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Analysis of Effort Prediction as an Influencing Parameter of Success in Software Development Projects

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Abstract — Effort prediction is a key aspect in software development, and any deviations have an impact on the success of the project. Both under-estimation and over-estimation impacts project execution and reduces the probability of success of the project. However, under-estimation could have a greater impact due to greater chances of project overrun in terms of effort and cost. It also has implications at the organizational level. The aspect of effort prediction has always been a challenging task. The need for effective software metrics and enhanced estimation capabilities coupled with the dynamic changes in the software sector pose a greater challenge. Research surveys have also revealed the importance of effort prediction in a software project.

Keywords— Software development, effort prediction, project success, estimation accuracy, under-estimation, over-estimation, overrun

I. INTRODUCTION

Effort estimation is a significant element of software development projects, and the success of a project depends on the accuracy with which we are able to predict software development effort [1]. When actual effort is higher than estimated effort, it impacts the project under execution in terms of cost, schedule, customer satisfaction, project/organizational reputation, and profitability. Both under-estimation and over-estimation of effort have impacted projects across the globe.

The necessity for software metrics and estimation capabilities to keep pace with the dynamics of the software field is one of the key challenges in software effort estimation [2]. Some trends that have posed challenges in project sizing and estimation include evolutionary development, model-driven development, web-based development / net-centric systems, and agile processes.

II. PREDICTION OF SOFTWARE EFFORT

The prediction of effort in a software development project facilitates the project manager in taking important decisions, and in resource planning / allocation. Over-estimation of effort results in non-optimal resource allocations and the software development vendor being non-competitive, whereas under-estimation of effort leads to cost overruns [3]. When cost overruns happen in projects, organizations tend to look at minimizing costs in the project which could lead to skipping or minimizing tasks in the project life cycle that were originally planned. Such cost minimization measures could impact the quality of the software product / deliverables [4].

Estimation is required to be viewed from the perspective of cause-effect relationship. The prediction or forecast for a specific phenomenon will have an impact on other processes. If the entire chain of links is not considered, there is a high possibility of under-estimation or over-estimation. Estimation and measurement are inadequately adopted across organizations, and in many cases it is too late to re-do a proper estimation when projects face problems. Hence, they emphasize the significance of effort prediction and recommend improvement of the estimation process through a closed loop of estimation, planning, measurement, and periodical improvement of estimates [5]. In general, accurate estimation of effort in any project is not a simple task considering the inherent complexities. Unlike other domains, effort estimation of software projects involves challenges of a greater dimension.

More promises have been broken in the area of software estimation as compared to any other area of software development, but we always demand promises since it is required to survive [6].

The abstract nature of software coupled with dynamically changing requirements could make estimation of software size more challenging which in turn impacts the accuracy of software development effort. Further, lack of clarity in requirements, uniqueness of each project, high customer expectations, organizational dynamics, and inadequate assessment of risks are some factors which impact software development effort. These assume significance since they influence the understanding of project requirements; changes in design and development processes, quality of deliverables, and resource allocation mix which results in an impact of the project and the organization.

It has been a continuous challenge to consider various factors and accurately estimate software development effort [6]. The importance associated with software effort estimation has led to initiation of intensive research in this area and establishment of formal effort estimation models. Effort estimation models could be classified as empirical models, regression-based models, theory-based approaches, and machine learning techniques [7]. Though many software effort

estimation models have been established with a view to improve the estimation process, challenges continue to exist considering the dynamics, complexity, and risks involved [8].

Software development organizations adopt global delivery models involving software development teams distributed across the globe. Further, aspects such as standardization of project practices, design and code reusability, and deployment of tools / automation could influence the software development effort requirement and facilitate in successful completion of the project.

III. EFFORT PREDICTION ACCURACY

The probability of success (P(s)) in a project could be expressed as a function as given below:

P(s) = f(Eacc) where Eacc is the Effort prediction accuracy

Effort prediction accuracy is expressed as Eacc = ΔEp / Ep where ΔEp is the deviation from predicted effort . This in turn is expressed as ΔEp = Ea - Ep with Ea being the actual effort and Ep being the predicted effort)

The level of accuracy in effort prediction and its impact on the success of a project is depicted below:

