites. Video conferences will be a good substitute for face to face meeting, though it cannot be replaced. In video conference, facial expressions can be seen. It reduces the demand of travel.

• “Proper usages of communication tools help improve communication”: Communication is found to be the greatest challenge in distributing projects. Proper tools need to be used in order to communicate and keep in contact with the team members. There are several tools available in market for communication. Using high bandwidth network is very important as the teams are distributed a need to communicated often via the Internet and intranet facilities.
RISK MANAGEMENT

Challenges

- “Inability to manage risks leads to failure of project”:
  Several challenges are faced due to risk management. Risks are considered to be more general and are neglected, which in future leads to failure of the project.

Practices

- “Encourage team to self-organize in order to prevent occurrence of risks”:
  Team is motivated in such a way that they manage challenges themselves. Appreciation and appraisals motivate them to improve their progress and achieve organizational goals. It also avoids pressure of management on team.

- “Using of trained people helps to avoid risks”
  It is very important to hire right people and evaluating their expertise before hiring avoids lack of expertise in team. People with high experience will have come across several experiences which help in expecting risks and preventing risks before they occur.

- “Sessions for brainstorming helps in finding consequences of activities”
  Brainstorming sessions are conducted regularly, scheduled according to the team’s convenience. In these sessions, the consequences of each activity being performed are discussed and risks can be expected. This helps in measuring the risk and finding out existence of dependencies. After measuring risks action to prevent occurrence of risk is done. If it is already occurred, action is taken to alleviate those risks.

PROCUREMENT MANAGEMENT

No management challenge and practice found relevant to this category.

SCRUM BENEFITS

Few benefits were explored regarding used of SCRUM in a GSD project during empirical study to answer RQ3. Following is the detailed description of each challenge.

- Easy to Use
  The SCRUM practices are very easy to use. They don’t have any complex procedures. The teams help the new members of SCRUM team who were unaware of the practices. Practices can be mould according to their need.

- Implementing SCRUM provides better control in the team.
  SCRUM helps in providing better communication and improving processes for training the team. SCRUM helps in improving the practices and resources to have improved control.
Visibility and flexibility is provided:
Working hours can be made flexible while implementing SCRUM, beginning and ending times on a week day can be adjusted according to teams convenience, employees are allowed to work from anywhere, let it be clients office or from home. Work can be shared among people. SCRUM allows changes in technology and makes team to adapt new technologies and advancements.

Stakeholders get a shared focus:
SCRUM practices when implemented in GSD environment, can bring out the increase in morale and spirit of the team members, which results in high productivity, Improved satisfaction of the customer, keeping in mind the market trends and meeting the financial goals of the organization. All the stakeholders are encouraged to have shared common goals.

Better feedback mechanism is used:
In usage of SCRUM practices there is no change of hiding status of the project; feedback is provided regularly on all the concepts, not just quality. Feedback that is provided will be tracked and set of actions are planned on modifications that need to be done according to the given feedback. These changes should be controlled frequently. In a well-functioning SCRUM, suggestions are provided more consistently, timely and particular.

Improved Innovation
Based on the market needs, more and more trends can be added. Innovative ideas can be introduced in the successive sprints.

Improved Quality
The major benefit of implementing SCRUM is improved quality. Quality of the end product can be increased by implementing SCRUM practices in GSD projects.

CHALLENGES FACED DURING SCRUM IMPLEMENTATION

Results from empirical study regarding “challenges faced while implementation of SCRUM” are listed and discuss in following section. The result helps us to find RQ3. Following is the detailed description of each challenge.

Lack of knowledge about SCRUM makes it difficult for team members to actively participate:
Members of the SCRUM team without proper knowledge on SCRUM practices lack interest in actively involving in the project.

Hard to comply the team with the communication model:
Other major problem is to encourage effective communication model. Due to geographical distance, it is hard to provide effective information sharing without using proper tools with low communication bandwidth.
- **Not having a strong Product owner and SCRUM master leads adopting SCRUM more fragile:**
  Hiring right product owner and members of SCRUM team is like walking in parkland when equated to hiring a perfect SCRUM master. Not having a right SCRUM master makes it delicate to initiate SCRUM.

- **Good product manager can be a good product owner leads to misinterpretations:**
  The assumption that a good project manager can be a good Product owner leads to several problems. The leadership without knowledge about agile practices leads to problems.

- **Defining the sprints and deciding the weekly deliverables is challenging:**
  Decision making is very challenging as the sites are distributed globally. Determining the sprints and making a decision on deliverables is very hard.

- **Training**
  Having an un-trained team leads to lack of common goals: untrained members concentrate less on standards and organization goals. They always think about their individual goals. They lack having shared goals. Especially, when the leaders are not properly trained on SCRUM, right guidance will not be given to the teams. This is always challenging in a distributed SCRUM team.

- **Effective usage of SCRUM practices**
  It is challenging to effectively implement the SCRUM practices when they are too many sites. It is hard to encourage all members of team to actively involve in Scrum meetings.

- **Lack of support from the executives makes initiating SCRUM fragile:**
  If the higher executives think that using traditional methods for software development is better and they don’t encourage team to initiate SCRUM.

- **Fear of criticism leads to poor performance:**
  An important challenge in implementing Scrum in GSD is that the members of the team are worried to share their opinions or mistakes during the meetings. The main reason behind this is the fear of criticism and they hide their mistakes which lead to poor performance of the members of the team.

- **Convincing the Senior Management and the Project sponsor on Agile:**
  The major problem in implementing SCRUM in GSD is to make the senior management and project sponsor to realize upon the importance of agile. They always think that the traditional method is better than agile practices.

- **Getting people volunteer to take tasks and contribute to the sprint:**
  It is very difficult to encourage members of SCRUM team to take responsibility in working on several tasks and to contribute to sprint.
The team worried in getting exposed of their weaknesses:
Members of the team always feel inferior to share about their week points. They keep hiding if they cannot solve an issue until last moment which leads to project delay.

Large team size:
Another major issue in implementing SCRUM is large team size. It is difficult to communicate and conduct meetings. It is difficult to manage the teams.

Members of team feel inferior to accept their backlogs or mistakes:
Due to inferior complexity, the members of team do not react favorable for their own mistakes.

Difficult to build a shared vision on SCRUM:
One of the most challenging issues in implementing SCRUM in GSD is to encourage team to have a shared goal. It leads to disinterest of team members.

Concentrating too much on practices instead of SCRUM values and attributes is a greatest challenge:
It is really challenging if the members of the team focus much on the practices they implement rather than the final objectives of the organization.

Not supplying members of team with sufficient flexibility
It is also found that one of the greatest challenges of implementing SCRUM is not endorsing SCRUM team members with enough flexibility. The team sometime loses interest to work in office late in nights.

Frequent requirement changes in a sprint leads to project delay:
It is very difficult to cope up with frequent changes during a Sprint. Project delays due to the fickle requirements which is very challenging while implementing SCRUM.

Fear and compliance with employees:
Another major issue in implementing SCRUM in GSD is having fear of working and surrendering to other employees. This leads to disinterest among team members.

Lack of test automation affected the Sprint and delayed turnaround time:
Not having automated tools for testing influences the sprint and it also leads to delayed turnaround time.

Allocating resource’s properly is difficult:
Due to several distributed sites it is challenging to allot needed resources to all members of team.

Shift the paradigm of the team to agile is difficult:
Another major issue in SCRUM implementation in GSD is to shift from traditional software development methodology to agile.
4.3 SURVEY

A comprehensive online survey has been conducted during this study in order to strengthen our research. Survey Questionnaire can be found in Appendix. Participants from different organisation are invited to share their experiences in implementing SCRUM in GSD.

4.3.1 DATA COLLECTION AND ANALYSIS

The reason behind conducting survey was to investigate further the use of SCRUM in GSD. The challenges and practices identified through the literature review and the interviews were included in the questionnaire.

An invitation email contains short introduction, about objective and overview of this research was sent to the candidate participants. Participants were asked to provide answers to multiple choices for questions which were designed on the basis of literature review and interview results. Survey questionnaire are available in appendix “B”. 24 persons have participated in the survey.

In order to conduct the survey, an online tool was used (monkey survey.com) which provided many features to analyze data as well. Survey questions were prepared with the help of literature review and from the interviews. The respondents of the survey are professionals from software industry with experience in both SCRUM and GSD. Project managers, SCRUM masters, product owners developers are involved in this study. Mail requesting for their participation along with the short description of study is sent to the respondents. The outcome of survey helped us to answer our research questions as well as better understanding towards SCRUM usage in GSD environment.

4.3.2 SURVEY PARTICIPANTS

The participants of this study were software engineers who are currently or had been involved in GSD projects in industry. The participants include all functional groups involved in GSD project, such as project management, developers, analysis and design, coding, testing etc. They were contacted through emails. Concerned persons having experience in SCRUM and GSD projects were requested to participate in the online survey regarding our research. Total 24 persons from different companies with different designations participated in the survey. The details of companies and role of the persons participated are shown in the table below.

<table>
<thead>
<tr>
<th>Company</th>
<th>Role of Person participated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. e4e healthcare services</td>
<td>SCRUM Master</td>
</tr>
<tr>
<td>2. Cyber India Pvt.Ltd.</td>
<td>Developer</td>
</tr>
<tr>
<td>3. CashEdge India Pvt. Ltd.</td>
<td>Developer</td>
</tr>
<tr>
<td>4. Wipro</td>
<td>Developer</td>
</tr>
<tr>
<td>5. Valtech India Systems</td>
<td>QA Engineer.</td>
</tr>
<tr>
<td>6. Patna Computers Pvt Ltd</td>
<td>SCRUM Master, Developer</td>
</tr>
<tr>
<td>7. CSS Corp Pvt. Ltd</td>
<td>SCRUM Master, Developer</td>
</tr>
</tbody>
</table>
The persons participated in the survey included members from both development team and management team.

