A Model for Applying Agile Practices in Distributed Environment: A Case of Local Software Industry

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***Abstract*— Distributed teams faced a lot of obstacles faced while applying Agile practices in distributed environment, these obstacles were poorly understood by local software industry. In market, Agile and distributed software development became a need more than a trend. It seems to be problematic when Agile and distributed software development merge. There is need to identify those Agile practices adoptable for distributed teams and can also help local software industry to produce a quality software. This study contributes an empirical based investigation of the critical factors affect in Agile distributed. Study inductively formulated a theoretical model of how specific agile alignment practices affect in mitigating distributed Agile software development process. The model presented in this paper presented state-of-the -art of critical factors affect in Distributed Agile environment given in literature. For further proof of concept a case study was conducted to test the applicability of proposed model in local environment. Results indicate basis for further research in local industry Proposed model makes applicability of agile practices in distributed environment by tailoring Scrum and XP methods.**

Keywords—Agile Practices; Distributed Software Development Environment; Local Software Industry; Method Tailoring; Pakistan Software Industry; Scrum; XP.

I. INTRODUCTION

In the field of software engineering Agile software development methodologies has been adopted by software industry around the world. Applying agile practices in distributed environment became a need for many software producing organizations. Development teams need to know the payoffs that can result by mixing of Agile and distributed software development [1]. Teams need to coordinate daily regarding their individual and relative activities [2]. There is a need to tailor Agile practices in such a way that they can be easily adoptable for distributed teams. Applying Agile practices in distributed setting became more challenging due to critical barriers affect during development process due to geographical distance present between teams, lack of face to face team meeting [3] [4].

Foreign talent availability can help distributed teams to excel well in global market. Distributed software development is a way for teams to get closer to clients and utilize locality specific capability to tailor or localize software products. International credibility for national software industry is achievable by having successful projects completed by local teams [5]. Distributed software development process became a common practice in software industry [6]. The development teams may be locally or may be globally distributed. There are different levels of teams distribution Fig.1 describes the scenario of distributed software development process [7]. We categorize the team distribution based on geographical location and distribution across organization type. Nowadays many organizations distribute their teams across multiple location according to their business need. The reason behind multisite software development is that, it offer a lot of benefits like flexible working hours, taking benefit of low cost destinations, nearer to market, minimum time-to-market cycles and quick response to customer requirements . In this paper we gather data from published empirical studies and list of challenges faced by distributed teams while implementing Agile methods and the best practices followed by the teams to overcome these challenges. Finally, we categorize the major factors affect in Agile distributed environment and these are human factor, process factor, management factor and organizational factors. As nowadays software development became a social cultural activity and also Agile software development purely base upon the people and their integration therefore, we find out the major human base challenges faced by distributed Agile teams and based upon the successfully executed case studies we draw the practices for resolving human issues. Distributed software development is the environment and Agile is a software development process therefore, it is a very careful decisions for the development team to follow which of the development process (like in our proposed model we tailor scrum and XP process techniques in order to overcome distributed teams issues). Proper selection of process, include defining project scope, project requirement, planning etc. A well-organized project management process will provide good project tacking mechanism, team communication. Organizational factor need

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strong executive support from upper management and in organizations where Agile methodology is universally accepted produce cross functional teams. We combine all of the factors effect during distributed Agile software development process the challenges associated with it and the Agile practices followed by distributed teams and make a model for supporting distributed teams. For proof of concept of our proposed model a case study was designed for the evaluation of practices given in proposed model, l. The distributed teams were located in Pakistan, USA and Turkey. The objective of the case study was to understand the difficulties faced by distributed teams while managing Agile practices. Also how the proposed model will be efficient to control the real-time issues faced by distributed teams in Pakistan [8]. The case study [9] is the most suitable empirical research method[10] to determine the real- world problem [11].

