Software Requirement Engineering For Small and Medium Enterprise: A Case Study

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Master of Software Engineering and Management Thesis

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SOFTWARE REQUIREMENT ENGINEERING FOR SMALL AND MEDIUM ENTERPRISE: A CASE STUDY

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ABSTRACT

Context: *Small and Medium Enterprises (SME) are large part of economy. Challenges faced by them are unique and different from large scale organizations. One big problem faced by SME is management of Requirement Engineering (RE) activities. Requirement Engineering is one of the most important and critical phases in any software development project. Managed, precise, accurate RE activities and optimal process can play vital role in successful completion of any software development project.*

Objective: *This thesis will identify State-of-art RE techniques for SME, which they can use to perform Requirement Engineering activities in better and optimal way. This task has been achieved by providing of a methodology and guidelines. These guidelines are based on Qualitative research and exploratory case study at a company named Fortex. This work will help requirement and software engineers in managing requirements and performing RE activities in a better and more optimized way.*

Method: *Surveys and semi-structured interviews were used in order to collect Qualitative Data. Intensive study of relevant literature was carried out to deduce information about current state-of-art and other related work. A model was designed to perform RE activities on basis of that data. Later, a case study was performed at Fortex to benchmark the results. Results were analyzed to present guidelines and a model, for RE activities in SME.*

Results: *A new method Communication Center Prototyping for RE (CCPRE) is presented for improving communication, user involvement and requirement during of RE activities. Guidelines are also provided after case study, which will help during the selection of suitable RE techniques for projects in SME.*

Conclusion: *SME show unique behavior due to their small size, cohesive nature and open communication. This communication, added with prototyping, interviews and workshops can result in better management of RE activities for SME. CCPRE model presented here, proved to be successful during case study, by overcoming tradition challenges in RE phase.*

KEYWORDS: *Requirement Engineering, Requirement Gather, Small Medium Enterprises.*

Acronyms: RE = Requirement Engineering, SME = Small and Medium Enterprises, LSE = Large Scale Enterprises CCPRE = Communication Center Prototyping for RE.

1. INTRODUCTION

Small companies form big part of today's software industry and economy [2]. Only in the US, Brazil, Canada, China, India, Finland, Ireland, Hungary, and many other countries, small companies make up to 85 percent of all software organizations working [3]. The challenges faced by small companies are quite different and unique in their own sense.

Although there is large percentage of small software organizations all over the globe, relatively few publications present software engineering solutions focusing specifically on small software companies [3]. Due to their small size, lack of resources and other limiting factors, challenges faced by small companies are totally different from large scale organizations. Small software firms are extremely vulnerable to changes in technologies and markets [4].

Apart from large contribution in business, the needs and challenges that Small and Middle Enterprises face are often overlooked. The requirement engineering community has mostly overlooked needs and characteristics of small organizations [2]. Although there can be many reasons of less progress in this area, this may be due to a lack of access to these companies, or to the mistaken assumptions that they are essentially no different from their larger counterparts, that they are a minor component of the economy, or that they do not pose any significant research challenges [2]. One of the biggest challenge for any software company is management of their RE practices. These practices involve requirement gather, management, analysis, verification, volition and other relation activities.

Many software companies do not use existing RE approaches; this indicates that there is room and opportunity for improving the usability of existing RE approaches [5]. The main objective of requirement engineering is to understand customer's needs, problems to be solved before system development, the delimitation of system boundaries, as well as other types of constraints imposed to the solutions, such as economic, technical, systemic, environmental, time and resource constraints [6]. RE phase in any project have much more significance than others, due to its impact on later phases of project. Negligence in this process can easily result in failure of project, whereas using suitable techniques and

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methodologies, putting required efforts and focusing on this area, can greatly contribute in the success of a project. A clear relationship between requirement engineering and project success has been reported since the 1970s from various empirical research studies and surveys, typically putting insufficient requirement engineering on top of the list of factors contributing to project failures [7].

One of the biggest challenges faced by small companies is selection of appropriate RE techniques for any project. Numerous techniques have been developed in the last three decades which aim at providing support for RE processes, yet in reality, there still exists a big gap between theory and practice. One of the major reasons for this is the lack of support for the selection of the most suitable RE techniques for a specific software project [8].

Selection of the most appropriate RE techniques for a software project based on the project's characteristics is a non-trivial process, and a common challenge faced by software developers [8]. There are many factors which can affect the selection of appropriate techniques, like budget, time, resources etc. As RE techniques can greatly affect on a project, it makes it even more important and complex also. This is because RE activities are effectively integrated and dependent on each other. RE activities, in contrast to other software-engineering activities, may be more iterative, involve many more players who have more backgrounds and expertise, require more extensive analyses of options, and call for more complicated verifications of more diverse (e.g., software, hardware, human) components [9].