<table>
<thead>
<tr>
<th>Role</th>
<th>No. of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCRUM Master</td>
<td>6</td>
</tr>
<tr>
<td>Product Owner</td>
<td>4</td>
</tr>
<tr>
<td>Developer</td>
<td>10</td>
</tr>
<tr>
<td>SAP SD Consultant</td>
<td>1</td>
</tr>
<tr>
<td>test engineer</td>
<td>1</td>
</tr>
<tr>
<td>Quality Assurance Engineer</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3 Number of Survey Participants

4.3.3 DATA ANALYSIS

The total number of respondents completed the survey are 24. Their responses were included and analyzed for the purposes of this research. Participants are from different companies and backgrounds, most of them are developers and Scrum Masters. Most of them work with small SCRUM teams. The best motivation behind implementing SCRUM in their organizations is to “Improve Quality and productivity”. Top three SCRUM practices they preferred are “Synchronized working hours”, “Reduce Scrum meeting length” and “Key Documentation” and “High reliable communication bandwidth” accordingly. Majority of participants used “Excel” as software tools are used by them for planning projects in SCRUM.

4.3.4 RESULTS FROM SURVEYS

PROJECT MANAGEMENT CHALLENGES

Participants of the survey were asked to rate the management challenges faced during the implementation of SCRUM in GSD projects. The mostly opted management challenge was “Inexperience” by almost all participants. Other significant management challenges are “Process Management”, “Multi sourcing” and “coordination” respectfully. However Budget overrun and Infrastructure are the two challenges which were not selected at all.
The survey results for the management challenges are displayed in the following graph.

![Management Challenges in GSD](image)

**Figure 5** Management challenges rating through surveys

**SCRUM PRACTICE**

Participants were also asked to rate common SCRUM practices according to their usage in their organization. According to the results, it is also been noticed that they used multiple SCRUM practices in the organization. The most significant SCRUM practices are “Reduce SCRUM meeting length” and “Synchronized working hours” respectfully. It has been observed that all SCRUM practices are being used widely in industry. The survey results for the performed SCRUM practices are displayed in the following graph. All the practices are being implemented by at least one of the respondents.
SCRUM BENEFITS

Participants were also asking to mention what benefits they get after implementing SCRUM in their organization. The results show that by using SCRUM practices, they succeed to achieve maximum business value, productivity and improved quality. Most significant benefit of using SCRUM is “Improved productivity and quality”. Other widely selected SCRUM benefits are “Improved Innovation”, “Easy to adopt changes in scope” and “Issues can be identified early in the development” respectfully.

The results of the survey for the SCRUM benefits are displayed in the following graph. There were no benefits that were not chosen at all.
CHALLENGES WHILE IMPLEMENTING SCRUM

Participants were asked to choose the challenges they experience while implementing SCRUM. Most significant challenges are as follows.

- Communication to comply the team with the communication model
- Un-trained team
- Lack of knowledge about SCRUM
Figure 8 SCRUM implementation challenges rating through surveys
5 DISCUSSION

In this thesis, we identified several project management challenges in GSD and a number of SCRUM practices to overcome these project management challenges. The challenges faced by the organizations while implementing SCRUM practices in GSD projects were also captured. We answer the research questions of this study in the following paragraphs.

RQ1. What are the project management challenges in globally distributed software projects?

There are several project management challenges in GSD projects and several Scrum practices used in GSD projects. Table 4 shows the list of project management challenges that were reported in the literature.

<table>
<thead>
<tr>
<th>No.</th>
<th>List of Project Management Challenges found in literature review</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Risk Management challenges</td>
</tr>
<tr>
<td>2</td>
<td>Higher Documentation overhead</td>
</tr>
<tr>
<td>3</td>
<td>Budget Overrun</td>
</tr>
<tr>
<td>4</td>
<td>Strategic Challenges</td>
</tr>
<tr>
<td>5</td>
<td>Complex Hierarchy</td>
</tr>
<tr>
<td>6</td>
<td>Communication</td>
</tr>
<tr>
<td>7</td>
<td>Linguistic diversity</td>
</tr>
<tr>
<td>8</td>
<td>Cultural Diversity</td>
</tr>
<tr>
<td>9</td>
<td>Technical Challenges</td>
</tr>
<tr>
<td>10</td>
<td>Data Privacy challenges</td>
</tr>
<tr>
<td>11</td>
<td>Coordination</td>
</tr>
<tr>
<td>12</td>
<td>Staff Management</td>
</tr>
<tr>
<td>13</td>
<td>Process Management Challenges</td>
</tr>
<tr>
<td>14</td>
<td>Knowledge Management challenges</td>
</tr>
<tr>
<td>15</td>
<td>Time zone differences</td>
</tr>
<tr>
<td>16</td>
<td>Contextual differences</td>
</tr>
<tr>
<td>17</td>
<td>Cross border transaction</td>
</tr>
<tr>
<td>18</td>
<td>Trust</td>
</tr>
<tr>
<td>19</td>
<td>Trained Team members</td>
</tr>
<tr>
<td>20</td>
<td>Multi sourcing</td>
</tr>
<tr>
<td>21</td>
<td>Maintaining Quality</td>
</tr>
<tr>
<td>22</td>
<td>Inexperience</td>
</tr>
<tr>
<td>23</td>
<td>Monitor</td>
</tr>
<tr>
<td>24</td>
<td>Managing Development</td>
</tr>
<tr>
<td>25</td>
<td>Infrastructure Challenges:</td>
</tr>
<tr>
<td>26</td>
<td>Willingness</td>
</tr>
</tbody>
</table>

Table 4 List of Management challenges found from literature review
The project management challenges being faced by the organizations are gathered by conducting interviews with six different organizations. List of project management challenges found during interviews are summarized in Table 5.

<table>
<thead>
<tr>
<th>No</th>
<th>Project Management Challenges from interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Dependency among modules leads to project delay”</td>
</tr>
<tr>
<td>2</td>
<td>“Long meetings leads to disinterest of team members to participate”</td>
</tr>
<tr>
<td>3</td>
<td>“Poor technical expertise fail resolving conflicts”</td>
</tr>
<tr>
<td>4</td>
<td>“Poor feedback reduce team commitment”</td>
</tr>
<tr>
<td>5</td>
<td>“Poor standards reduce quality of the product”</td>
</tr>
<tr>
<td>6</td>
<td>“Poor planning leads to project failure”</td>
</tr>
<tr>
<td>7</td>
<td>“Poor coordination reduces trust and team does not share common goals”</td>
</tr>
<tr>
<td>8</td>
<td>“Incorrect estimations results in project failure”</td>
</tr>
<tr>
<td>9</td>
<td>“Short deadlines reduce team performance”</td>
</tr>
<tr>
<td>10</td>
<td>“Linguistic issues results in misinterpreting things”</td>
</tr>
<tr>
<td>11</td>
<td>“Complex procedures are confusing”</td>
</tr>
<tr>
<td>12</td>
<td>“In proper training result in project failure &amp; team members of team lose confidence”</td>
</tr>
<tr>
<td>13</td>
<td>“Hiding status result in project delay”</td>
</tr>
<tr>
<td>14</td>
<td>“Management pressure leads to mistrust and reduce confidence”</td>
</tr>
<tr>
<td>15</td>
<td>“Poor customer satisfaction result in mistrust”</td>
</tr>
<tr>
<td>16</td>
<td>“Time zone Issues reduce knowledge sharing”</td>
</tr>
<tr>
<td>17</td>
<td>“Socio Cultural Issues leads to misinterpretations”</td>
</tr>
<tr>
<td>18</td>
<td>“Complex hierarchy results in poor decision making”</td>
</tr>
<tr>
<td>19</td>
<td>“Low visibility leads to coordination issues”</td>
</tr>
<tr>
<td>20</td>
<td>“Lack of communication leads to project failure”</td>
</tr>
<tr>
<td>21</td>
<td>“Data security issues reduce trust on employees due to high attrition rate”</td>
</tr>
<tr>
<td>22</td>
<td>“Work synchronization leads to poor task distribution”</td>
</tr>
<tr>
<td>23</td>
<td>“Conflicts arise due to new processes &amp; emerging technologies”</td>
</tr>
<tr>
<td>24</td>
<td>“Lack of trust leads to project failure”</td>
</tr>
<tr>
<td>25</td>
<td>“Lack of Shared goals leads to failure of business goals”</td>
</tr>
<tr>
<td>26</td>
<td>“Convincing the stakeholder on Agile is difficult”</td>
</tr>
<tr>
<td>27</td>
<td>“Lack of willingness leads to poor quality”</td>
</tr>
<tr>
<td>28</td>
<td>“Lack of test automation leads to poor validation of product developed”</td>
</tr>
<tr>
<td>29</td>
<td>“Decision making is difficult in innovative world”</td>
</tr>
<tr>
<td>30</td>
<td>“Inability to manage risks leads to failure of project”</td>
</tr>
<tr>
<td>31</td>
<td>“Incomplete requirements results in misinterpretations”</td>
</tr>
<tr>
<td>32</td>
<td>“Lack of information sharing delays project delivery”</td>
</tr>
<tr>
<td>33</td>
<td>“Large number of developing sites makes integration difficult”</td>
</tr>
<tr>
<td>34</td>
<td>“Poor work environment leads to task slippage”</td>
</tr>
<tr>
<td>35</td>
<td>“Low band width result in decreased transfer rate”</td>
</tr>
</tbody>
</table>

Table 5 Project management challenges found in interviews

The mapping between organization and project management challenges are represented in Table 6. The row represents organization numbers. The column represents the project management challenges faced by the organizations.
Figure 9 shows statistical view of each management challenge faced by how many organization(s) using SCRUM in GSD projects. The x-axis is the management challenges found and y-axis present the total companies involved in study. It has been observed that 26 challenges out of 37 were similar among companies.

