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Research Article

An Improved Software Development Process for Small and Medium Software Development Enterprises Based on Client's Perspective

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Abstract

Currently, the Global Software Development (GSD) has changed the overall software development paradigms thus resulting in of GSD, a large number of small and medium sized software development companies. All these companies prefer to follow lightweight agile based methodologies of software development due to limited resources available. Generating or developing a new software development process is not feasible for these companies; therefore the preference is given to tailor an existing software development process to use it. The existing work on tailoring a software development process is of very surface level that provides guidelines to large software development companies and tailor only one or two processes. It does not provide a general framework on process tailoring especially for small and medium sized companies. The main objective of this was to addresses this limitation and presents a process tailoring framework for small and medium sized companies which are following agile based methodologies. The client was identified as a critical element in agile methodologies that provide basis for the formulation of process tailoring framework. A case study of real projects was selected as a research method to validate the framework and its various components.

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INTRODUCTION

Software process improvement and tailoring practices have always been a part of continuous debate on software processes among the software engineers, practitioners, researchers and academicians. Although, research publications and articles on software processes appear regularly but they are focused more on a particular type of project and organization under some specific scenario. Besides, all the previous research more or less talk about some general practices while leaving many critical areas un-attended.

Research studies showed that software engineering researchers have contributed little to the various important aspects of software process improvement research which has mostly been under taken by software industry (Serrano, 2004). The contribution of actual and real practitioners of software processes such as project managers, system analysts, developers and team leaders to research is very rare. Any proposed model or suggestion from them would truly bring revolutionary changes in the software process paradigm. The work done so far is from academic researchers who have no practical experience of industry or from those who are part of some standardized organization which is indirectly involved in software development and improvement practices. This gap needs to be filled up by realizing the role of practitioners in this software processes growth and stability tug of war.

There is a need to switch the research focus to the real time issues, problems and scenarios that occurs in actual software development companies instead of proposing theory based process improvement models and methodologies one after the other. Software industry along with academic researchers now requires contribution of project managers, technical team leaders and product managers who are actually involved in software development besides their tight schedules and deadlines. The objective of this study was to work on this track and beginning of catering real time scenarios through research and working on the critical areas as mentioned above.

In context of software process improvement and standardization, well defined guidelines and standards have been presented such as Capability Maturity Model Integration (CMMI), Six Sigma, Lean Development and International Organization for Standardization (ISO) 9001. However, these approaches lack participation of the academic research community (Card, 2004). All of these approaches describe similar set of principles and methodologies. Unlike small and medium sized companies which are mainly practiced by large software companies because of having proper resources and infrastructure. These standardized approaches and many others proposed by researchers and practitioners are more likely to be adapted in various organizations to improve the quality of processes. The main issue in all these approaches such as CMMI and ISO 9001 is the ignorance of client. Although, these models focus on process improvement but they miss an important factor of client's perspective which is considered a critical factor for the success of project.

It has been observed that client's direct intervention in the overall software development process, role of different stakeholders, factors influencing the development team, effective communication channels between client and project team have never been addressed till to-date. These critical factors are considered essential for the success of a project in a software development company. Due to this, a lot of research on software processes has not been able to contribute to the project success ratio.

Most of the existing research works also focus on large software development companies and presents formal and well defined set of software processes in a well organized manner (Pedreira et al., 2007). On the other hand, due to limited resources, medium and small scale organizations are unable to adopt the standardized practices such as CMMI and ISO. Besides, non of these software process improvement approaches identifies the specific best practices for a software development process. It was assumed that assessment of these standards is expensive and time consuming; therefore it is difficult to practice these approaches in medium and small companies (Tarawneh et al., 2007). In such a situation, medium and small scale companies require light weight methodologies as a part of solution to their processes issues. In the present study, software process tailoring approach was presented to solve the process issues in the medium and small scale companies instead of heavy and complex processes.

Software Process Tailoring (SPT): The SPT is a process to tailor an existing software development process according to the requirement of the project and/or organization. Software development processes are tailored to standardize and improve according to the requirements. A good quality process is expected to produce good product thus achieving the client's satisfaction by meeting his/her requirements. Actually, this client factor has not been properly presented in the existing models, frameworks and standardized approaches. Any organization that selects CMMI, ISO standards or any other methodology such as agile wants to satisfy his customers by meeting their

requirements as a result of internal best processes. Unfortunately, majority of the organizations which are over-processed or use complex processes tend to fail to satisfy their clients due to involvement in un-necessary and unproductive processes which are not required by the client instead of spending time on working code. Previously, low quality, unreliable, over cost and late software products with less functionality have been produced (Visconti and Cook, 2002).

Adopting a new process during project development is quite risky and has limitations in deliverable and quality degradation which is not acceptable to client. Therefore, it is obvious that to meet the expectations of the clients, organizations customize or tailor and adapt the processes according to their environment and needs. But they altogether miss the importance of client's perspective while customizing a process which leads to un-satisfied and unhappy clients ultimately resulting in project failure. The goal of software process tailoring is to adapt an "off-the-shelf" software process to meet the needs of a specific organization or project (Pedreira et al., 2007).