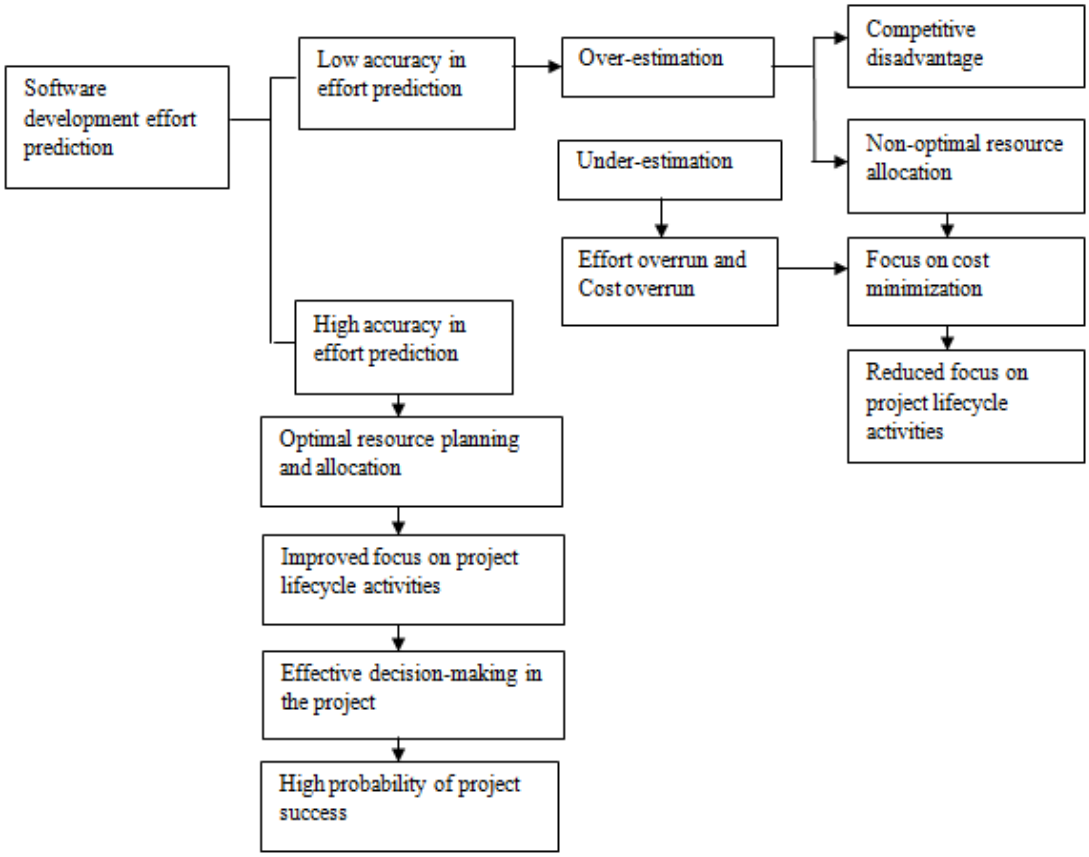

Fig.1. Influence of effort prediction on project success

IV. RESEARCH SURVEY ANALYSIS

The inability to have high accuracy of estimates related to software development effort and cost has been portrayed in various sources such as reports provided by project management consultancy organizations, case studies pertaining to failure of projects, estimation-related surveys, and published articles. Three surveys conducted over a period of time and in different countries highlight the estimation accuracy factor by indicating that the percentage of projects completed beyond budget are 61%, 70% and 63% respectively [9].

According to a survey conducted in more than 100 software development organizations by Cutter Consortium in 2008, 48% of software organizations have either cancelled or abandoned projects in the previous three years on account of substantial budget or cost overruns. According to the Cutter Consortium report, only 37% of the surveyed organizations had a budget success rate of 70% or more in their projects, and only 10% of the surveyed organizations had a budget success rate of more than 90%. Further, the Cutter Consortium report also refers to Boehm and Valerdi's project estimation performance data of 8000 projects in 350 organizations in 2006 which indicates that 19% of projects were cancelled before completion and 46% of projects had budget and schedule overruns [2].

V. CONCLUSION

The paper discussed the aspect of project sizing and effort estimation and how these could have a significant impact on the success of a project. It is critical to understand the requirements and customer expectations and appropriately consider them during the process of software sizing and effort estimation. In addition, estimation of software development effort needs to consider aspects such as distributed development models, agile software development approaches, and cloud-based scenarios for solution development.

The various research surveys and their analysis discussed in the paper depict the significance of effort estimation accuracy and their impact on the project in terms of budget overruns. The occurrence of overruns in the project in terms of effort and cost due to inaccurate effort estimation does not only cause an impact at the project or program or portfolio levels, but can have far-reaching consequences at the organizational level.

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