Most reported project management challenges found are Incorrect estimations results in project failure, Socio Cultural Issues leads to misinterpretations, Poor feedback reduce team
commitment. Lack of communication leads to project failure and Lack of trust leads to project failure.

An online survey has been conducted, in which 24 people from different organizations with experience in SCRUM and GSD projects participated. Surveys are conducted to investigate if the challenges found in the literature are being faced by the respondents in their organizations. A questionnaire is prepared based on the data gathered from literature review and interviews are sent to the respondents. The most reported Management challenges from the surveys are discussed in Section 4.3.

RQ2. Which SCRUM practices are currently being used in software organizations that develop software globally?

Answer for RQ2 is answered by conducting literature reviews along with interviews. There are several Scrum practices used in GSD projects that were reported in literature. Notice collect and think technique is used for analysing the quality data. The data gathered is used as a basis to prepare interview questions and also survey questionnaire. Table 7 shows the list of SCRUM practices that were reported in the literature:

<table>
<thead>
<tr>
<th>No.</th>
<th>SCRUM practices found in literature review</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>“SCRUM master needs to be a strong negotiator”:</td>
</tr>
<tr>
<td>2.</td>
<td>Synchronized working hours:</td>
</tr>
<tr>
<td>3.</td>
<td>“Site based local SCRUM team”</td>
</tr>
<tr>
<td>4.</td>
<td>“Modified SCRUM practices”:</td>
</tr>
<tr>
<td>5.</td>
<td>“High reliable communication bandwidth”:</td>
</tr>
<tr>
<td>6.</td>
<td>“Dedicated meeting room”:</td>
</tr>
<tr>
<td>7.</td>
<td>“Mandatory participation”:</td>
</tr>
<tr>
<td>8.</td>
<td>“Single room”:</td>
</tr>
<tr>
<td>9.</td>
<td>“Gradual team distribution”:</td>
</tr>
<tr>
<td>10.</td>
<td>“Coffee/ice cream meetings”:</td>
</tr>
<tr>
<td>11.</td>
<td>“Reduce SCRUM meeting length”:</td>
</tr>
<tr>
<td>12.</td>
<td>“Visits”:</td>
</tr>
<tr>
<td>13.</td>
<td>“Key documentation”:</td>
</tr>
<tr>
<td>14.</td>
<td>“Distribution policy”:</td>
</tr>
<tr>
<td>15.</td>
<td>“Team Gathering”:</td>
</tr>
<tr>
<td>16.</td>
<td>“Additional distributed meetings”:</td>
</tr>
<tr>
<td>17.</td>
<td>“Proactive resource management”:</td>
</tr>
<tr>
<td>18.</td>
<td>“The use of a “global” task board”:</td>
</tr>
<tr>
<td>19.</td>
<td>Training</td>
</tr>
</tbody>
</table>

Table 7 List of Practices found in literature review

The SCRUM practices being implemented by the organizations in developing software globally are gathered by conducting interviews with six different organizations. We have conducted 2 face to face interviews and 4 interviews via video call with the help of the communication tool Skype. The data gathered is analysed by applying Grounded theory. Table 8 shows the list of SCRUM practices that were analyzed from interviews.
Scrum Practices from interviews

1. “Prioritizing the objectives avoids schedule slippage”
2. “Regular information sharing keeps all the participants involved in the project”
3. “Sessions for brainstorming helps in finding consequences of activities”
4. “Regular status updates helps the team understand where they stand”
5. “Sharing common goals helps in doing project right on time”
6. “Assuring the justification of decisions improves progress of the project”
7. “Time zones of all development sites need to be kept in mind while planning for the meeting so that there won’t be any overlap”
8. “Reduce meeting duration to stop discussing solutions for problems”
9. “Email on the important points need to be discussed is sent prior to meetings”
10. Local daily SCRUM meetings avoids asynchronous communication
11. “Record minutes of meetings to avoid loss of data”
12. “Motivate team in using video communication”
13. “Encouraging team involvement in meetings”
14. “Limited team size, number of developing sites and distributed SCRUM teams improves coordination”
15. Encourage team to self-organize in order to prevent occurrence of risks:
16. “Using of trained people helps to avoid risks”
17. “Customer and end user involvement”
18. “Avoid dependencies in user stories”
19. “Using planning poker avoids anchoring while making estimations”
20. “Consider user stories when an experienced person is making estimates”
21. “Two step estimation method to make sustainable estimates”
22. “Provide training to new employees in usage of SCRUM practices”:
23. “Proper usages of communication tools help improve communication”:

Table 8 SCRUM practices from interview

<table>
<thead>
<tr>
<th></th>
<th>Practices</th>
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<tbody>
<tr>
<td></td>
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<td>X</td>
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<tr>
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</tr>
</tbody>
</table>

Table 9 Map between companies and SCRUM practices

Figure 10 shows statistical view of each SCRUM practice used by how many organization(s) in GSD projects. The x-axis is the SCRUM practices and y-axis present the total companies involved in study. It has been observed that 19 practices out of 23 were common among companies. It is also noticed that practices 3, 16, 23 are commonly used in all companies.
Figure 10 SCRUM practices against all companies

“Sessions for brainstorming helps in finding consequences of activities; Local daily SCRUM meetings avoid asynchronous communication, using of trained people helps to avoid risks and proper usages of communication tools help improve communication.

An online survey has been conducted, in which 24 people from different organizations with experience in SCRUM and GSD projects participated. Surveys are conducted to investigate if the challenges found in the literature are being faced by the respondents in their organizations. A questionnaire is prepared based on the data gathered from literature review and interviews are sent to the respondents. The most reported Scrum practices from the surveys are discussed in Section 4.4

**RQ3.** What are the major challenges and benefits of implementing SCRUM practices in GSD?

Answer for RQ3 is answered by conducting interviews with six different organizations about SCRUM benefits achieved and challenges being faced by them during SCRUM implementation. The data gathered is analyzed by applying grounded theory. Table 9 shows list of SCRUM benefits.
### SCRUM BENEFITS

1. Helps in developing right things in right perspectives:
2. Implementing SCRUM provides better control in the team.
3. Visibility and flexibility is provided:
4. Issues can be identified early in the development life cycle:
5. Less turnaround time or Time to Market:
6. Stakeholders get a shared focus:
7. Easy to adopt changes in scope:
8. Better feedback mechanism are used:
9. Retrospectives help the team to self-evaluate:
10. Improved Innovation
11. Improved Quality
12. Easy to Use

Table 10 SCRUM benefits

Table 11 represents the mapping between the organizations and the benefits in implementing SCRUM practices in GSD projects. The row represents the organization numbers. The column represents the benefits in implementing SCRUM practices in the organizations in GSD projects.

<table>
<thead>
<tr>
<th>Organizations</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tr>
<td>3</td>
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<td>X</td>
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<td></td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>X</td>
<td>X</td>
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<td></td>
<td></td>
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<tr>
<td>5</td>
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<td>X</td>
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<td>X</td>
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<td>6</td>
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<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Table 11 Map between companies and SCRUM benefits

Figure 11 shows statistical view of each SCRUM benefits found in organization(s) during study. The x-axis is the SCRUM practices and y-axis present the total companies involved in study. It has been observed that most the benefits are common between all organizations.
Most reported benefits achieved by organizations while implementing SCRUM are Visibility and flexibility are provided, better feedback mechanism are used, easy to adopt changes in scope and improved innovation.

It is found from the interviewees that the organizations are facing several challenges while implementing SCRUM in GSD projects. A list of found challenges is shown in Table 12.
Challenges faced while implementing SCRUM

<table>
<thead>
<tr>
<th>No</th>
<th>Challenges faced while implementing SCRUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Un-trained team</td>
</tr>
<tr>
<td>2.</td>
<td>Concentrating too much on practices instead of SCRUM values and attributes</td>
</tr>
<tr>
<td>3.</td>
<td>Not supplying members of team with sufficient flexibility</td>
</tr>
<tr>
<td>4.</td>
<td>Effective usage of practices</td>
</tr>
<tr>
<td>5.</td>
<td>Lack of support from the executives</td>
</tr>
<tr>
<td>6.</td>
<td>Frequent requirement changes in a sprint</td>
</tr>
<tr>
<td>7.</td>
<td>Not having a strong Product owner and SCRUM master</td>
</tr>
<tr>
<td>8.</td>
<td>Good product manager cannot be a good product owner</td>
</tr>
<tr>
<td>9.</td>
<td>Fear and compliance with employees</td>
</tr>
<tr>
<td>10.</td>
<td>Lack knowledge of knowledge about SCRUM</td>
</tr>
<tr>
<td>11.</td>
<td>Fear of criticism</td>
</tr>
<tr>
<td>12.</td>
<td>Convincing the Senior Management and the Project sponsor on Agile</td>
</tr>
<tr>
<td>13.</td>
<td>Getting people volunteer to take tasks and contribute to the sprint</td>
</tr>
<tr>
<td>14.</td>
<td>Lack of test automation affected the Sprint and delayed turnaround time.</td>
</tr>
<tr>
<td>15.</td>
<td>The team worried in getting exposed of their weaknesses.</td>
</tr>
<tr>
<td>16.</td>
<td>Allocating resource’s properly</td>
</tr>
<tr>
<td>17.</td>
<td>Large team size</td>
</tr>
<tr>
<td>18.</td>
<td>Members of team feel inferior to accept their backlogs or mistakes</td>
</tr>
<tr>
<td>19.</td>
<td>Shift the paradigm of the team</td>
</tr>
<tr>
<td>20.</td>
<td>Communication to comply the team with the communication model</td>
</tr>
<tr>
<td>21.</td>
<td>Defining the sprints and deciding the weekly deliverables</td>
</tr>
<tr>
<td>22.</td>
<td>It was difficult to build a shared vision on SCRUM.</td>
</tr>
</tbody>
</table>

Table 12 Challenges while implementing SCRUM

An online survey has been conducted, in which 24 people from different organizations with experience in SCRUM and GSD projects participated. Surveys are conducted to investigate if the SCRUM challenges found from the interviews are being faced by the respondents in their organizations. Survey questionnaire was prepared based on the data gathered from interviews and from the literature review (see Appendix B).