The research question that this study explored was *"Which Requirement Engineering techniques are suitable to identify, gather and analyze requirements at SME to contribute toward the success of a project".*

This paper presents a methodology for SME to perform their RE activities. Guidelines provided in this study can help to identify suitable RE techniques for any project.

Section 2 in this paper will present similar research conducted in areas of RE and RE in SME. Section 3 will provide detailed description of research methods used in this study. Section 4 presents results of interviews, surveys and cases study. I will also explore analysis of model designed for RE. Section 5 have contains brief discussion on whole study, and section 6 share the conclusion with reader.

2. RELATED RESEARCH
This section is divided into two further sections, RE Research and SME and RE Research.

2.1 RE Research
In recent years, a lot of research has been conducted to develop and design Requirement Engineering methods and techniques which can support development of today's complex software.

A panel consisting of both practitioners and academic experts concluded that the Requirement Engineering process is still the most problematic area in Software Engineering activities [10]. The problems and challenges in RE activities can result in inaccurate requirements from the customers, impacting the success factors of a project.

Software project managers still think that problem of misunderstanding and managing requirements is their second most important risk that should be managed [11]. This challenge of finding and using techniques which can help in the management of requirements is still a headache for many project managers. Even though we have made significant progress in software development, we still face some challenges that we experienced already 20 years ago: software development process tends to be over budgeted and late in its end product [12].

With the increase of software and systems complexity, more frequent changes and shorter time available to the market, forces the organization to establish better requirement engineering processes. Thus, improving RE processes with respect to organization specific needs is becoming a crucial challenge for many organizations [13].

Wang et al [14] has presented a model called MORE (Model Based Object Oriented Approach to RE) to manage RE phase and activities. They applied this during a case study. By applying modeling and OO technologies to requirement phases, the domain knowledge can be captured in a well-defined model, so the completeness, consistency, traceability and reusability of requirement and its integration with the artifacts of other phases can be cost effectively improved [14]. This model is very difficult to implement, due to its complex mathematical requirements of models.

Anwer and Ikram [15] explored a model called GORE (Goal Oriented Requirement Engineering) for RE. This technique is very promising but developing consensus among all stakeholders on same concepts and principles in very challenging.

2.2 SME and RE Research
There is one big aspect which has been neglected i.e. use of suitable and optimal Requirement Engineering Techniques in small size companies.

Small software companies have a number of characteristics that makes their requirements processes different from those of large corporations [2].

Not many researches have been conducted on this area. This is mainly because of the view or assumption that needs of small scale and large scale organizations are the same. Small software development companies have been severely understudied by the requirement engineering community;

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and in instances when field studies have been reported, the size of the participating companies often goes unmentioned (as many other elements of their context), complicating the history of the field [2].

Ochoa et al [16] suggest usage of an automation tool for small sized enterprises; which can help them to automate many of RE activities. This automation tool can be hard and challenging to adopt for many companies because of project nature and processes companies are following.

Li Jiang and Armin Eberlein [17] in their work present a model called RE Technique Suitability Assessment (RETSA) to select suitable RE techniques based on different attributes of project. There are several challenges in using this model. Apart from using complex mathematics in this model, it does not address needs of SME.

Carter et al [18] has proposed a methodology to develop components for small size teams. Main focus of this work is on small-sized teams. This work does not present any methodology for small company, but only for small teams.

Recently, Jorge et al [2] has presented their work in which they have explore different aspects and common patterns which small sized company follow while performing RE activities. Although this work is very useful and comprehensive, but it still does not provide any model/methodology or technique which can be used by SME to follow.

There is still a need for a better Requirement Engineering methodologies and techniques, which can be used by SME in their Software Projects. Similarly, there is need of Architecture Design guidelines which will help them to identify important aspects which can play role in designing a better architecture. To overcome and contribute toward achieving these requirements, this study will help SME to perform their critical tasks in a better way by using these method and guidelines.

3. RESEARCH DESIGN

This section presents detailed overview of research method used. It will also provide reasons for making the selection of that particular method. Later in this section, application and setting of research conducted is discussed.

3.1 Applied Method

During this study, qualitative research methods combined with a case study and literature study were used. This research used triangulation [19] (multiple measurement instruments, i.e. Interviews, Surveys) so that more than one measures can cover the issue [20].

It is always suggested that researcher should use more than one measure to achieve triangulation [18]. Interviews, surveys and case study methods were used with combination of literature study. This helped not only to validate information, but it made it more reliable and authentic. Main objective was to get as much inputs as

possible from the professionals and from the industry, as possible. This helped to get better understanding of state-of-art in industry.

Survey was conducted using online tool [21]. Survey was sent to 30 different professionals, total of 19 participated and provided useful information.

