Investigation to Improve the Productivity of Employees in the Software Industry through Proper Estimations and Training

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ABSTRACT

The software industry is a very important and critical industry in today's world. A lot of new technologies are being introduced and the existing technologies are being upgraded. To deliver good products with correct functionalities the skills and knowledge of the employees are essential. Therefore, the employees need to spend a lot of time on learning and practicing new technologies. Hence, the organizations in this industry have to spend a lot of money on employee learning.

The complexity of a technology cannot be measured and there are no proper criteria to measure those complexities in a task. Therefore, when doing estimations it is difficult to analyze the accurate time required for a given task. Because of that the end result is inaccurate project estimations and also less productivity of the employees.

In this work it was planned to analyze the wastage cost due to learning and testing time of employees and to find out the root causes for this problem. Also, this investigation was done to find out proper criteria for project estimations.

The data were collected from the software engineers and analyzed to find out the causes for the problem. The collected data were analyzed statistically and the mean and the deviation factor for the deviation hours from the real estimated time were calculated. The total cost that has to be spent due to the employee learning was also calculated. The root causes for the problems were identified and the solutions were also identified in this research.

KEYWORDS: Complexity of a Technology, Software Industry

INTRODUCTION

The software industry is a very important and critical industry in today's world, because almost all the business functionalities are automated and because of that software industry is becoming very much essential to every country and every business all over the world. Every day the new technologies are coming and also the existing technologies being upgraded. Therefore, the engineers in this industry need to learn and be aware of those new coming technologies and platforms.

When doing project estimations it is a hard task to estimate the time needed because when new technologies are needed to be used, they can't predict the actual time because of the risk factor of how fast it can be achieved. Hence the end result allocates too much time, cost and employee hours or less time and cost.

In this research it was planned to analyze the estimation criteria and propose more suitable criteria for project estimates.

The study was carried out in the delivery section of a well established organization in the software industry to find out the reasons for the productivity decreases of the employees. This was for the whole development process, therefore the whole System Development Life Cycle (SDLC) - planning, designing, implementation and testing procedures, were also analyzed.

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Software Project Management

Software project management involves initiating, planning, execution, control and termination of projects in formal, directed and intelligent fashion. Main focus of Project management is to deliver the software system

- Within the time frame
- Within budget
- With full functionality

System Development Life Cycle (SDLC)

This compose of four fundamental phases as

- Planning
- Analysis
- Design
- Implementation

System Development Methodologies

A methodology is a formalized approach to implement the SDLC. These methodologies can be categorized into three major categories as,

- Structured Design
- Rapid Application Development
- Agile Development

Work Breakdown Structure

The work breakdown structure (WBS) is a powerful tool for expressing the scope or extent of a project in simple graphic terms.

Software Project Estimation Criteria

These are used in estimating the software projects.

METHODOLOGY

Research Design

The research methodologies used are,

- Descriptive research by surveys, interviews with relevant parties and observation of practices and procedures.
- Cause-and-effect studies to analyze the current procedures and practices and their drawbacks.

Data Collection Strategy

According to their positions and experience of the engineers data were collected from three major categories

- Associate Software Engineers and Software Engineers (ASE/SE)
- Senior Software Engineers (SSE)
- Technical Leads and Architects (TL/AR)

Data Analysis Strategy

The data were analyzed statistically. The Mean (average), Standard Deviation from project estimated times were calculated for the three categories. When doing projects estimations these values can be taken into consideration for more accurate estimates. These data can be used to estimate the inexperience projects. The cost spent for non productive work in the organization was also calculated. The amounts of waste during the period have been calculated due to this problem.

DATA COLLECTION AND ANALYSIS

The data were collected by sending a questionnaire to the employees. The questionnaires were sent by E-mail and the feedback was obtained from them. The questionnaire was prepared to collect the following data.