The mostly reported challenges found while implementing SCRUM in SD projects from empirical study is “untrained team” and “Communication to comply the team with the communication model”. An interesting thing observed that every organization face almost different problems while implementing SCRUM in their organization.
Data Triangulation:

We have data qualitative analysis results from literature review and from industrial interviews also we have quantitative results as well from industrial survey. Therefore we triangulate the results we have from these two methods.

Methodology

Data triangulation was done by following way.

From literature review we have found few practices and management challenges.

Management Challenge:  CL1, CL2, CL3, CL4, CL5, CL6…..CL26
SCRUM Practice:  PL1, PL2, PL3,PL4, PL5, PL6,……. PL19

From interviews we also have found few practices and management challenges also SCRUM benefits and SCRUM challenges.

Management Challenge:  CL1,CL2,CL3,CL4,CL5,CL6…..CL35
and SCRUM Practice:  PL1, PL2, PL3,PL4, PL5, PL6,……. PL23
SCRUM benefits:  B11, B12, B13, B13, B14, B15, B16….B12
SCRUM Challenges:  S11,S12, S13, S14,……S19

Similarly in surveys we have asked organizations to rank

Management Challenges:  CL1, CL2, CL3, CL4, CL5, CL6…..CL19,
SCRUM Practices:  PL1, PL2, PL3,PL4, PL5, PL6,……. PL22,
SCRUM benefits:  B11, B12, B13, B13, B14, B15, B16….B122,
and SCRUM challenges:  S11,S12, S13, S14,……S19.

We have compared results from three studies. C1, C2, PL1 and PL4 are common among three studies hence they are considered as highly reported. B11, B15, S11 and S16 are reported by at least 4 out of 6 organizations during Interviews. B11, B15, S11, S16 are ranked high during surveys. Hence, they are highly reported benefits and challenges.

Data triangulation results

Through interviews we have some most important management challenges faced by participants. We also conducted a survey in which date from literature review used as input for to answer RQ1 and RQ2. After the analysis of both studies interesting results were observed regarding similar management challenges between both studies. Some management challenges were found most reported among literature review, interviews and surveys:

1. Communication
2. Coordination
3. Time zone
4. Socio Cultural
5. Trust
It was observed that these most reported management challenges related to core issues of GSD project regarding their three dimensions (Geographical, Temporal and Cultural).

Similarly 3 mostly used SCRUM practices were also found common among literature review, interviews and surveys:

1. Reliable Communication
2. Local Daily SCRUM
3. Encouraging team involvement

It shows trend about SCRUM usage regularly, which needs good communication with team involvement

Using SCRUM in a project results in number of benefits. Most reported benefits found during interviews and surveys are

1. Implementing SCRUM provides better control in the team.
2. Easy to adopt changes in scope:
3. Better feedback mechanism is used:
4. Improved Innovation
5.1 VALIDITY THREATS

Validity threats must be dealt to determine the major components that influence the exactness of the findings. In this section we mentioned several threats, related to our study. Actions were performed by authors to reduce and deflect the disconfirming affects of each validity threat.

- Internal Validity

“Internal Validity is the approximate truth about inferences regarding cause-effect or causal relationships” [70].

Correctness of data gathered: We have prepared notes while conducting the interview, in order to avoid misinterpretation and loss of the data gathered. Transcripts were prepared for each interview, right away after conducting the interview meeting. Moreover, the transcribed interviews were mailed to the respective interviewee to affirm the correctness of the data. Hence, the chance of an internal validity is reduced.

- Conclusion Validity

Conclusion validity is the degree to which conclusions we reach about relationships in our data are reasonable” [69].

Industrial respondents: It is very hard to make conclusions by conducting interviews with six different organizations. To overcome this threat we have conducted surveys that strengthen the findings from both interviews and literature review performed. Hence there is not much reach reason in treating it is a threat.

- Construct Validity

“Construct validity involves generalizing from your program or measures to the concept of your program or measures” [71].

Data triangulation: In our study, we have data from literature review, interviews and surveys. It is hard to compare results between Interviews, Surveys and Literature review. Due to inconsistencies in the data gathered, we have considered it as a threat. To overcome this threat, data is mapped properly and the commonalities among the studies were identified.

Data categorization: A very major threat for our study is categorizing the challenges and practices gathered from both literature study and interviews. In order to reduce the impact of this threat, we used a predefined framework discussed in project management body of knowledge. There are same challenges and practices that fall under different categories, which created confusion. To reduce this confusion, authors have referred different related studies.
Determining primary studies: The reason behind literature study is to gather as many studies relevant to GSD project management challenges and SCRUM practices. We initially planned to use snowball technique to gather articles by making use of a most recent systematic literature review as basis of our study. After following snowball sampling, we noticed that we may have missed several related papers. We considered this as a threat. In order to overcome this threat, we used search terms based on our study. Several combinations of those search terms were used to gather articles related to project management challenges in GSD and Scrum practices in GSD.

**External Validity**

“External validity is the degree to which the conclusions in your study would hold for other persons in other places and at other times” [72].

Population threat: Participants in interviews and surveys for our study are from different organizations and dissimilar backgrounds; different roles in the organization, different kind of projects. Furthermore, we have conducted our study with organizations from Asia, Europe and Australia. These organizations again work for organizations across USA, Asia, Africa, Australia and Europe which involves several people with different cultures and domains. It gave more strength and quality to the data gathered.

Generalization over time: Nowadays, market trends are continually evolving with several technologies and tools. Several practices are being used by the organizations according to their convenience, Therefore, assuring the generalization of the findings cannot be done.
6 CONCLUSIONS AND FUTURE WORK

In our study, the use of SCRUM practices in GSD was investigated. In first phase of the research, literature review was conducted to find several challenges in managing global projects and various SCRUM practices that alleviate those challenges in managing them. In second phase of research, various SCRUM practices that are currently being applied by the industries are gathered by conducting interviews. Surveys are also conducted in order to support the usage of SCRUM practices to address the challenges faced during management of global projects. Lastly, data were analyzed by applying grounded theory.

The usage of SCRUM practices in order to overcome project management changes in GSD found from literature review is compared with results of interviews and survey conducted with organization and software professional experience in SCRUM and GSD.

From the results it was observed that 26 management challenges and 19 SCRUM practices explored during literature review (Section 4.1). 35 Management challenges and 23 SCRUM practice found during interviews are shown in Table 13.

<table>
<thead>
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<th>Management Challenges</th>
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<td>Literature Review</td>
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<td>Interviews</td>
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<tr>
<td>Total</td>
<td>61</td>
</tr>
</tbody>
</table>

Table 13 Number of Management challenges and SCRUM practices in GSD

Furthermore 26 “challenges which were faced during SCRUM implementation” in GSD projects were also found. 12 “benefits of using SCRUM” were also among the findings. It was also observed during interview that there are some management challenges, which were not identified during literature review. The list of these management challenges is following:

1. “Dependency among modules leads to project delay”:
2. “Poor feedback reduce team commitment”:
3. “Incorrect estimations results in project failure”:
4. “Short deadlines reduce team performance”:
5. “Complex procedures are confusing”:
6. “Hiding status result in project delay”:
7. “Work synchronization leads to poor task distribution”:
8. “Lack of Shared goals leads to failure of business goals”:
9. “Convincing the stakeholder on Agile is difficult”:
10. “Incomplete requirements results in misinterpretations”:
It was also observed during interviews that there are some SCRUM practices which were not found during literature review. The SCRUM practices are

1. “Prioritizing the objectives avoids schedule slippage”
2. “Regular information sharing keeps all the participants involved in the project”
3. “Sharing common goals helps in doing project right on time”
4. “Assuring the justification of decisions improves progress of the project”
5. “Encourage team to self-organize in order to prevent occurrence of risks:
6. “Using of trained people helps to avoid risks”
7. “Customer and end user involvement”
8. “Avoid dependencies in user stories”
9. “Using planning poker avoids anchoring while making estimations”
10. “Consider user stories when an experienced person is making estimates”
11. “Two step estimation method to make sustainable estimates”

**Data Triangulation:**

In our study, we considered factors such as, number of teams, team size, time zone differences, team locations, number of sites, culture. There are few factors that we did not address due to time constraints such as complexity, type of project, expertise, duration of the project, etc. in implementing SCRUM in GSD. All these factors mentioned can be investigated in future study.