Interviews with professionals were also part of this study. The entire transcript of interviews, supported with voice recording and hand notes were also saved as suggested [22]. Interviews conducted were also very helpful to get deeper and more accurate information from the professionals. These interviews were semi-structured, open-ended and less rigid [23] to get more useful information from interviewee. This helped interviewee to share their thoughts and experiences in much more open and easy way.
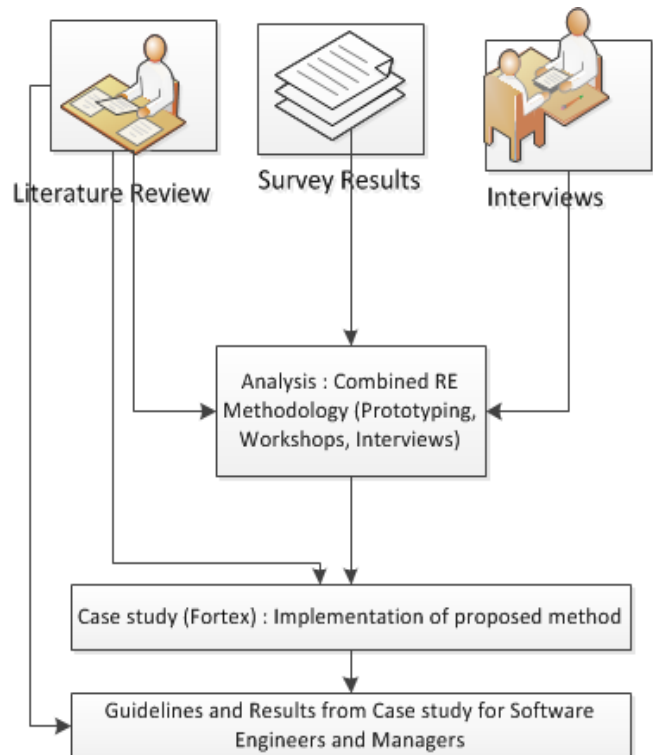

Figure 1. Research Design Overview

Figure1. shows the overview of research methodology followed throughout the study. Interviews, surveys and literate review was used in start to analyze current state-of-art techniques for RE. A methodology was designed after careful analysis, to support RE activities in SME. This methodology was then applied during case study at Fortex. Results and guidelines from that case study are presented later in this paper.

Case study research is a qualitative tool, which aims to provide rich description of some specific and narrowed down case [18]. An exploratory Case Study, to explore state-of-art techniques and methodologies currently used by other companies was part of this study. Intention of this

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study was to gather data, from industry and academics and then formulating the techniques, which can be tested during the case study to bench mark results.

Literature study provided information on current research trends, which helped to understand what have already been done and what were the results. Literature study was one main supporting activity conducted throughout the project.

3.2 Application of Research Method
Survey and interviews were conducted with Software/System Engineers, Project Managers, Team Leaders and other roles associated with any Software Development Project.

Surveys
Surveys were conducted to establish and gain basic knowledge of industry and professional opinions from individuals working in the industry. Questionnaire was designed by keeping the outcomes and research questions in view.

More than 25 companies were contacted for participation in the Survey. These companies were selected via personal contacts, internet and help of colleagues. 18 companies agreed to participate in the Survey. Companies then gave contact information of relevant person. 30 professionals in 18 different companies were contacted via email, with request of their participation in the Survey. A separate link was provided in that email to survey. Out of 30, 19 professionals from 10 different companies participated in the Survey with valid input.

Online tool [21] was used to gather data. The data provided by respondents was then analyzed with provided [21] visualization tools. Some questions in the Survey required detailed textual answers. That contributed in sharing and understanding of individuals' point-of-view using surveys. These surveys helped to gather data about how these companies are performing their RE activities, what challenges they are facing and how do they overcome them. After analysis, this data was then further used while working on case-study.

Interviews
During surveys, three participants were requested to volunteer themselves for detailed interview. Semi-structured interviews with selected individuals were conducted. Semi structure interviews helped to get better understanding and perception of selected key roles.

These individuals were selected from different fields of Software Engineering Domain.

One interviewee was System Engineering with one of leading car manufacturer in Sweden, One was Integration Engineer at small size company based in Stockholm and last interviewee was working as a Free-Lance Developer. They had extensive work experience in Software Development and Requirement Engineering. No other Management, Finance, or other related role was interviewed during this study.

3.3 Case Study Setting
A case study was conducted with Fortex AB during this study. Fortex AB is Small Sized Organization (with less than 10 employees), operating business from Sweden. Their business is expanded in more than 35 different countries. This small scale organization is doing business in forest goods in Sweden. The process model which Fortex is following is much more efficient than competitors, which resulted in more than 738 million SEK turn over just in 2008.

This case study was conducted during period of two months at Fortex office in Sweden. This study included extensive communication with employees of the organization, long meetings to discuss prototypes and communication with suppliers/customers. A methodology for requirement gathering, management and elicitation was also designed and implemented during this period. This methodology will be discussed later in results section.