The present study formulated and proposed a framework for tailoring software process based on the importance of client's perspective factor in small and medium sized companies. Client's perspective can be well defined as "What client has in its mind? What does he wants? What are his requirements and changing preferences that need to be identified and should be completed first at high priority?"

Identification of elements of client's attitude and technical aspects that directly affects the development process, are the fundamental part of this research. The elements of client factor, key tailoring operations, project states and tailoring scales would be defined as the main components of the process tailoring framework.

Client's perspective keeps changing during different phases of development and is different in different situations. Therefore, tailoring is required during each phase of the process. A good project manager has always to predict and understand client's perspective from his experience, meeting with the clients, meeting minutes, changing scenarios, past practices and mind reading of the client and then tailor his process to meet the ultimate goal of client's satisfaction. Adjustments in the software development processes should be done during the project lifecycle to meet the project requirements. Despite the importance of software process tailoring, only few guidelines are available in this regard (Xu and Ramesh, 2008).

Since, software process tailoring from client's perspective is a continuous process throughout the project life cycle, therefore this study proposed a process tailoring framework which is based on client's perspective and its changing aspects.

Client factor: In today's rapidly changing software development paradigms, organizations increasingly face continuously changing business and technological environments; traditional software development approaches which are predictive in nature are most likely unsuccessful in addressing the software processes issues (Mirakhorli et al., 2008). The reality check that project and client's pressure causes development teams to deviate from well defined processes, forces companies particularly small and medium sized to make realization of process tailoring during the project progress according to the project requirements instead of adopting a new process or changing the whole existing process during project execution at the cost of bad impact on client.

Client requires the deliverables, product and components well in time according to his requirements irrespective of how sound, refined and mature processes are used by the organization. Though a CMMI or ISO level standardized organization is a factor in achieving good global clientage but not to keep the client satisfied and winning his trust throughout the project life. Managers from software industry also realize that the introduction of these standardized approaches and certification systems is unnecessary which does not contribute to the software quality (Xiaoguang et al., 2008). Although, companies with good internal processes have worth in the industry but the client has no concern with internal processes and practices except completion of his requirements and work.

The approach presented in this study takes into account the most important factor (the client) and proposed a framework to tailor a software process keeping in view the interests and preferences of client. Client always wants changes and keeps adding new requirements irrespective of the cost of the whole development process. The requirements can be frozen as a part of requirement of the management process but it is not usually practiced at the cost of unhappy client. The reason is that you can't refuse the client. Client wants changes because he needs them; he is the owner of the software who is investing money and above all must have his/her own further clients or investors of that software. If the changes from client are not always welcomed, then it results into premature closure of the project from client which is observed even in big standardized organizations. The process tailoring to

accommodate client is the foremost requirement of the software industry both for the present time and future as well. This study mainly focused on tailoring or customizing a software process during different stages of a project based on those practices about which client is more concerned.

Many studies were reviewed during this study which lack this important factor (client satisfaction) in their proposed process improvement and tailoring techniques and models (Mirakhorli et al., 2008; Keenan, 2004; Lindemann et al., 2001; Kang et al., 2008). Also, this most important factor of client is the most neglected area by the researchers in their studies, proposed models and methodologies in spite of all software engineering principles and practices revolves around the client. There is no single model found that incorporates client's elements while improving a process. But the attention is only given to make an organization a standardized organization by adopting standardized practices. Although, this is good but ignoring client's interests in process modeling leads to dissatisfaction of client. Here comes the ultimate goal of this research by identifying and incorporating client's factor elements like early delivery, quick releases, resources allocation with client approval. Thus, tailoring would ultimately be selecting, adding, removing and merging only the most required activities to be performed during each phase of a process scoping out the rest.

Proposed preliminary framework: An ultimate outcome of this research is a proposed framework for process tailoring by absorbing client's interests and confidence elements. An initial abstract level process tailoring framework is shown in Fig. 1.

The frame work proposed in this study consists of the following components as shown in Fig. 1:

- Client's perspective model
- Project states model
- Key project phases
- Process tailoring schema

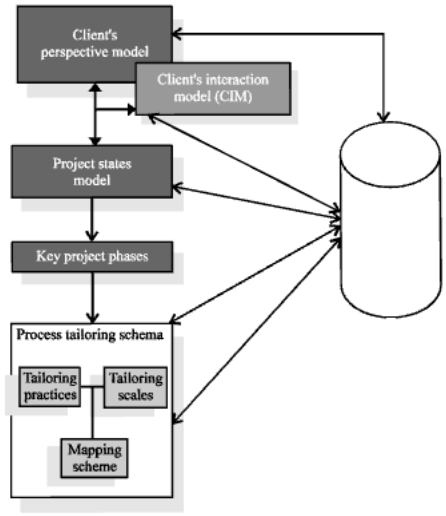

Fig. 1: Preliminary process tailoring framework

In this framework, the client's perspective model was first defined. Further project states were identified along with key project phases of agile based methodologies from the existing literature, models, framework and real projects. Lastly, these elements were be mapped to formulate the final process tailoring schema and framework.