Future work can be done on mapping the relation between the various project management challenges in GSD and the SCRUM practices that were identified. In our study, we have identified various SCRUM practices; contribution can be made by considering any one of those practices as a prospect. Another important contribution could be to investigate how various industrial settings could influence the choice of SCRUM practices.

Moreover, research on perspective of developers’ on usage of SCRUM practices would be beneficial as we conducted interviews based on manager’s view. There is a need for conducting even more in-depth case studies to investigate the usage of SCRUM practices in addressing challenges of global software project management.
7 REFERENCES


APPENDIX

APPENDIX-A

INTERVIEW QUESTIONNARE

Introductory Questions:

1. What is your role in the organization?
2. What are you responsibilities in the current project?
3. How long have you been working with the organization?
4. How long have you been working with globally distributed projects?
5. Can you please tell about history of the organization?
6. Can you give brief introduction about the current project?
7. Team size, their nationality and number of developing sites?

Domain specific questions:

1. What are the several agile methodologies you are adopting in your projects? Can you also motivate your idea behind implementing SCRUM?
2. Can you discuss in short, several experiences you faced in implementing SCRUM?
3. What are the various responsibilities of a SCRUM team?
4. What kind of artefacts’ do you use?
5. What are the several activities that happen in SCRUM methodology implementation?
6. How do you implement practices such as sprint, daily SCRUM meetings, burn down charts, product back logs?
7. How do you make decisions on planning for meetings, preparing artifacts and estimating the project effort and budget?
8. How is task distributed among teams and within team members? How do you build trust and mutual understanding between and among the teams?
9. Do you plan communication among teams and within teams? Which kind of tools do you use for communication? How often do they meet face-face? How often do they communicate?
10. What kind of management challenges occur while implementing SCRUM?
11. Do you train the members of team before implementing SCRUM? Do culture, language and experience affect SCRUM implementation in GSD projects?
12. How do you overcome challenges such as time zone differences, integration, data security, infrastructure and delays?
13. Can you discuss the benefits of implementing SCRUM in globally distributed projects?
14. Are you satisfied in implementing SCRUM? Can you tell us few issues that need to be changed for more benefits?
15. Are there any other external factors that affect implementation of SCRUM?
APPENDIX-B

SURVEY QUESTIONIRE

1. Please let us know about your company/organization

2. What is your role in the company/organization?
   - SCRUM master
   - product owner
   - developer
   - Other (please specify)

3. What is the number of SCRUM teams in your company/organization?
   - 1-5
   - 6-10
   - 11-25
   - 25-50
   - >50

4. What is motivation behind implementation of SCRUM?
   - To improve delivery speed
   - Improved quality & productivity
   - Planning and delivering deliverables according to schedule
   - Flexible and adaptive with changes

5. Based on your experiences, which of the following benefits are achieved in implementing SCRUM in globally distributed teams
   - Helps in developing right things in right perspectives:
   - Implementing SCRUM provides better control in the team.
   - Visibility and flexibility is provided:
   - Issues can be identified early in the development life cycle:
   - Less turnaround time or Time to Market:
   - Stakeholders get a shared focus:
   - Easy to adopt changes in scope:
   - Better feedback mechanism are used:
   - Retrospectives help the team to self-evaluate:
   - Improved Innovation
   - Improved Quality
   - Easy to Use

6. Please rate the SCRUM practices according to usage in your company/organization
   - Synchronized working hours
   - Reduce SCRUM meeting length
   - Site based local SCRUM team
   - Modified SCRUM practices
   - Team Gathering
   - Visits
   - Additional distributed meetings
   - Training
   - Key documentation
   - Mandatory participation
   - High reliable communication bandwidth
• Proactive resource management
• Distribution policy
• Single room
• Dedicated meeting room
• Gradual team distribution
• SCRUM master needs to be a strong negotiator
• The use of a “global” task board
• Coffee/ice cream meetings

7. Can you please rate the following issues which you were facing during implementation of SCRUM in GSD context?
   • Un-trained team
   • Concentrating too much on practices instead of SCRUM values and attributes
   • Not supplying members of team with sufficient flexibility
   • Effective usage of practices
   • Lack of support from the executives
   • Frequent requirement changes in a sprint
   • Not having a strong Product owner and SCRUM master
   • Good product manager cannot be a good product owner
   • Fear and compliance with employees
   • Lack knowledge of knowledge about SCRUM
   • Fear of criticism
   • Convincing the Senior Management and the Project sponsor on Agile
   • Getting people volunteer to take tasks and contribute to the sprint
   • Lack of test automation affected the Sprint and delayed turnaround time.
   • The team worried in getting exposed of their weaknesses.
   • Allocating resource’s properly
   • Large team size
   • Members of team feel inferior to accept their backlogs or mistakes
   • Shift the paradigm of the team
   • Communication to comply the team with the communication model
   • Defining the sprints and deciding the weekly deliverables
   • It was difficult to build a shared vision on SCRUM.

8. Which of the following are aligned with SCRUM?
   • Product owner
   • SCRUM master
   • CEO
   • Software development life cycle
   • Project management
   • Business
   • Change management

9. Which of the software tools are used by you for planning projects in SCRUM?
   • EXCEL
   • Mingle
   • SCRUM works pro
   • Version one
   • SCRUM pad
   • Wiki
   • Everything is done manually
   • Note cards
   • Target process
   • Pivotal tracker
10. Management challenges faced during a globally distributed project. Can you please rate the following challenges?

- Data Privacy
- Infrastructure
- Quality Management
- Managing Development
- Process Management
- Monitor and Control
- Multi sourcing
- Cross border transaction
- Contextual Differences
- Staff Management
- Linguistic Diversity
- Budget Overrun
- Higher Documentation Overhead
- Willingness
- Risk Management
- Trust
- Training
- Coordination
- Communication
- Time zone Differences
- Technical Challenges
- Cultural Diversity
- Knowledge Management
- Complex Hierarchy
- Inexperience
- Strategic Challenges
Appendix C

Interview Transcription

Interview 1:

We have conducted the interview in two different parts. In the first part, we have enquired about the various project management challenges faced while developing software globally. The interviewee pointed out that earlier they have used waterfall methodology. The interviewee pointed that it is very challenging to share the task among the teams who distributed globally. When modules are being developed at different locations, there exist dependencies among the modules. He talks about his current project distributed on three different locations Mexico, Denmark and London. The project is building banking software with 2 important modules being developed at Denmark branch, 1 module being developed at Mexico and another module being developed at London. Module being developed by Mexican team is dependent on the module that has to be developed by London. Denmark team has completed their work. London team had delay in finishing their module and the Mexican team has to wait for the London team to finish and it delayed the overall project delivery. Feed back is not always provided regularly in globally distributed teams.

The interviewee talks about challenges that team loses interest and thereby knowledge sharing decreases which in turn reduces the overall quality of the software project. Due to this, the team will no longer be committed to the project. He further said that they always face problems due to standards; members at each location follow their own standards and it is always difficult for other teams to understand. Unclear standards create confusion among teams. The interviewee also mentioned that planning a project is very important for any project. He said that they always face issues while planning due to geographical separation.

He mentioned that distributed projects often fail due to issues related to coordination and communication. This poor communication leads to poor knowledge sharing which effects on the project. He said estimating a globally distributed project is very hard due to several reasons: unclear problem statement by clients and developers due to their insignificant perspectives. He added that estimations without any historical data are quite difficult. He also mentioned that poor estimations and lack of common vision always lead to failure of the project. The interviewee mentioned that the stress created by the project managers on employees due to very abrupt deadlines will effect on team members involvement.

The interviewee mentioned that cultural and language issues always arose in globally distributed software projects. He said that the team lack knowledge exchange which leads to assumptions that leads to failure of project. Interviewee said hiring right people is very important for distributed software projects. Improper training leads to several issues such as delay in project, time and budget consuming. The interviewee stated that it is hard to update status of the project regularly in GSD requires rework caused delays in the project. The most significant challenge in GSD project raised by the interviewee is time zone differences. Time zone differences leads to communication delays. The whole load of differences in time is endured by one location. Making a decision in a GSD context is very hard, due to complex hierarchies, ideas given by members of team are neglected only superiors decision will be finalized which leads to mistrust.

The interviewee stated that in distributed projects, in order to save expenses, distributed teams very rarely meet face to face. Due to this reason, the team’s lack trust which in turn leads to project failure. Interviewee stated that the teams often do not cooperate with each other and project delivery delays. As the teams are distributed globally, functionalities are developed at different locations and make it difficult to integrate. Due to lack of face to face meetings, the members of team often communicate with tools and often the bandwidth is poor and loss of information exchange. The interviewee concluded the first part of interview by stating that they have decided to shift to SCRUM, an agile
software development methodology in order to minimize all those challenges faced by globally distributed software projects. He further mentioned the main reasons for shifting to SCRUM from a traditional software development methodology: higher flexibility, adaptability of changes, easy to handle frequent requirement changes, iterative in nature, high visibility of the process and on time delivery.

The interviewee said that in order to overcome the problems with estimations in a GSD they make use of certain SCRUM practices depending on the requirements. In order to make estimations in their distributed SCRUM projects they don’t use any complex methodology. They make the team understand requirements without any ambiguity, historical data of similar projects is considered and person days are used. Encourage team in understanding the goals and to make use of rich communication tools especially video conferences. The interviewee mentioned that the distribution of tasks among teams is done by the data base and business logic experts in their organizations based on their experiences and also considering dependencies among modules.