In Fortex, due to growing business needs, changed business requirements and becoming more productive, Fortex decided to use ERP system to support the business. Many solutions from market were explored but due to their unique work flow, implementation cost and complex customization, Fortex decided to start in-house development of small ERP system. Objective of this development was to develop software which can help them to be more productive and efficient than competitors in business.

During the first phase of project, it was decided to make requirements clear. The deliverable of this phase was a document comprising requirements of system, on which all stakeholders can agree.

When developing products, companies must deal with the difficulties of eliciting, managing and prioritizing requirements [3]. As most of the employees at Fortex are businesses, financial and marketing personal, it is very challenging for them to communicate requirements of desired system in engineering way. RE process for a non-IT based company can be very challenging, as it requires some specialized knowledge of Unified Modeling Language (UML), software engineering and other related subjects. Due to complex RE processes, Fortex AB is looking for optimized and implementable RE techniques, which they can use to communicate their requirements in best possible manner.

The main objective of this case study was to find optimized and implementable RE techniques, which can be used by SME to communicate requirements in best optimized way. Using these methodologies, Fortex communicated their requirements for designing of a requirement specification

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document on which all stake-holders agreed. This document can later be used by software developers to build system.

4. RESULTS

This section presents results from different studies conducted during this thesis.

4.1 Results from Surveys and Interviews

Survey was launched using online automated website [21]. Participants were contacted via email, and then half of them were reminded via telephone calls. Emails containing objectives of the study and link to online survey was sent to 30 professionals.

Most of participants in the Survey were from SME, doing business in software development and consultancy. There were participants from all sizes of companies, most of the participants were from middle or small scale organizations as shown in figure 2.
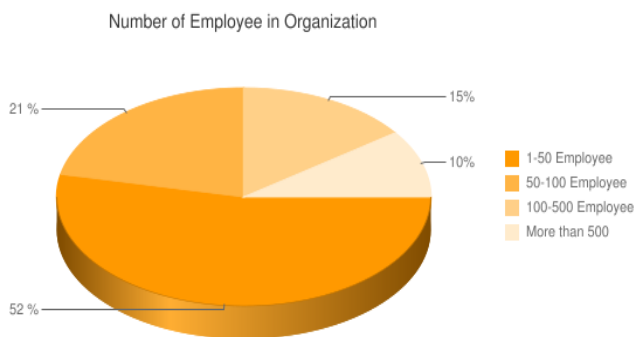

Figure 2. Number of employees in participants' organization

Professionals from different roles participated in the Survey. Largest pool of participants was of developers and software architects as shown in figure 3.
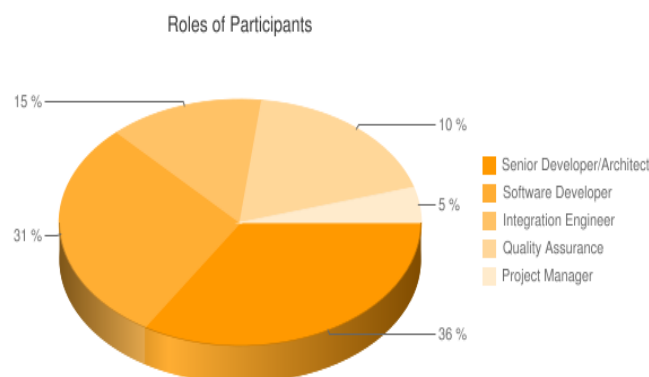

Figure 3. Overview of participants' roles in organization

Participants were given option to select on scale of 1 to 10 in four different questions, where 1 is the lowest and 10 is highest. Four questions in this section were designed to understand the challenges companies are facing in managing their RE process.

4.1.1 RE is challenging

Observation: Large amount of participants (12 participants) suggested that managing requirements for their company is very crucial (above 8 on scale of 10).

When asked *"Question : how difficult/challenging it is currently for their company to manage requirements"*, more than 7 participants said it is very difficult, whereas 8 participants said it is difficult and only 4 participants said it is not difficult. This also means that if responses are combined, we can state that nearly 78% (15 participants) consider this aspect as difficult or very difficult for their organizations.