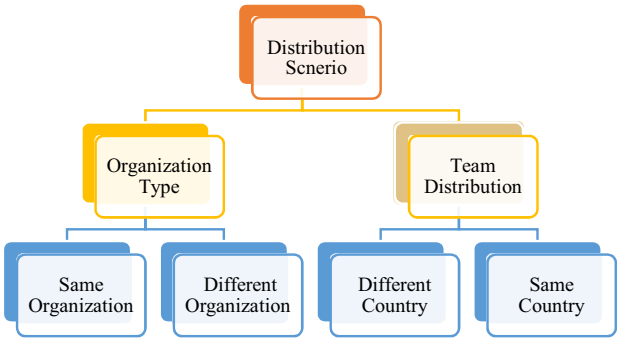

Fig 1. Scenario of distributed software development

II. MATERIALS AND METHODS

In order to determine critical factors affecting Distributed Agile software development and challenges, Systematic mapping is performed. Systematic mapping is a well- defined process to build a classification scheme of distributed Agile software development process [2]. This is useful for presenting state of the art of critical factors and critical barriers in Agile Distributed EnvironmentThe structure after systematic mapping can be helpful to answer more specific questions like the factors affecting DASD process challenges associated along with each factor and the risk mitigation practices. Based on this mapping we propose a theoretical model for Agile distributed environment to support local software industry of Pakistan shown in Fig.2. Case Study research method is used to check the effectiveness of proposed model in real- life settings. [12] Software engineering case studies [13] help to study software engineering phenomena in their real- life context [14].

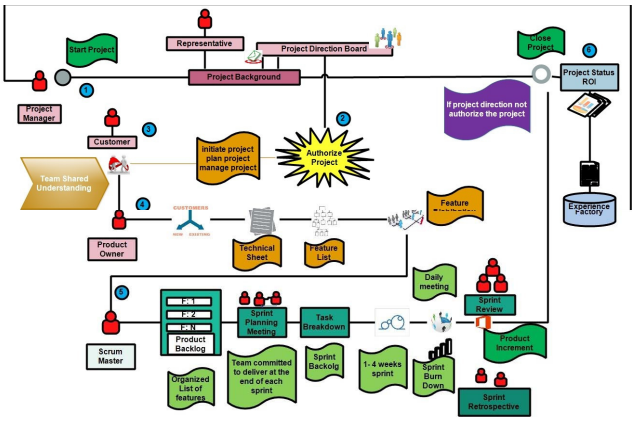

Fig. 2 Proposed model for Applying Agile practices in distributed environment

A. Case Study Design

The team was distributed over N distributed locations, to determine the critical factors affecting distributed software development process and how the extracted mitigation practices will be able to overcome the measured challenges. Detail about distributed teams, team location, number of sites and number of team members is given as:

Total number of distributed team members: 8

Team distribution: Turkey, USA, Pakistan

Duration of the project: 55 day

B. Research Questions

The study aim is to find the benefits and limitations of applying Agile practices in distributed settings. We formulate following research questions seek to explore in this paper

RQ1: Which factors need to address while applying Agile practices in distributed environment?

RQ2: What the major distributed Agile software development challenges?

RQ3: How the proposed model will helpful for the multisite development team?

With RQ1 we aim to categorize the major factors associated while distributed software development teams want to avail benefits of Agile methodologies. We plan to categorize the major factors affect during Agile distributed environment. RQ2 plan to investigate the challenges faced by distributed team. Based upon the mitigation practices we formulate a model that support distributed teams to avail benefits of Agile practices. RQ3 validate the proposed question.

C. Data Collection

We collect data from previous published literature and draw a systematic mapping for collecting the factors associated with Agile and Distributed software development. We identify the challenges faced by different distributed teams. The type of identified challenges varies from region to region. The teams participated in this case study were linked from Agile software development process, distributed software development and

global software development. We conduct approximately one hour face to face interview from the team members located in Pakistan. International participants collaborate through emails and video chats. The aim of getting responses from the software industry is to validate the real-world challenges faced by local software industry while applying Agile practices were also extracted during the interviews. Few risk mitigation practices used in the industry.

D. Data Analysis

Data collected from Published literature and industrial responses helpful to investigate the research questions. In order to meet research objective we analyze the data. The categorization of the factors affecting Agile and distributed software development are: human, management, process and organizational factors. The challenges and mitigation practices linked with these factor is shown in the Figure 3. The mapping provide the clear relationship between each factor. All these factors were validated through the industrial responses. The data analysis help to create a model for applying Agile practices in distributed environment.