The interviewee mentioned that they conduct several meetings such as daily SCRUM meetings, planning sprint meetings, retrospective meetings. He said that daily SCRUM meetings are conducted to have synchronous communication. He also added that, in distributed projects it is always important to hire the right people based on their understanding level, technical expertise etc. He said that using SCRUM practices build an environment in which members of them could communicate in a clear and fair manner. There are various rich tools to communicate to overcome barriers due to communication. The interviewee mentioned that members of the team are encouraged to share information regularly in order to involve all the members of the team actively. Status of the project needs to be updated regularly to know the situation. He added due to large number of distributed teams, there are reduced numbers of face to face meetings and this challenge can be overcome by using SCRUM of SCRUMs and he suggested it is always preferable to have limited number of sites and reduced team size. He said this practice of SCRUM of SCRUM grants clumps of teams to talk about their tasks, concentrating particularly on fields of convergence and consolidation. A recursive approach is used to scale SCRUM of SCRUM. He mentioned that they have used two step estimations while estimating the project. In first step, each team member is asked to make estimation of all stories as points. In the next step, each team member is asked to list out their tasks. The time they require to finish each task. Collect the paper in which tasks and estimates of each person is gathered. Sum up all of them and the final estimate can be calculated.

The interviewee mentioned that when there are lazy and unskilled members in the team, they handle them by providing them better training on the areas they lack knowledge. If, the member of team doesn’t have much knowledge on the functionality he has to work, then his task will be changed to a less complex one. He said they help them and provide them with better suggestions. The interviewee recommended setting right expectations, clarifying the requirements. He also said that it is highly useful to make use of protocol. A central management system, in which all the completed tasks will be saved and updated regularly, is maintained.

The interviewee said that they face several challenges while implementing SCRUM while developing software globally. He also said untrained team on SCRUM is a major problem. Concentrating too much on practices instead of SCRUM values and attributes is another setback. Not supplying members of team with sufficient flexibility related to failure, timeliness to rescue, selecting the appropriate method. He said that SCRUM is like a tool, success or failure mainly depends on how the teams apply the practices.

While discussing the benefits of SCRUM, he mentioned that the team is fully satisfied in implementing SCRUM practices in GSD. He added that the SCRUM promotes the members of the team to preserve all the user stories, impediments, requirements in a prioritized manner to improve business values. SCRUM reduces rework and waste. Innovation is improved and increases visibility. It is very simple to use, flexible and adaptable practices. Quality of the product is highly increased.
Capability of adapting to changes is possible. Improved satisfaction of customers is achieved. SCRUM practices encourage team to understand the requirements. Early identification of issues is a major benefit of implementing SCRUM.

**Interview 2:**

The interview is conducted in two different phases. In the first part, one of the interviewer posed question on the project management challenges being faced by the organization in developing software globally. He said that due to distance, the teams are not able to meet face regularly. The approach followed by the distributed team members to communicate among them is one of the reasons for poor communication which is a major challenge. Reduced information sharing among the teams is an important issue in GSD where the members of the team possess information but they refuse to share with each other. Data security issues frequently arose due to relocation of members of the team. Attrition rate is increased in the organizations.

The interviewee mentioned that and work synchronization, lack interest and shared goals are challenge in GSD. He also said that low communication band width is also a major issue. If the tools are of low bandwidth there will be lack of audio and video quality which leads to loss of data in turn team starts making interpretations on their own. The interviewee said that requirements are often ambiguous and unclear. Incomplete requirements lead to assumptions and only at the end the team realizes that what they developed is not what the customer wanted. Risk management is the procedure of evaluating or measuring risk and then formulating schemes to handle risks. Identifying and mitigating the risks is a very significant challenge in developing software globally. While developing software globally, there are members from distinct cultures. Due to differences in cultural and language backgrounds, there arose cultural and linguistic issues. Superiority complex often exists in members of the team. Members of the team with high expertise think whatever they say is correct and rest of the members need to obey their decision, which an issue in project management of distributed software projects. The interviewee said that decision making is very difficult in case of distributed projects.

The interviewee mentioned that lacking trust among the team members is the most significant challenge. An environment in which the members of the team are not well treated leads to distrust. Lack of communication among members of the distributed teams. Not sharing status of the project is another challenge distributed teams always face. In globally distributed environment, members of team are from various technical backgrounds. Hence, improper training leads to several problems in having a project with improved quality and productivity. Interviewee mentioned that estimating cost, schedule and effort is a major challenge in distributed projects especially when they lack historical data on similar projects. The other challenge mentioned by the interviewee is the force from higher level management on the hourly paid employees. Lack of timeliness to deliver leads members of team to lack interest on completing tasks. They forget business goals and concentrate on individual goals. The interviewee stated that unclear standards and complex procedures create several confusions in distributed teams.

In the second part of the interview, we have enquired about the usage of SCRUM practices in developing software with globally distributed teams, benefits of applying SCRUM practices and the various challenges being faced by them while implementing SCRUM. He said Product owner, SCRUM master and developers are the main people involved in SCRUM implementation. 7-9 for a SCRUM team is the preferred size according to the interviewee’s experience. In case of more people, SCRUM of SCRUM needs to be introduced. Product back log, burn down chart and sprint backlog is the artifacts gathered. Daily stand up meetings, sprint planning meetings, weekly SCRUM meetings and retrospective meetings are the several meetings conducted in their projects that use SCRUM practices.
He said that daily stand up meetings are conducted daily for about 15 minutes where three daily questions on what has been done yesterday? What need to be done this day and any issues are raised, but not solutions. Weekly sprint review is conducted to discuss weekly progress of the team. Product owner, SCRUM master and developers are involved. Minutes of meeting is noted and posted on wikis, in case of large team. Interviewee said that all the members of the team sit together and decide on time and venue. Usually they prefer it to be in the morning. In case, if any member can’t make their presence they need to mail their answers and issues prior to the meeting. Planning meeting is decided by product owner. Product backlog is discussed and decisions are made accordingly. Whole sprint is planned during sprint planning meeting. Estimations are based on historical data of similar projects. User stories are considered by experienced people while estimating advances.

The interviewee pointed that decisions are usually made by discussion with all the members, but major role is played by the product owner. He said that SCRUM masters don’t have any role in decision making. He reports everything to the management. Team is responsible for distributing the tasks based on the project. Strive not to have too much on solution with different teams. Interviewee mentioned that it is important not to split on technical expertise. Based on functional basis is preferred. Interviewee mentioned that communication is planned before itself. SCRUM master meets the onsite team regularly. Right prioritization delivers valuable products. Problems can be discussed. There are several communication tools such as live messengers, netlog, video conferencing etc that improves communication among team members. He said that communication is regular, so that changes can be made according to the market needs and requirements. Appreciation builds trust among the members of the team. Senior management must form a culture where there exists trust between globally distributed teams. Enhancing trust is possible when members of team understand that leader will make proper decisions. Leaders should be capable of differentiating between positives and negatives of the members of team. Regular feedback on employees work should be given and the team members should be motivated to be innovative.

The interviewee mentioned that training is given to all the members of the team on basic SCRUM implementation. If there is no enough time, the members of the team help new member of the team in understanding the organizational standards. Any issues such as language culture are overcome by having regular social gatherings among members of distinct back grounds. The interviewee said that working in flexible timings makes it avoid time zone issues. Meetings should be planned in such a way that any overlap in times can be removed. He mentioned that integration is made easier by making the project more visible and sharing common database by all the members. He said that brainstorm meetings are conducted to find the results of the task performed by the distributed members. Leaders should always give reason to all the employees on why a decision has been taken.

He stated that all the members of all the teams should regularly share their work and they are also encouraged to have common vision to avoid delays. He said in a software industry agile way of thinking gives more common sense. SCRUM helps in developing right things in right perspectives. Members of team should be encouraged to have more written communication which is formal. Sharing desktops in critical cases found to be an effective practice. The other efficient practice is to motivate all the stakeholders to actively participate in project and also encouraging team to self organize will avoid risk occurrence. The interviewee mentioned that in case of too many SCRUM teams, SCRUM of SCRUM of SCRUMS is implemented. These meetings ought to take place once in a day for about fifteen minutes. The important thing that is to be considered is that the duration of the meeting should not be exceeded. These meetings are similar to the usual stand up meetings except that the team members are allowed to discuss the solutions of the problems rose unlike the daily SCRUM meetings where the members of the team are free to interrupt the meeting in case if any of the members are discussing solutions to problems that have been raised. In SCRUM of SCRUM, issues are resolved and discussions are made with the help of team backlog.

The interviewee mentioned that there are several advantages of implementing SCRUM practices in GSD.SCRUM is very simple tool to implement. A Successful SCRUM leads to better quality. SCRUM is very flexible. He said that practices of SCRUM are not constant; they are mould according
to the circumstances and requirements. He mentioned that SCRUM methodology is very iterative in nature. Mutual understanding and trust among the team members makes the members of team to organize among themselves in a better way. Interviewee pointed that Members of SCRUM team are encouraged to choose their own tasks. With the help of SCRUM, issues are easily resolved by prioritizing them carefully and working according to their severity. The interviewee mentioned that the productivity and quality of the end product will be improved to a high extent. He said that implementing SCRUM makes the team more adaptable to changing needs. Investment on building documentation can be reduced while implementing SCRUM practices in a GSD.

