

## Improving Software Cost Estimation in Emerging Companies

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### Abstract

Emerging companies have special effort estimation requirements. They are under immense pressure to adopt immature technologies due to market and management pressure, which often led to different effort estimation problems. The abstracted data from different software organizations revealed that the most common effort estimation problems in emerging companies were related to inexperienced staff, lack of proper estimation culture and communication. A discussion of why these problems exists in the context of emerging companies in Nepal is provided; and although limited to certain areas, evidence based changes in four significant areas to improve estimation process in the emerging companies are given.

**Keywords:** Software process improvement, effort estimation, accuracy, evidence based

### 1. Introduction

Software engineering is more prone to risks compared to other engineering domains. Because of unique demands in terms of both project specific features and customer expectation, software project commonly contains a significant amount of uncertainties such as continuous change of project scope, imprecise budget and schedule estimation and incompetence staff. Due to these factors, software projects suffer from frequent cost overruns. Most in-depth study of these software projects have pointed out that they lacked explicit early concern for indentifying and resolving their high-risk elements, and that most of their problems could have been avoided or reduced heavily (Boehm, 1991). During early phase of project, optimistic and enthusiast nature of team members caused them to miss the signals of high risk issues, which laid foundation for downfall of the company.

According to C.H. A. O. S. (2013), 18% of software projects are cancelled before they ever get completed, while 43% of projects had additional 74% time overrun and 59% cost overrun than original estimates. The growth rate of worldwide software cost increasing per year but software companies tends to lose billions of dollars annually as a result of project delays and not meeting customer needs at the time of delivery (Charette, 2014). Many projects fail to meet their original cost estimates due to current approaches in software process to make high-risk commitments that they will later regret. As indicated in a review of estimation surveys by Moløkken & Jørgensen (2003), there has been little

improvement in software cost estimation accuracy over the last 20 years. This illustrates software industry's inability to provide accurate estimates of development cost, effort, and/or time and how it is affecting heavily in terms of business opportunities and significant losses.

### 1. 1 Problem Domain

Software development effort estimates are the premise for project bidding, budgeting and planning. These are basic practices in the software industry, since poor planning and budgeting frequently has dramatic results. Whenever budgets and plans are excessively sceptical, business opportunities can be lost, while over-confidence might be trailed by critical losses. Thus, significance of accurate estimates is reported in an extensive variety of studies. It is therefore necessary to improve software cost estimation accuracy in order to avoid huge cost overruns which impacts business process heavily.

### 1.2 Objective

The primary objective of this research is to study the current challenges and practices for effort estimation in emerging companies of Nepal and to suggest an evidence based software engineering techniques for improving the estimation process. The study proposes a series of effort estimation techniques which shall help organizations to improve overall estimation process. In order to fulfil the primary objective, secondary objectives of the research are to study the major effort estimation practices followed by the software organizations and their consequences.

-What effort estimation techniques are being followed by emerging companies in Nepal?

-How is effort estimation being done?

-What do factors are necessary to improve the overall process?

The paper has been further divided into four sections. Section II describes about the related work which includes studies on applying evidence based software engineering for improving effort estimation. Section III describes the overall approach of this research explaining how data has been collected, qualitatively analyzed to suggest different evidence based effort estimation techniques for reducing cost overrun. Next, in section IV, the findings about the study of current challenges and practices in software effort estimation is presented. In the next section V, why these problems exists and how the effort estimation challenges can be addressed is discussed. In the last section VI, the paper has been summed up briefing about the overall findings and limitations of this research.

## 2. Related Works

Project managers and other high level authorities have to make decisions about the technologies to be used in their projects. They may be familiar with their situation and development procedures (for example, cost overrun, delay in product development etc) and want to solve those problems. Alternatively, they might have heard about this new technology that they want to take benefit of. However, even with our evolving knowledge about software process improvement, it might prove difficult for practitioners to make an informed decision about whether or not to adopt a new technology because there is little or no evidence to confirm that its suitability, quality, costs and inherent risks. This can lead to



poor decisions about technology adoption. We can take example of California DMV given by Standish (1994) where redeveloping their old application for “adoption of new technology” had negative effects on their productivity and the project was cancelled after suffering huge loss.

Emerging companies are often under a lot of pressure to implement immature technologies because of market and management pressures. In particular, these companies often find that they must tender for contracts for which they have no expertise in the project problem or solution domains. Additionally, they have little spare capacity for project management and improvement. Dyba et al. (2015) strongly suggests that we can consider evidence-based software engineering (EBSE) as mechanism to support and improve our technology adoption decisions and to develop a more integrated approach. This way, software organizations will be able to implement good practice more quickly and with fewer risks to improve the quality of products, and reduce the risk of project failures.

### 3. Methodology

In order to dig out the answers to the research questions, this study adopted survey as the research strategy and, questionnaire and documents as data generation methods. The challenges and major estimation problems encountered by the software organizations in the software project have been explored. The most common effort estimation errors are identified and evidence-based changes are suggested to improve effort estimation process.