The proposed framework is expected to be accommodating and flexible in response to the changing preferences and requirements of the client. This would help project managers to make quick changes in existing process model without compromising on process standards and introducing a new process at run time. The framework will propose client's elements involved, their cause and effect relationship and practices to modify, remove, merge or add sub-processes and respective activities during the development of the project to tailor the main process according to the

changing scenarios from the client side. As a result, a general Meta-model framework was developed based on client's factor. This framework was mapped to the process model to customize each phase several times during the life cycle of project. The tailoring process would be a bottom-up incremental approach. This process would tailor activities of each phase of the whole process in use.

Research methodology: The most common research strategy in software engineering solves some aspects of a software development problem by producing a new procedure or technique and validating it by analysis or by discussing an example of its use. The examples of use in actual practice are more compelling than examples of use on idealized problems (Shaw, 2002; Keenan, 2004). Qualitative research methodologies were adopted to formulate the framework and its validation. Qualitative methodologies give more realistic results and deep insights into real phenomena and were considered more reliable. The framework components were identified from existing literature. The validation of the proposed framework was made through a case study of two real projects being developed following agile-based processes. Both projects were outsourced and clients were onshore.

Table 1: Project and team details

Project name	Process base	Client location	Development type	Team size	Skill level	Average experience (years)
Project X	Agile	Onshore	Outsourced	12	Medium	3
Project Y	Agile	Onshore	Outsourced	8	Medium	2

The characteristics of the project and software development teams selected for the case study are presented in Table 1. Additionally, project names were modified due to the privacy policy.

In the first phase of the case study, the client's perspective factors were analyzed closely with respect to the influence of client during the development. Secondly, detailed project analysis was performed to identify and analyze different phases of a software development project and its behavior during those phases. In the third phase of the study, process tailoring operations such as add, delete, modify, split and merge presented in existing works (Yoon et al., 2001; Dai and Li, 2007; Welzel et al., 1995) were identified as the common practices of process tailoring. Lastly all these elements were combined and the process tailoring operations were applied during different phases of the projects and observations were recorded.

RESULTS AND DISCUSSION

The experimental results of the case study are summarized in Table 2. The study results show that clients were influential in both the projects but satisfied with the progress of the project and team performance. The reason behind the satisfaction of clients was the understanding of client's perspective in each project. On an average 14 and 8 problems of varying complexities were found in project X and Y, respectively. To resolve these problems and the other issues such as meeting the requirements of the client and smooth progress of the project, a total of 102 and 93 activities were tailored in X and Y projects, respectively. Individual tailoring operations performed in each project are presented in Table 2. The tailored version of the processes, sub-processes and activities helped in the smooth progress of projects, resolving different issues and problems and build up the client's trust on the project teams. Both projects successfully completed their lives.

The successful completion of both projects showed that process tailoring is a beneficial practice that should be a part of the software development processes in small and medium sized companies. Because, adoption of this process will help such companies in resolving the processes issues faced throughout the lifecycle of the project.

The present study results are in agreement with many researchers such as Bresciani et al. (2004) who introduced and motivated a methodology called TROPOS for building agent oriented software systems. They used two key ideas i.e., notion of agent and the very early phases of requirements analysis in all phases of software development to cover interactions between software and human agents. Similarly, Martin and Raffo (2000) developed a model of the software development process using continuous and discrete models. Whereas, Barrett et al. (2006) developed a flexible component-based software system which is identical to the present study model. While, Jiang et al. (2004) carried many software projects and examined performance of projects in relation to the activities at these various levels of maturity. They indicated that the activities associated with the managerial control of development related positively to project performance measures.

Table 2: Summary of results

Element	Project X	Project Y
Client perspective factor	Achieved, satisfied client	Achieved, satisfied client
Problems found (Avg.)	14 (Low, medium, high complexity)	8 (low, medium, high complexity)
Activities tailored: Add	42	35
Delete	21	19
Modify	19	17
Split	11	8
Merge	9	14
Total activities tailored	102	93
Project status	Successfully completed	Successfully completed

In another study, Subramanian et al. (2007) stated that Capability Maturity Model (CMM) is part of several Software Process Improvement (SPI), Six Sigma and Total Quality Management (TQM) initiatives in organizations. They concluded that CMM levels do associate with IS implementation strategies and higher CMM levels relate to higher software quality and project performance.

CONCLUSION

The proposed process tailoring framework provided a solution for software development process issues in small and medium sized companies. The proposed framework provided guidelines to tailor agile based methodologies based on the agile principles. Above all, the tailoring software development process seems to be more applicable and unique, once project is in a particular phase rather to apply it at the beginning of the project. The proposed framework is more applicable in small and medium sized environments which can be scaled to large and distributed environments as well.

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