The interviewee also mentioned that there are several challenges being faced by them while implementing SCRUM practices in GSD. He said that lack of support from the executives for the SCRUM implementation is the most significant challenge being faced. He pointed that frequent requirement changes in a sprint are also a major challenge. Not having a strong Product owner and SCRUM master is a very major challenge in implementing SCRUM. He mentioned the assumption that a good project manager can be a good product owner leads to SCRUM failure in most of the cases. He mentioned that employees with fear and compliance are also a challenge. Members of the team who lack knowledge on implementing SCRUM practices are a challenge. The most significant challenge of implementing SCRUM practices in GSD is fear of criticism, hiding their mistakes by the members of the team. The interviewee concluded that from his experience on several SCRUM projects, teams are satisfied in implementing SCRUM.

**Interview 3:**

In this interview, the interviewee discussed about the several project management challenges in GSD, the various SCRUM practices implemented by their teams in order to overcome the challenges being faced by them. The major benefits and challenges in implementing SCRUM. There are several challenges being faced by the organization in managing globally distributed projects: Communication between teams is a very major challenge that results in project failure. Tools to communicate, with low band width reduce transfer rate. Coordinating tasks among the distributed sites is very difficult. The interviewee said that sharing common goals is hard in globally distributed projects. Quality standards differ from each distributed site and make other teams to misinterpret. He said that there are several variations in cost of developing the project among teams distributed globally and hence difficult to make estimates with incomplete requirements. He pointed that time zone differences makes it difficult for teams to exchange knowledge that leads to delay of the project which is the most significant challenge faced by them in distributed teams said the interviewee.

The interviewee said that there is always less time to ship the product and the higher level management forces the employees to complete task in less time, which leads to lack of willingness among team members to work, reduce productivity and quality, and reduce innovation. He said that distinct cultural, linguistic and technical backgrounds are also a challenge in managing globally distributed projects team members lack trust. He said that there always exists relation between two models and when developed at different sites they have dependency and lead to integration issues. He added that planning, integration and synchronizing the work is a challenge in GSD. Employees fail to solve problems when are not experienced, He said, if higher level management delays giving feedback team loses confidence. The interviewee added that another challenge that leads to failure of project is lack of trust. The interviewee mentioned another significant issue is estimating the effort and budget of the project due to geographical separation. Project fails when estimations are not done exactly. Misinterpretations occur due to incomplete requirements and linguistic barriers. Changing market needs and technologies create several issues.Status hiding is always high in case of distributed members which increases rework and delays the project. He said that making a decision in creative generation is challenging issue.

While discussing about the SCRUM implementation the interviewee mentioned that the SCRUM team should have shared responsibilities and goals. Everybody is responsible for the quality, delivery. The product owner is responsible for the project life (in terms of money and time); the SCRUMmaster
is responsible for project progress ensuring that all impediments to the projects are removed. He said that the main artifacts used by them in implementing SCRUM are product wish list / backlog, the burn down chart for SCRUM, Project plan prepared in MS_Project and the weekly status reports for the Management. He mentioned that the several meetings conducted by them include Sprint Planning meeting, Daily SCRUM meeting, Sprint Review meeting and Sprint Retrospective meeting. He stated that they have a modified Sprint running for 2-3 weeks. The interviewee mentioned they conduct sessions for group actions to discuss about consequences. The daily SCRUM meetings are must usually happen on a predefined time. He added that the points that are to be dealt are sent to all members before the meeting starts to avoid meeting delays. He said that they record all the information discussed during the meeting to avoid information loss. Members of the team are motivated to use video communication since it acts a good substitute of face to face meetings.

He mentioned that the burn down charts is prepared in a white board with the help of stickers. The product back log is shared with the product owner, the Excel file is kept in a shared folder. The meeting plans are defined in the Project planning meeting itself.

He mentioned that the tasks are distributed among the members based on experience, expertise, and also give an opportunity to the team to volunteer to accept tasks. The Daily SCRUM meetings are the catalysts to build trust and understanding among the team. Every project has a communication plan, which says which information, in what form, when and to whom. He said that they use mails, Blog updates and also face-to-face meetings. Involving all the stakeholders is possible by sharing information regularly. He mentioned that the language was not a barrier because English was adopted as the common language. The experience was a problem as in SCRUM we were unable to put a hierarchy based on the role and experience. The stakeholders were either ‘Chickens’ or ‘Pigs’. He stated that for the project time zone difference (JKT time is 1.5 hrs ahead of IST) were met by putting a common available time of 11.00 am IST (9.30 JKT time). The communication plan and weekly status reporting as part of PMP (Project Management Plan) helped them to avoid delays to a great extend. He said that coordination among distributed members is improved by having reduced number of developing sites and team size. The interviewee also added that risk can be avoided by recruiting right people. He said that user stories are concentrated in estimating the project by experts.

The interviewee also stated significant challenges while implementing SCRUM globally distributed software projects:
- Convincing the Senior Management and the Project sponsor why Agile is better than the classic waterfall.
- Getting people volunteer to take tasks and contribute to the sprint.
- Lack of test automation affected the Sprint and delayed turnaround time. It was difficult to build a shared vision on SCRUM.
- The team worried in getting exposed of their weaknesses.

The interviewee also stated significant benefits of implementing SCRUM in globally distributed software projects: In a successful SCRUM:
- The stakeholders will get a shared focus
- Easy to adopt changes in scope
- Better feedback mechanism
- Retrospectives help the team to self evaluate.
- It helps to improve quality and innovation.
- Easy to learn/

**Interview: 4**
The interview is conducted in two different parts. In the first part, one of the interviewer posed question on the project management challenges being faced by the organization in developing software globally. Managing software project in GSD context is very difficult which includes several
challenges. They always faced problems like short duration to finish project, lack of sensible fashion to integrate, lack of visibility. He mentioned that allocating tasks and removing dependencies among modules is a significant issue in globally distributed projects. People with poor technical experience never understand the copulation between business and organization goals. Time zone differences, communication coordination, cultural, linguistic, and integration issues are the major challenges that significantly affect the success of distributed projects. He said other challenge is using poor communication tools with low band width leads to reduced transfer rate. Higher level management delays feedback and that leads to poor performance. Lack of trust among members of distributed teams is a most significant challenge that leads to project failure; other major challenge mentioned by the interviewee is estimating cost and budget incurred in the project. He added that not having shared goals among members of teams affects the organization goals. He said that they followed waterfall model initially, then SCRUM in order to overcome the challenges due to GSD.

In the second part of the interview, the interviewee discussed the process used by them in implementing SCRUM. The several benefits and challenges faced in implementing SCRUM in distributed projects. He pointed that firstly it takes time to grasp SCRUM especially for people who are still following waterfall model; secondly people try to modify the SCRUM as per their comfort which causes lot of struggles. Management really has to support the SCRUM model thought including the organization hierarchy. He stated that the spring planning, stand up meeting, retrospective meeting are the various meetings conducted. Story board managing is done by using the physical story board, excel template to store product backlog, sprint backlog, status update, burn down chart. Interviewee mentioned that Product backlog meeting, sprint planning meeting, technical planning meeting, stand up meeting, retrospective meeting are the various meetings conducted. He said they used excel for all this, but there are tools in market like SCRUMWorks, VersionOne, VSTF-2010. He said that they check for any overlapping among user stories and avoid dependencies.

The interviewee stated that there were sessions for members of team were brainstormed on the various tasks performed by them to determine the results. The interviewee mentioned that they didn’t use any estimation method other than dividing the task granularly & viewing the history of the sprints to check what was delivered on what time. Also he mentioned that they formally followed T-shirt sizing i.e. XXL, XL, L, M, S etc. Another formal method used was two-step estimation. During everyday’s stand up meeting every team member would talk about what task they did yesterday, what are they going to work on today, if there are any roadblocks? These meetings are a good means of synchronous communication between teams. The other practice mentioned by the interviewee is to update the status everyday which will be traced by burn down chart to check the progress of sprint. He stated that making use of several communication tools is a very important practice to avoid communication barriers among teams.

Interviewee added that time zone issues are reduced by working in common time. While setting time for a meeting time zones of all sites should be considered. He added that initially they used to have stand up meetings during end of the day so that US guys can also join the meeting, but later on they realized to have the meeting on morning & not having US guys in that meeting. Every team was headed by SCRUM Master who in-turn will handle the feature teams & have weekly meeting with US folks. Several benefits of implementing SCRUM in GSD projects are discussed by the interviewee. He said that good part about SCRUM is to having working model of the system, after iteration. He also mentioned that it gives the stakeholder clear picture about where are we, how much time is required in short better traceability. The interviewee mentioned that rework can be highly reduced. Status of the project is made visible to all the distributed team members.

The interviewee mentioned that they face few issues in implementing SCRUM in distributed projects. He said that allocating resources properly is a major issue in implementing SCRUM. He said when the team size is too large they face challenges to adapt SCRUM. Members of team feel inferior to accept their backlogs or mistakes.
Interview 5:
Interview was conducted to enquire about the interviewee’s experiences in implementing SCRUM on GSD projects. The interviewee mentioned that managing globally distributed projects is very hard which includes various issues. He stated it is challenging to convince all stockholders on agile usage. He said that lack of trust is a major challenge in GSD. He mentioned that mistrust is created due to poor satisfaction of customers. He added the main reason behind losing trust is poor communication which in turn leads to failure of project. The interviewee said that lack of trust, lack of risk management skills, inaccurate estimates are major challenges that leads to failure of GSD projects. The interviewee also mentioned that activeness of members reduce due to reduced feedback frequency. The interviewee pointed that performance of teams reduce due to less duration to deliver projects. The interviewee pointed that assumptions arise due to language and socio cultural issues which are a challenge in GSD.