4.1.2 Extensive use of Prototyping in RE

Observation: Use of specific RE techniques which a company was using was also asked. Most of the people (11 participants) told that they are using Agile/Prototyping method for Requirement Gathering. Similarly, use of User Stories (3 participants) and Onsite workshop (2 participants) was also reported by some participants. Some participants told that use of tailor-made techniques (3 participants) for their own company us very useful for them. The overview of results is shown in figure 5.
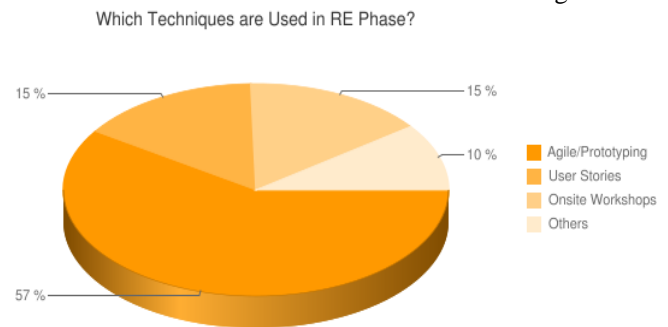

Figure 5. Techniques/Methods used in RE phase by participants

4.1.3 User involvement is crucial

Observation: In the Survey, for suggestions to improve current RE techniques, many participants proposed that continuous and iterative inputs from the end-users are highly required in RE activities. Few participants suggested using iterative process in finalizing requirement documents and other deliverables in RE activities.

In interviews, interviewee stressed on the need of continuous user involvement throughout the RE phase. This helps user to communicate, verify and validate the requirements.

While answering question: *"How important is prototyping for RE phase in your work"*; interviewee from SAAB responded: *"We use prototyping to communicate requirements with our offshore customers on regular basis; it gives them possibility to see software functionality and working in advance and verify them, so it is one of integral and important part of our RE activities"*.

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4.1.4 Requirement Management is necessary

Observation: During interviews, participants emphasized on using established tools for management of requirements. Some of the participants suggested that due to rapid changing requirements, managing them is very important and challenging task in their companies.

Interviewee working as Integration Engineer in a SME at Stockholm said *"When requirements are changing so often, it is very important to keep track of them. It can be simple excel sheet, but use of professional software is always better"*

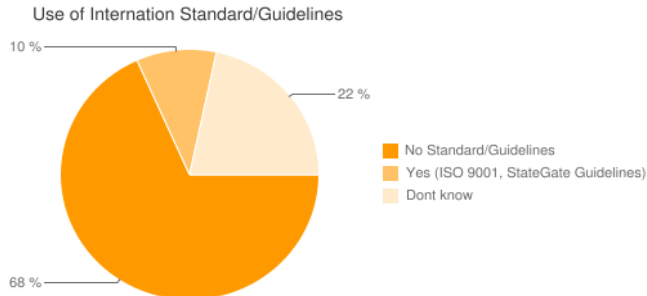### 4.1.5 Less following of Standards/Guidelines

Figure 4. Use of International Standards in participants organization

Observation: Surprisingly 13 out of 19 (68%) participants said that their company is not having or following any international standards/ guidelines for managing RE process. 22% didn't answer. Only two participants (10%) said that they are using tools and guidelines (ISO 9001 and Guidelines provided by StageGate [24].

4.2 Need of a Model: Communication Centered Prototyping for RE (CCPRE)

This section will discuss the need and importance of model designed for RE phase during the case study at Fortex. Many participants suggested that use of prototyping is one of the most helpful and supporting tool during RE activities. Apart from prototyping, user participation plays very critical role in getting requirements from the user effectively. A large amount of research conducted is available to prove that the user involvement plays positive role for design and implementation of a mature project [25].

Three main points from results of the Survey and interviews were:

- **More Communication** : Need of more communication between user and software engineer

- **Prototyping** : Prototyping can support RE activities

- **Requirements Management** : Management of requirements continuously is very important

After careful analysis of literature, survey results and interview transcripts, it was observed that there is need of a method in which user participation, prototyping and regular management of requirements is ensured for SME.

Figure 6 explain the overall working of proposed model. The challenges that this problem address is improve communication, involve users, more prototyping and requirements management.

During the start of the project, all initial requirements are gathered by studying workflow, official documentation and meetings with the stakeholders. This document can be very basic in start, but as steps are followed, this document can handle more desired requirements by asking users during different interactions.