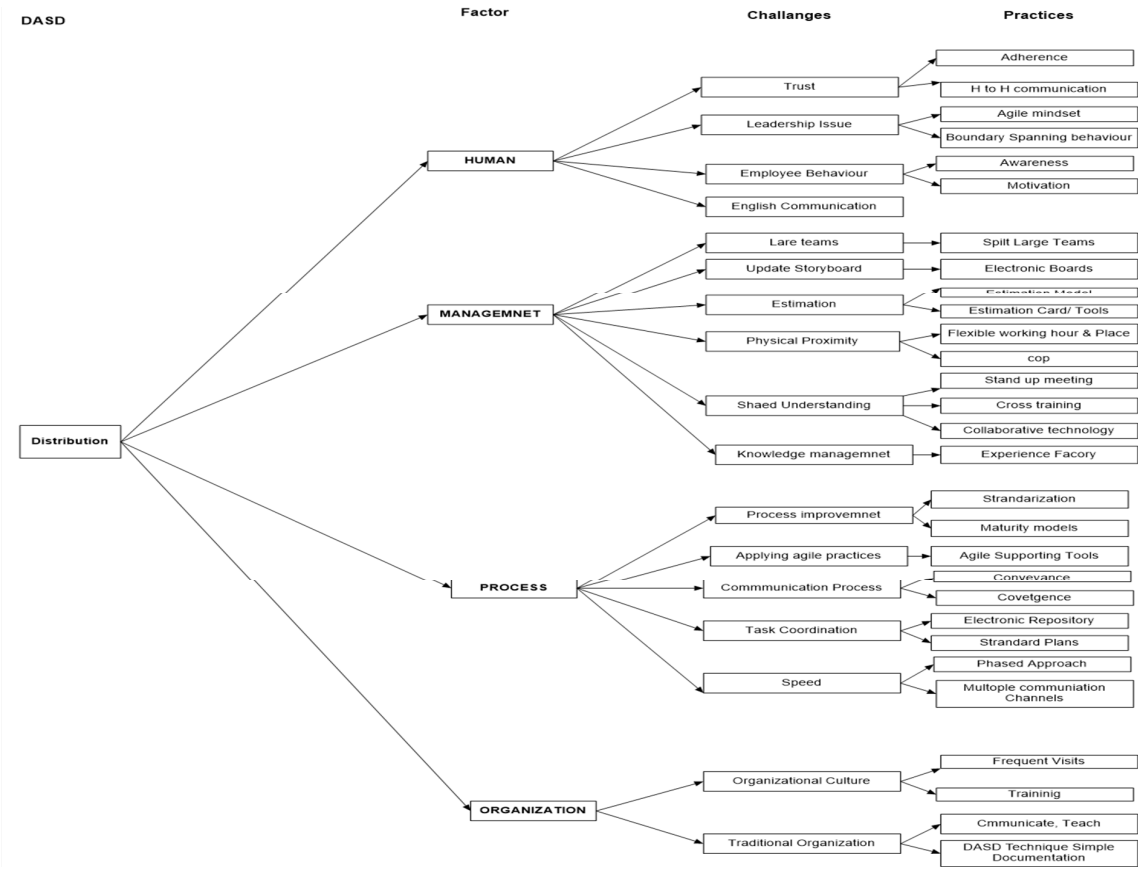

Fig. 3 Systematic Mapping of the factors affecting Distributed Agile process

III. RESUTS

The case study results are based on research questions. The team develop a web based application named as Baha. It is designed for football club. Its aim is to provide a place for game administration, players and football fans to watch videos, photos. It manages profile of football players and game administration, sports doctors. Update news about each match on the application. Players can make a professional network through this application.

A. Factors

RQ1: Which factors need to address while applying Agile practices in distributed environment? Fig.3 summarize the factors need to address while applying Agile practices in distributed. As Agile software development evolve self-organizing and cross functional team. Human factors plays an important role to make a cross functional Agile team distributed over multiple location. It was very difficult for project managers to manage multi-site team therefore; management factor must be address while applying Agile practice. Selection of the software

development process should be carefully selected to deliver the product within available cost. In Pakistan, most of the local organizational fail or become successful just because of the success or failure of projects. Therefore, organizational factors purpose is to not repeat the mistakes and best practices [15] should repeat again. During the case study, it was observed that success organizational factors. Fig.3 shows the graphical description of the different factors affecting Agile practices in distributed environment. It was observed during the case study that the rate of each factor varies from location to location.