#### 3.1 Data Collection Procedure

The research was carried out using interviews and documents as primary source of data. Initially, questionnaire was designed to get a clear view of what estimation concepts were used in the company and how well the members of the company understood the cost estimation concepts. Documentation about previous projects of the company was also analyzed and included in the process of finding effort estimation errors in the company and to suggest necessary changes.

Questionnaires were prepared focusing on the effort estimation approaches followed by the organizations, estimation errors, problems faced by the organizations. There were altogether 12 questions. The questions were asked to different members of the company including personnel from management, marketing, engineering and few of the developers and designers. The developers and designers included had different background and gave comprehensive viewpoint of diverse challenges the company was facing at the time.

#### 3.2 Qualitative analysis

Many people do not properly analyze all the possible reasons for estimation errors. They tend to reach conclusions from the most common problems without analyzing further for more reasons. However, in reality, the real reasons that need to be addressed properly can be hidden behind the most common reasons or might be comprised of various reasons. Furthermore, we are not good at identifying lacking information. So, it is essential to evaluate the information given by the respondent and use relevant follow-up questions to find out all the reasons for estimation errors.

The questions asked were comprised of general questions about the estimation concepts and their involvement in the company. The credibility of the answers given was

evaluated qualitatively using content analysis approach (Burnard, 1991). The transcribed interview data was categorized and coded into meaningful data segments using this approach. The findings in this research are based on information found during the analysis and to some extent on the impression of the person.

#### **4. Findings**

Emerging companies usually performed estimation based on their past experience and misjudged the nature of project with their past successful projects. They usually relied on project manager's "gut feelings", without involving all the project members, which sometimes created the necessity to work late by the employees for customer satisfaction and to meet deadlines. This eventually created frustration amongst employees.

Based on literature survey and collected data, the effort estimation challenges were listed out. The most common effort estimation problems which influenced software projects are focused. The major effort estimation challenges faced by the organizations during software projects were found to be related to inexperienced staff, lack of proper estimation culture and communication. Hence, this study basically focused on these factors.

##### **4.1 Lack of Proper Estimation Culture**

The lack of standardize set of estimation baselines and little experience of project managers in using appropriate estimation techniques for different phases of the project life cycle were usually responsible for effort estimation errors. Project manager usually estimated using arbitrary techniques and didn't utilize historical data appropriately. This usually created misconception about proper estimation process among the employees causing less confidence in the overall estimation process, which led to high inaccuracy in the estimation.

Subsequently, as the estimation process was not seriously taken into account in various stages of the development phase, project managers were not familiar with methods of minimizing the risk of cost overrun. They usually ignored the fact that there might be some unexpected events in the future and opted for spike solution when encountering any problem.

##### **4.2 Inexperienced Employees**

Even though the numbers of employees in the emerging companies are limited, they were skilled in their respective fields. However, they were quite inexperienced in handling larger projects. Most of the employees did not have proper knowledge about estimation process. The project managers did not follow proper effort estimation methods and this usually led to confusion while starting the project. Also, the fact that they didn't have any strategy regarding cost estimation wasn't helpful either.

The lack of proper trainings to project managers and employees was pretty obvious from the observation. The employees were often asked to come out of their comfort zone and adapt to new technology without any proper trainings. Project managers weren't trained to handle any unexpected events or situations where accurate effort estimation might be difficult to accomplish. In general, the lack of importance given to the whole estimation process made the employees care less about it, which reduced their experience level in effort estimation.



### 4.3 Failure to take into account possibility of unexpected events

Although the project managers of the companies were aware that there might be some unexpected events during the project, they were quite reluctant to accept the fact that there typically will be some kind of unexpected events. They didn't allocate much time into dealing with such events. They had opinion that these events were uncommon and they have already overcome similar types of problem in the past without much deviation in delivery time.

Project managers didn't take into account the actual estimates of the developers as they had the opinion that "Developers usually tend to overestimate the time frame to do the task slowly" or "They will only work hard if the delivery time is challenging". This made it even more difficult to adapt evidence based estimate. As a result, the estimate were done incorrectly and they ended up relying on couple of experienced developers and using spike solutions to overcome such unexpected events.

### 4.4 Lack of Communication Hierarchy

The team members in the companies consisted of people from different sectors working together to successfully deliver the project. However, there was a lot of communication problems between the parties involved in the project. There is lack of proper communication between project managers and team members. Project managers are not updated regularly about the progress of the individual team members. Project progress meeting are not scheduled as often and team members are usually not aware about how others are doing in regards to time and progress of the project.

Some of the companies had tried in the past to impose good collaboration strategy by providing their employees with learning materials and introducing different applications. These applications were useful for sharing their research findings and to keep in track with what others were doing in the project. However, overall impression was it was not working well as it seemed that it wasn't monitored properly and employees had already lost interest in it. Due to lack of proper coordination, there had been large overruns in the project and this is one of the major problems in the companies.