He also added that not training the employees properly leads to failure of project and reduce confidence levels among members of the team. Too many development sites are also a great challenge in GSD that leads to difficulties in integration. Hiding information and progress of the projects leads to delay of project. He added another major challenge that leads to postponing the work due to pathetic work culture. The interviewee mentioned that not having automated testing results in poor validation of the product. The interviewee mentioned that differences due to changing market trends and new technologies are a great challenge in GSD projects. The interviewee added that reduced satisfaction of customers leads to mistrust.

He mentioned that SCRUM is the only agile method they have used so far. Sprint planning meeting, self organization retrospective meeting daily stand up meetings, SCRUM of SCRUMs are the meetings conducted during the SCRUM implementation in distributed projects. Sprint burn down charts, product burn down charts and product back logs are the various artifacts used in implementing SCRUM. Sprint is usually between 2-4 weeks. He mentioned that they have used daily stand up meetings, where the SCRUM master and team meet together to discuss three questions. It lasts for about 10-15 minutes only problems are discussed rather than solutions. The interviewee mentioned that the SCRUM meetings need to be winded up soon, else the team loses interest. These meetings reduce issues with asynchronous communication. In a Product backlog all the activities that should be performed are saved in product backlog. According to priority these activities are performed.

The interviewee mentioned that ranking of the objects help in finishing soon the important tasks, so that delay can be reduced. Only product owner can change contents in product back log. Back log is transparent to all the members of team. He pointed that they have used excel sheets to create them. This is very helpful in knowing the remaining work for a particular time. It is modified every day. Access to alter the burndown charts is possible only to the product owner. The Status of the project is informed to all the team members regularly. The interviewee said that effects of the tasks performed can be easily found out through conducting brainstorming sessions.

He added that team members are made to have common goals. Communication among the team members happen frequently. If there is any issue, they are asked to contact relevant people immediately. Several tools are used for communication to reduce barriers. He said that they used video conferencing, VoIP calls, instant messaging, netlog, wikis, blogs etc. the local team members meet daily where as the product owner will meet the onsite team for planning meetings and for every three weeks face to face meetings builds trust. It gives the clear picture of what is expected and progress of the work. There is no tool that can be used for replacing face to face meetings. He said that risks can be avoided by recruiting the people that suits the position. He added that the best practice is to encourage customers and end users to involve in the project. As a product owner, the interviewee suggested that coordination issues can be reduced by having fewer number of developing sites distributed SCRUM teams and reduced number of members in each team.

Interviewee mentioned that training plays an important role. Team will be trained on basic fundamentals on implementing SCRUM for a short duration. He said that there are cultural and
language issues in implementing distributed SCRUM this can be overcome by having a person between the team who knows remote languages too. Time zone differences are overcome by starting to work bit earlier to cope with onsite team time zone. If required, working late nights by members of team is done. Estimations are made by using a two-step method. On the first day, each team member is asked to make estimation of all stories as points. Second day, each team member is asked to list out their tasks. These are collected and sum up the individual time taken for each person and final estimate are made that way.

The interview mentioned the major benefits of SCRUM implementation in GSD: Simple, natural, flexible, adaptable, high quality, less duration, reduced waste, reduced rework, high visibility, increased innovation. Teams can be relieved from management force. Self-organization of teams is possible. Product quality can be improved. Work satisfaction, customer satisfaction and product can be highly improved. Integration of SCRUM practices with several agile methods is possible. He also stated that they are fully satisfied in implementing SCRUM practices did not face any major challenges in implementing SCRUM. He said it all depends on the team on how they modify the practices of SCRUM.

Interview6:
The interview was conducted in two different phases. In the first phase we investigated on the project management challenges faced by the organization in globally developed projects. The interviewee mentioned that due to distribution of sites globally, there always exist dependent functions being developed in sites and hence it takes too long to deliver the project than estimated. The management doesn’t provide regular feedback on their work to the team and the team do not commit to their work. Building and maintaining trust is a very significant challenge in GSD. Due to geographical separation, the team coordination reduces, which in turn reduce trust and the goals become more individual than having common goals. He said another challenge is that the meetings conducted are prolonged as they don’t have meetings regularly. Team mates feel bored of being there for a long time and hence they lack interest to actively participate. He said that there are several cases in which the final product failed because of wrong estimations. The interviewee also pointed another challenge that the standards and procedures stated by experts are too complex, but it was not possible for people with low experience always get confused.

The interviewee stated that not giving training properly to the team will affect the success of the project in a negative way which in turn reduces confidence among members of the team. He also said that poor customer satisfaction and force from higher level management reduces trust and confidence among members of the team. The interviewee pointed the most significant challenge being faced is because of different time zones, people could not work at same time so they get delay in responses and they can’t share information. Members at one site doesn’t know what members at other site are doing hence they lack coordination among them which is also a challenge. He added lack of communication and visibility is also a greatest challenge in distribute projects which results in failure of project. The interviewee also added that not having automated tools to test leads to improper validation. Other great challenge mentioned by the interviewee is incomplete requirements that lead to misinterpretations. The interviewee said that it is challenging to integrate when there are too many sites.

During the second phase of the interview the interviewee shared his experiences in implementing SCRUM and challenges faced by them in implementing the methodology along with its benefits. The interviewee stated that “Mainly we are focusing on SCRUM. In fact SCRUM is the best fit for our kind of projects”. He said that they need quick visibility and feedback from all their development projects He said that the first build of their application on one of the platform was the kick off to move to SCRUM. It was not that good but team got familiar with the process. In fact, the team had a training session on Agile Software development methodology and one of their Tech Team Lead got the external training as “SCRUM Master”. After the first build based on the SCRUM kick off project they started following the SCRUM since November 2007.
The interviewee mentioned that the best practice to avoid project delay is to prioritize the objects. He stated that they need quick communication and sharing information regularly to involve all the members to participate. The interviewee added that, in the first step, SCRUM team needs to understand the strategy, covering Vision and Goals to accomplish them. Goals should be commonly shared in order to complete the project according to the estimated deadline. Brainstorming sessions are conducted to find consequences of activities. Interviewee stated that Planning poker is the most efficient way recommended by the interviewees for estimating the schedule and budget. Card deck is given to each person who is involved in estimation and asked to pick one card. Second person should not see the card. When turning of cards is done, discussion on various estimates is done by keeping a tile imit. This process is repeated till estimates are met. It overcomes problem with anchoring. It is funny and everyone is involved.

When an experienced person make estimates he always over estimate things in which he is an expert and ignore things he is not familiar with. This challenge is overcome by using user stories while planning, if required. Mean average is also best methods the organizations referred about through which estimations there are sustainable and agreeable are met. Important thing is that any tool can be used by them. But objective should always be kept in mind.

He said that the decisions are made in the weekly sprint meetings. Sometimes, the decisions are also made in daily SCRUM. He stated that they have teams based on their expertise and areas, e.g. “we have separate teams for all platforms, and there is a separate team for web development to maintain our web portal, similarly other teams including VoIP, QA, databases, IT, SCM, Designers and tech writers. So based on the task it is assigned to the relevant team and then within the team, the task is assigned to the relevant team member”. He stated that they are having sprint meetings in the time zone which matches all the required stakeholders. Planning should be done carefully in order to avoid overlap by keeping in mind different time zones. Sessions for brainstorming helps in identifying consequences of the tasks performed. He added that maintaining a distribution policy is very effective practice which will increase coordination among teams. Risks are avoiding by evaluating the capability of people before hiring them. He added that an experienced person is recommended to estimate the project by keeping in mind the user stories. He added that sending email on important points that need to be discussed before meeting itself reduces length of meetings. The interviewee mentioned that all the members of the team are encouraged to participate in all the meetings so that issues can be identified early. The interview said that involvement of customer and end user will help in reducing risk of last moment changes.

The interviewee pointed that trust and mutual understating within a team is being built during daily SCRUM meetings whereas among teams it is being built in weekly sprint meetings. Team members meet face-to-face during the daily scum meetings and also in the weekly sprint meetings. The distributed teams meet during phases that are critical for the project. He stated that they are using various tools of communications and have very well defined communication mechanism within the team to improve communication. In addition he said that they have open communication model to reduce any kind of communication barriers. The tools used by them are, Wiki, JIRA, Project Server and emails.

The interviewee said that SCRUM implementation adds value to the business goals. He added that a successful SCRUM has the opportunity to innovate new things. He mentioned that throughout the day there will be availability of the people in order to get some advice or clarify doubts. The interviewee said that the implementation of SCRUM practices is very flexible and changes can be easily adapted. He stated that the most significant benefits they achieved are easy adaption to changes, makes the organizations to develop complex projects by modifying practices according to the customer needs and emerging trends. He said that the regular and better feedback given to the members of team that encourage the team to commit to project. According to the interviewee, the major challenges faced while implementing SCRUM in globally distributed projects was to shift the paradigm of the team. Second major challenge was the communication to comply the team with the communication model required in SCRUM. He stated that they initially provide the training to the team members but now since they are following this model so every new team member becomes part of it and follow the
same process. In their case, culture, language and experience did not affect the SCRUM implementation. The third challenge they cope up was defining the sprints and deciding the weekly deliverables. In the first kick off project the sprint backlog was also a big challenge which caused delay in the planned delivery. The interviewee mentioned that as a group all the members of the team are satisfied in implementing SCRUM.