- The Estimated duration for the task
- The actual time spent to complete task
- The time spent on learning the new technologies and codes
- Whether he had the experience in such kind of task before or not

The whole data set which was collected was summarized in an Excel sheet that helps easy data manipulation. The data were tabulated separately according to the three major categories of employees. The data of one category of employees were again divided into four data sets according to the experience they had before on such kind of tasks. The data filtering technique was used to divide the data set accordingly. Those categories are

- Had experience before
- Had learned but not experience
- No experience and haven't learned
- Have experience for only some parts of the task

Calculations

The following calculations were done to analysis the problem.

$Differences = Actual\ Time\ Spent\ for\ the\ Task - Estimated\ Time\ for\ that\ Task$

$Difference\ per\ One\ Estimated\ Hour = \dfrac{Difference}{Estimated\ Time}$

$Mean\ \bar{X} = \dfrac{\sum Difference\ per\ One\ Estimated\ Hour}{Number\ of\ Records}$

$Deviation\ Risk\ Factor = \dfrac{\sum |Xi - \bar{X}|}{\sum X}$

$Hours\ of\ Learning\ per\ Day = \dfrac{Time\ for\ learning\ in\ whole\ task \times 8}{Estimated\ Time}$

$Total\ Cost\ per\ Day = (Mean\ No.\ of\ Hours) \times (Salary\ Scale\ per\ Hour)$

$\times (No.\ of\ Employees\ in\ that\ Category)$

RESULTS AND DISCUSSION

The time utilization in three employee categories in productively and learning has deviated depending on the employee category. The ASE/SE and TL/AR categories have used more time in learning. As shown in the table, all the employee categories have spent more time for learning new technologies that they don't have any experience with or pre-learning. The deviation risk factor is giving the deviation from the mean of the data set. As mentioned above the deviation risk factor has been calculated separately for the categories that were categorized according to the experience of employees. For each category there is a big deviation risk factor for the

tasks that have no experience. Therefore when estimations are done these values should be taken in to consideration.

List of Alternative Solutions

- Maintain a database with the information of the past projects and technologies
- Provide proper training for the employees and establish a training and development team
- Conducting Exams on important and essential technologies
- Introducing a method to minimize the idle times of working
- Estimation procedure to add the mean deviation in the task duration calculations
- For the estimations the most Optimistic, Most Probable and the most Pessimistic times should be calculated
- Establish a Research and Development department

When project estimations are prepared following calculations have to be done.

Table 1: Calculated Results for Mean and Deviation Factor

Employee Category	Experience code	Mean	Deviation Risk Factor
ASE/SE	1	-0.134	0.223
ASE/SE	2	0.083	0.141
ASE/SE	3	0.760	0.293
ASE/SE	4	0.125	0.125
SSE	1	-0.049	0.096
SSE	2	0.210	0.151
SSE	3	0.271	0.374
SSE	4	0.065	0.139
TL/AR	1	0.020	0.101
TL/AR	2	0.162	0.076
TL/AR	3	0.546	0.336
TL/AR	4	0.134	0.204

Table 2: Calculated Cost per day for learning

Employee Category	Salary per Hour	Mean number of Hours of learning per Employee	Total cost for one Employee per day	Number of Employees	Total Hours	Total Cost (Rs.)
ASE/SE	227.27	3.75	853.81	500	1878.39	426908
SSE	397.72	2.47	984.33	200	494.98	196867
TL/AR	568.18	2.77	1579.12	80	222.34	126330
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New Estimated Time
$$= Estimated\ Time + Mean$$

The Most OptimisticTime = Estimated Hours −
$$\left(\begin{array}{c} Deviation\ Risk\ Factor \times Estimated \\ Number\ of\ Hours \end{array}\right)$$

The Most Pessimistic Time
$$= Estimated\ Hours$$

CONCLUSION

The main objective of the investigation was to increase the employee productivity. During this investigation the cause for reduced productivity was identified and the main reason is the lack of experience in new technologies.

Therefore, proper training should be provided to the employees.

The other is observation that the estimation procedures should also be changed according to the findings.

The deviation risk factor should be included into the estimations. However the complexity of the task has not been taken into consideration in this research. Therefore it would be appropriate to add weight according to the complexity of the task in the estimation procedure.

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