## 5. Discussion

Emerging companies have special effort estimation requirements. They are under lot of pressure to use technologies which are not proven to be efficient enough and often found themselves doing projects, in which they have little or no expertise in the project problem or solution domains. Also, they don't have enough capability to manage and improve the project management process. Therefore, they don't have any formal way of learning how to improve future effort estimates and consequently, encounter different estimation problems along the way. The lack of proper understanding amongst the employees and project managers about proper estimation techniques didn't favor the companies either, making it even more worse in terms of unusual cost overrun and significant losses.

Discovering and suggesting improvements to modify the current estimation process in the companies proved to be very tricky, as there were many elements that could have been improved to fit the actual need of companies. However, it is not a good way to start

the process of improvement by changing each and every element, because changing too many elements at the same time might be confusing for the employees. They might not be able to adapt to the changes properly, making the whole process ineffective. Therefore, importance was given to main areas that needed most improvement and have greatest impact on overall estimation process. Notwithstanding its limitations, this study suggests changes in four significant areas to improve estimation process in the company. Each company has its own unique requirements, so there are still more specific improvements that the companies can benefit from than mentioned in this study.

### **5.1 Introduction of Estimation Concepts**

In the context of emerging companies, changing how managers of the company viewed the concept of estimation is quite crucial to establish a reliable estimation process. The process of effort estimation is more than just “setting a deadline” or getting an expert’s judgment without involving all the stakeholders and considering all the factors. Companies with no proper historical data and limited resources can benefit highly from using group discussion to support their experts in the effort estimation process (Moløkken & Jørgensen, 2004).

### **5.2. Estimating Effort with Planning Poker**

Planning poker is new and light-weight technique for structured group discussion defined by Greening (2002), and made popular by Cohn (2005). Estimation process can be enhanced using planning poker by combining knowledge from diverse sources, reduction of biasness by simultaneous display of estimates and revealing unclear requirements (Moløkken-Østfold, Haugen, & Benestad, 2008). This change in estimation approach would be quite helpful in the current scenario and in the future projects to understand the client requirement clearly.

### **5.3 Use of Checklists**

In general, checklists represent standard work breakdown structures that list the most important aspects of the project, both product-oriented and process oriented. Checklists are believed to be especially useful when the estimators are inexperienced (Jørgensen, 2014). It helps to establish reliability of estimates by taking into account all the important aspects of the project. It is also recommended to use one standardize checklist as described by (Jørgensen & Moløkken, 2003) for all the projects (or at least for similar type of projects) in the company to reduce the estimation complexity and to avoid the problem of having incomplete checklists.

### **5.4. Development of Process for Collection of Historical Data**

Effort estimation often requires generalizing information collected from a small number of historical projects. Therefore, it is essential to collect and maintain the actual experience data from earlier works to use it as an estimation input factor in future projects. At first, it might seem easier to just use personal memory of past projects than to gather and analyze historical data. However, generating estimates from personal memory alone is a proven cause of cost and schedule overruns (Lederer & Prasad, 1992). Using historical data might be difficult as it is not easy to say how similar the projects are (Jørgensen, 2014).



However, after having few experiences, the team may find something that they can relate to and use in the future planning poker session.

### **5.5 Evaluating the Results**

Measurement of estimation accuracy depends upon company specific situation and meaningfulness of this measure depends upon what we think are going to harm or benefit the company. Customer satisfaction can be measured by conducting a survey or by collecting and analyzing customer feedback. Besides these surveys, getting customer feedback at each step of software development phase is also important. These feedback can help to accommodate changes needed in the system quickly and efficiently, boosting overall client satisfaction level. It is also recommended to measure the employee satisfaction level to ensure that team members are motivated and eager to adapt to changes. It is important for team members to be motivated to achieve optimal results.

### **5.6 Limitations and Future Works**

There are few limitations in this research. First, the research work covered only the software organizations located in the Kathmandu valley for collecting data and studying effort estimation process. Due to limited time-frame, only data from six different companies were taken into account. Although the changes suggested are evidence based and proved to be effective in improving software effort estimation, the results of the changes in context of emerging companies is still to be documented. Expanding this research by collecting and evaluating data from various software organizations around different geographical locations can be one of the areas for future work.

## **6. Conclusion**

This research studied the current challenges and practices for effort estimation in emerging companies of Nepal. The abstracted data from different software organizations revealed that the most common effort estimation problems in emerging companies were related to inexperienced staff, lack of proper estimation culture and communication. The major reason behind this is because of the immense pressure that these companies have to endure to adopt immature technologies. Furthermore, they have little spare capacity for project management and improvement, which leave these companies fewer options other than to focus on the software development. As a result, they usually faced estimation errors, huge cost overruns and significant losses.

## **7. Implication and recommendations for further studies**

This study suggests evidence based changes in four significant areas to improve estimation process in the emerging companies. These changes can be implemented by the companies to improve the consistency and accuracy of their estimation in existing and in new problem and solution domains. As per the development of emerging technologies an elaborated study should be performed in the future.

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