Mostly, SME have more internal communication, quick decision making and lack of organizational hierarchy. These factors also suggest that a model with more focus on user communication can be very helpful for them. Similarly, many interview participants suggested that prototyping is very helpful when user give response efficiently.
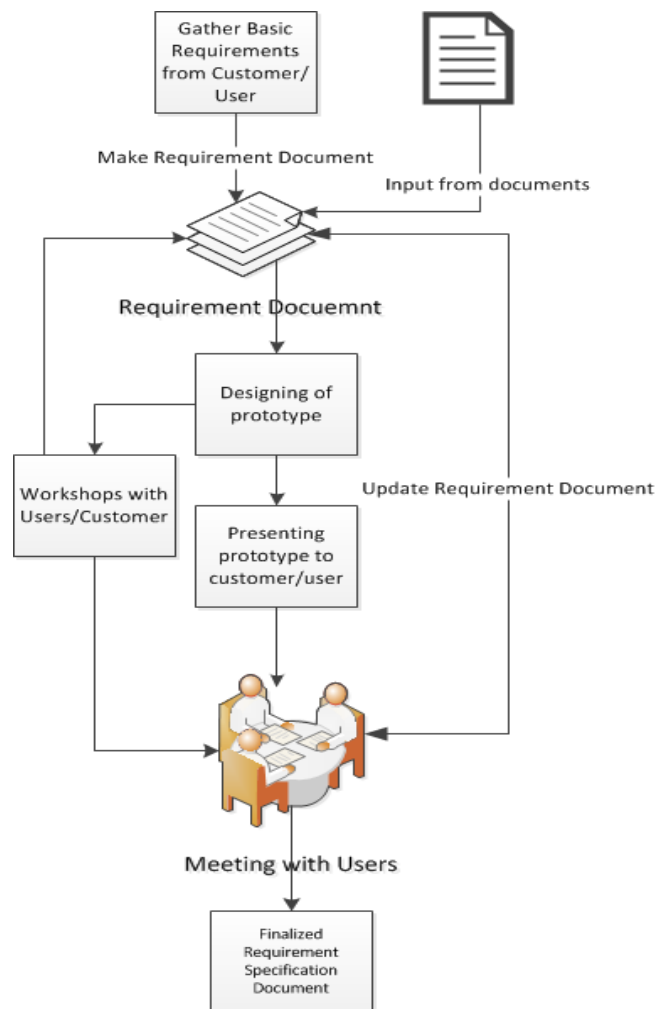

Figure 6. Overview of RE Process designed

These factors make the designed model suitable for the projects in SME. The process designed is flexible, as it includes different methods of user involvement like

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workshops, meetings and even documentation from the company.

One important requirement for this model is to continuously update the requirement document, which will ensure communication and tracking of requirement. It will also help to verify requirements from customers. Early involvement of user requirement in the documentation phase is very important and it helps the project to make it a success [25]. Steps involved in this process offer opportunity to both requirement engineers and stakeholders to communicate, and update the requirement document efficiently.

4.3 Implementation of CCPRE: A Case Study

Fortex AB is a small, non IT and Software based company, which made this organization more suitable for this case study, because for them it will be easy to adapt to any new methodology of RE. Being a non-IT based company gives them more flexibility to adapt any new technology, because they don't have any methodology already. Similarly, their IT section is not as advanced as in software intensive organization, which means for Fortex any new method will have same acceptance as any other. Basic requirements and organizational hierarchy of Fortex was first explored in order to apply the methodology and guidelines.

To design a Requirement Specification Document on which all stakeholders can agree, Rapid Prototyping was followed. As this project was totally new for the Fortex, and most of the employees were unaware of the usage of any RE techniques, it was very challenging for them to communicate their requirements in start.

Requirement engineering, in particular, requires higher levels of communication, self-organization and frequent adaptation to a dynamic environment [26]. The best and optimal method to communicate requirements was to evaluate and suggest improvements in prototypes.

Development of evolutionary prototypes, with continuous user involvement and review, can reduce risks, cost, and time associated with requirements specification and construction of software systems [27]. After every meeting, a prototype was designed and verified by the stakeholder. There were two different internal stakeholders (Marketing and Finance Department) were involved in first phase.

Being a small company, communication within employees was easy. As most of the users were at same geographical location, it helped to validate and elicit requirements on regular basis. For any project, management of requirement is very critical, as it can result in ambiguous and complex situations. It was discussed in start to use software for requirement management, but due to lack of budget it didn't materialized. All requirements were managed in a document, which was updated continuously.

Initial requirements were gathered by starting meetings with both stakeholders. It was later supported by exploration of documentation provided by the Fortex. This documentation describes the business flow and needs.

After initial requirements were written down in a document, a basic prototype was designed to elicit two starting modules. These modules were later presented to the user in a meeting. This cycle of designing prototype and presenting it in a meeting, was beneficial as it increased the participation of users in RE. Workshops, describing stakeholders with user-stories was often conducted to discuss the business process and validate requirements. This helped in designing better prototypes and increasing user participation.

Participation of users in RE process helped to define requirements in more clear, efficient, and organized way. Requirement document was updated on regular basis, after every change in requirement or receiving feedback from the user on prototypes.

After more than 35 iterations of updating and revising prototypes according to the users need, a document was designed, which contained requirements of two modules communicated by the stakeholders. These requirements were agreed upon by both users and the stakeholders in the company.

The Requirement Specification document presented after extensive meetings, interviews, and prototyping, was approved by both stakeholders. This document represents the requirements from both stakeholders. Although this process took much time, but in the end the agreement on one requirement document from both the stakeholders prove that method of Rapid Prototyping was useful and worked very well at Fortex.

4.4 Guidelines: After Implementation of CCPRE

Some guidelines after implementing the model during RE phase at Fortex are given in this section.