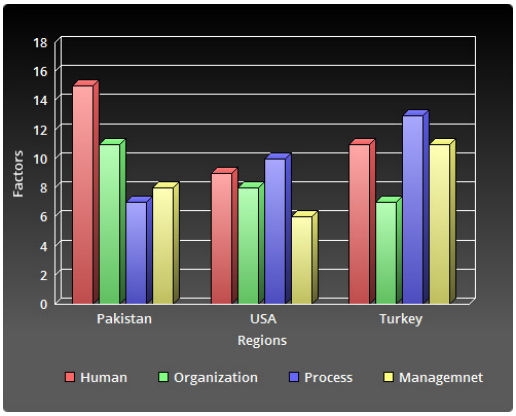

Fig. 3 RQ1- Results of the factors affecting DASD process in distributed regions

B. Challanges

RQ2: What the major distributed Agile software development challenges? Multiple challenges associated with each factor. Industrial collaboration and literature review is conducted to find out RQ 2. All the challenges summarized in the Fig.4. shows the major challenges faced by the Distributed Agile teams.

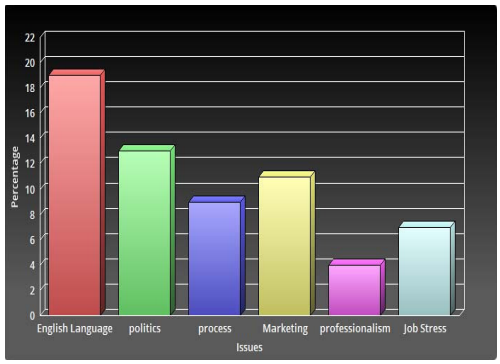

Fig. 4 RQ2- Results of the challenges faced by locally distributed teams

C. Proposed Model Outcomes

RQ3: How the proposed model will helpful for the multisite development team? The proposed model used the best practices given the Fig. 3 that were extracted from those projects which successfully apply Agile practices in distributed environment. All the best practices combine it proposed model that handle all major factors. Given model shown in Fig. 2 divided into four phases to cope each factor. A case study was designed to test the model in real world environment. Case study result shows that model is suitable for distributed team to successfully avail the advantage of Agile practices. Fig 6 the result of the proposed model efficiency in resolving the challenges.

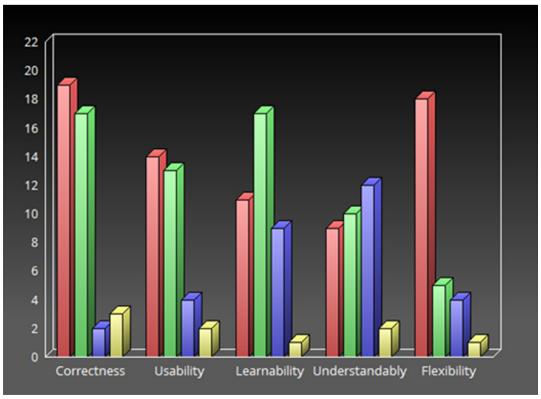

Fig. 5 RQ3- Overall benefits achieved by proposed model

IV. DISCUSSION

Investigate the factors affecting Agile and distributed software development and theoretical model for applying Agile practices in distributed environment is presented in this Paper. The proposed model mitigates the challenges faced by distributed teams. The model is based upon the extracted practices help to deal with the factors affecting distributed Agile software development process. The proposed model is considered as a reference model for handling some of human, management, process and organizational challenges. The model is divided into four phases including: (1) Pre-Implementation, (2) Implementation, (3) Team shared Understanding and (4) post development phase. In the first phase a baseline is set to make a cross functional Agile team.

As the distributed team need to communicate [16] throughout the project therefore, in the next step a team shared understanding practices are used to build a team mental model. In the implementation phase the team smoothly apply Agile software development practices. At last the whole distributed team project experiences saved in the experience factory so that, during the case study or after case study if any of the team member leave the team their experience saved. The case study shows that first phase deal with the human factors second phase deal with the management oriented factors, third phase solve the process based problems faced by distributed teams. The last phase "post- development phase "aim to strengthen the organization by using certain practices. And this practice become the need of the local software industry of Pakistan. Where the success and failure of project depend upon the success and failure of the organization thus just because of failure of few projects most of the software companies in Pakistan close their business also. During the case

study and interview this practice was much appreciated by the local software houses of Pakistan.

It would be suggested that to compete in international market local software industry need to use software engineering practices.

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