- Small companies are more cohesive and communication between individuals is strong. This can be very helpful in validating the requirements. Model presented is very helpful for the companies having these attributes.

- Use-stories and prototyping are very useful for non-technical stakeholders. It can give look and feel of software, which will help to gather requirements.

- Handle changing requirements by keeping track of them. This will helps to manage and communicate changing requirements with your stakeholders.

- Manage conflicting requirements in early stages of RE activities. This will result in less efforts and time spending.

- Managing changing requirements was very challenging; use of requirement management software can be helpful even in small companies.

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5. DISCUSSION

The state of the practice in RE is still one of the major problems in software development [28]. Especially for small scale companies it becomes even challenging due to limiting factors like resources, time constraint etc. Constant involvement of user can greatly reduce the chances of invalid requirements. Use of prototyping was very helpful as it gave chance for user to see how product will look in future. Similarly, workshops contributed to consolidate huge amount of information, identify and solve conflicting requirements and identify missing information. It was learned that combining interviews, workshops and prototyping can be very effective method for RE phase.

Guidelines provided in this study can help software engineers and managers to select RE techniques. Model presented can be applied to SME. Case study will provide them baseline and insight about advantages and disadvantages of techniques used. There is no silver bullet which can be used for all software projects in small companies, but lessons learned from this study will help them to identify suitable RE techniques for their project.

CCPRE method provided in this paper was applied during one case study only, nevertheless, this method can be used for other companies in future and results can be validated for them as well. In future, more case studies can be conducted to improve presented method for other SME also.

6. CONCLUSION

Selecting appropriate RE techniques, which can help to identify, gather, analyze and validate requirements, is very vital for the success of any project. SME struggles specifically to overcome this challenge due to certain limitation they face. Regular input from user, prototyping and other communication methods can be used to overcome these challenges. Interviews, Surveys and Case Study were conducted to gather data during the study.

This study presents a model CCPRE (Communication Centered Prototyping for RE), which was applied at Fortex[1] during a case study. This method can address the issue of communication and requirement management, as it suggests use of prototyping and extensive communication for RE. Guidelines provided can help SME for selection of suitable techniques for a project.

REFERENCES

[1] – FSA Fortex AB, http://www.fortex.com (August 20, 2010, 9:18PM)

[2] - J. Aranda, S. M. Easterbrook, and G. V. Wilson. Requirements in the wild: How small companies do it. In RE '07: Proceedings of the 15th IEEE International requirements Engineering Conference, pages 39–48, Delhi, India, 2007.

[3] - Ita Richardson, Christiane Gresse von Wangenheim, Guest Editors' Introduction: Why are Small Software Organizations Different?, IEEE Software, v.24 n.1, p.18-22, January 2007

[4] Mathiassen, L. and Vainio, A. M., 2007, Dynamic Capabilities in Small Software Firms: A Sense-and-Respond Approach, IEEE Transactions on Engineering Management, 54.3, pp 522-538.

[5] - Winbladh, K., Ziv, H., and Richardson, D. J. 2009. Eliciting required characteristics for usable requirements engineering approaches. In Proceedings of the 2009 ACM Symposium on Applied Computing (Honolulu, Hawaii). SAC '09. ACM, New York, NY, 360-364. DOI= http://doi.acm.org/10.1145/1529282.1529361

[6] - CARDOSO, E.; ALMEIDA, J.P.A.; GUIZZARDI, G. Requirements Engineering Based on Business Process Models: A Case Study, 13th International Conference on Enterprise Computing (EDOC 2009), Auckland, New Zealand, 2009.

[7] - Ebert, C. and Hickey, A. 2008. Requirements Engineering - Industry Needs. In Proceedings of the 2008 16th IEEE international Requirements Engineering Conference (September 08 - 12, 2008). RE. IEEE Computer Society, Washington, DC, 298. DOI= http://dx.doi.org/10.1109/RE.2008.64

[8] - Jiang, L. and Eberlein, A. 2007. Selecting Requirements Engineering Techniques Based on Project Attributes--A Case Study. In Proceedings of the 14th Annual IEEE international Conference and Workshops on the Engineering of Computer-Based Systems (March 26 - 29, 2007). ECBS. IEEE Computer Society, Washington, DC, 269-278. DOI= http://dx.doi.org/10.1109/ECBS.2007.65

[9] - Cheng, B. H. and Atlee, J. M. 2007. Research Directions in Requirements Engineering. In 2007 Future of Software Engineering (May 23 - 25, 2007). International Conference on Software Engineering. IEEE Computer Society, Washington, DC, 285-303. DOI= http://dx.doi.org/10.1109/FOSE.2007.17

[10] - Beecham, S., Hall, T., Britton, C., Cottee, M., and Rainer, A. 2005. Using an expert panel to validate a requirements process improvement model. J. Syst. Softw. 76, 3 (Jun. 2005), 251-275. DOI=http://dx.doi.org/10.1016/j.jss.2004.06.004

[11] - R. Schmidt, K. Lyytinxen, M. Keil, and P. Cule, "Identifying Software Project Risks: An International Delphi Study," J. Management Information Systems, vol. 17, no. 4, pp. 5-36, 2001.]

[12] - Jiang, L., Eberlein, A., and Far, B. H. 2005. Combining Requirements Engineering Techniques " Theory and Case Study. In Proceedings of the 12th IEEE

international Conference and Workshops on Engineering of Computer-Based Systems (April 04 - 07, 2005). ECBS. IEEE Computer Society, Washington, DC, 105-112. DOI=http://dx.doi.org/10.1109/ECBS.2005.25

[13] - Houdek, F. and Pohl, K. (2000): Analyzing requirements engineering processes: a case study Proceedings of the 11th International Workshop on Database and Expert Systems Applications, Greenwich, UK, 6-8 September, pp.983-987.

[14] - C.H. Wang, C.W. Lu, W.C. Chu, and C.H. Chang, "A Model-based Object-oriented Approach to Requirement Engineering (MORE)," the Proceedings of CompSAC 2007, pp.153 – 156, 2007.

[15] - Anwer S., & Ikram N., "Goal Oriented Requirements Engineering: A Critical Study of Techniques," in XIII Asia Pacific Software Engineering Conference India, 2006.

[16] - Ochoa, S.F., Quispe, A., Vergara, A., Pino, J. A. "Improving Requirements Engineering Processes in Very Small Software Enterprises Through the Use of a Collaborative Application". In Weiming Shen, Ning Gu, Tun Lu, Jean-Paul Barthès, Junzhou Luo (ed.), Proc. 14th Computer Supported Collaborative Work in Design (CSCWD), Apr. 2010. Shanghai, China. IEEE Computer Society Press. pp. 116-121.

[17] - Li Jiang , Armin Eberlein, Selecting Requirements Engineering Techniques Based on Project Attributes--A Case Study, Proceedings of the 14th Annual IEEE International Conference and Workshops on the Engineering of Computer-Based Systems, p.269-278, March 26-29, 2007

[18] - R.A. Carter, A.I. Anton, A. Dagnino, and L. Williams. "Evolving beyond requirements creep: a risk-based evolutionary prototyping model", IEEE 2001

[19] - MacNealy, M. S. (1997) Toward better case study research. IEEE Transactions on Professional Communication, v. 40, n. 3, p. 182-196.

[20] - R. E. Stake, "Case studies," in Handbook of Qualitative Research, N. K. Denzin and Y. S. Lincoln, Eds. Thousand Oaks, CA: Sage, 1994, pp. 236–247.

[21] – SurveyMonkey: Gratis webbaserade enkätprogram, http://www.SurveyMoney.com (August 20, 2010, 9:20PM)

[22] - D. Silverman, Interpreting Qualitative Data: Methods for Analyzing Talk, Text, and Interaction. Thousand Oaks, CA: Sage, 1993.

[23] - H. J. Rubin and I. S. Rubin, Qualitative Interviewing: The Art of Hearing Data. Thousand Oaks, CA: Sage, 1995

[24] The Official Website of the Stage-Gate Product Innovation Process, http://www.state-gate.com (August 20, 2010, 9:17PM)

[25] - Das, V. V. 2007. Involvement of Users in Software Requirement Engineering. In *Proceedings of the 10th international Conference on information Technology* (December 17 - 20, 2007). ICIT. IEEE Computer Society, Washington, DC, 230-233. DOI= http://dx.doi.org/10.1109/ICIT.2007.47

[26] - Brockmann, P. S. and Thaumuller, T. 2009. Cultural Aspects of Global Requirements Engineering: An Empirical Chinese-German Case Study. In Proceedings of the 2009 Fourth IEEE international Conference on Global Software Engineering (July 13 - 16, 2009). ICGSE. IEEE Computer Society, Washington, DC, 353-357. DOI= http://dx.doi.org/10.1109/ICGSE.2009.55

[27] - R.D. Acosta, C.L. Burns, W.E. Rzepka & J.L. Sidoran. A Case Study of Applying Rapid Prototyping Techniques in the Requirements Engineering Environment. First IEEE Int'l. Conf. on Requirements Engineering, pp. 66-73, 1994.

[28] - D. Mishra, A. Mishra, and A. Yazici, "Successful requirement elicitation by combining requirement engineering techniques," in Proceedings of Applications of the First International Conference on Digital Information and Web Technologies, (ICADIWT 2008), August 4-6, Ostrava, Czech Republic,2008, pp. 258–263. [20] - D. Silverman, Interpreting Qualitative Data: Methods for Analyzing Talk, Text, and Interaction. Thousand Oaks, CA: Sage, 1993.