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RESEARCH ARTICLE

Study of Uncertainty Factors Influenced in Software Phases Effecting in Cost Estimation

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Abstract— The IT industry has certain challenges for quality management. In order to meet business and organisational objectives and deliver quality software, it is essential to improve the organisational practices, and processes that produce the software. Software process improvement is both possible and essential. A key to successful software process improvement is making a step-by-step improvement effort, which gradually evolves, into a paradigm shift in the way the organisation does business. The processes and practices complement each other for improvement and both require human effort from everyone in the organisation. Software project risk management is crucial for the software development projects. It is used for project planning and control purposes during the project execution. To success in managing a software project, project manager needs to understand the nature of software risks. The estimation of the software cost remains one of the most challenging problems in software engineering; as a preliminary estimate of cost includes many elements of uncertainty. All projects have some uncertainties. Each project will have a different capacity for uncertainty. This paper discusses the issues involved in project uncertainty, and presents the feedback of Team leaders and team members.

I. INTRODUCTION

The Industry has gone through at least four generations of programming languages and three major development paradigms. As [2] software process improvement is people-oriented, it is essential to manage the organisation under a productive and encouraging environment to achieve the process improvement objectives. The productive environment may be nurtured with the help of certain organisational measures. There are certain external factors and internal issues that may create an impact on the effectiveness of these measures. Software organisations should identify their process strengths and weaknesses, improvement areas, potential risks and opportunities. Project managers can use different techniques and tools that are useful to manage projects efficiently. The use of these [4] techniques and tools could lead to better chance of easily identify the uncertainty factors. In this paper discuss about major causes of uncertainty and a questionnaire was designed to investigate the uncertainty factors that affect to the project success.

II. METHODOLOGY

The objective of this study is to investigate the causes of uncertainty of the projects undertaken by the team leaders and team members. A questionnaire was designed to investigate the factors that affecting the project success. [3]The questionnaire consists of two parts. Part one gathers information about the project title, company name, designation, etc., Second part contains project uncertainty assessment criteria. There are nine questions on major uncertainty factors in software development project, which are rated based on a rating of 1 to 5. In this questionnaire, information is gathered about the Team leaders and team members in the same project. Eight different project and different locations the Team leaders and team members are rating the questionnaire.

III. ANALYSIS OF DIFFERENT PROJECTS

The eight project teams were completed the project and invited to answer the questionnaire. Both the team leaders and team members were answer the nine questions in the questionnaire. The questionnaire covered the [7] key factors in uncertainty, namely, management, project design, communication, staff experience, funding problems, user's response, resources, price changes and technical factors. The given below table shows the rating given by the eight team leaders on the nine questions

Table 1: Rating given by the team leaders

Project Number / Question Number	1	2	3	4	5	6	7	8
1	3	2	3	4	2	3	3	3
2	4	2	2	3	2	4	3	3
3	3	2	3	2	2	4	4	3
4	3	4	4	2	2	4	3	3
5	1	1	1	3	0	1	0	1
6	2	2	1	3	2	3	1	2
7	2	1	0	2	0	2	4	0
8	1	2	2	3	3	2	1	2
9	3	2	2	4	2	1	2	2

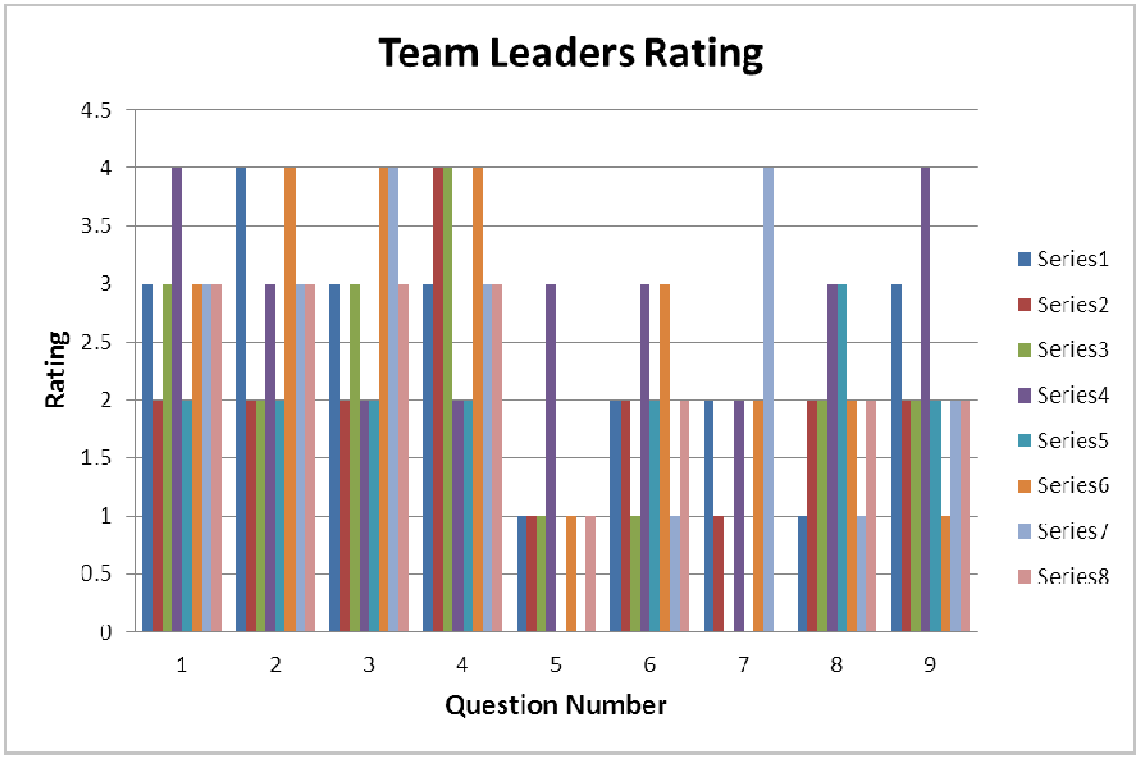

Fig 1: Rating given by Team Leaders

The above figure shows Team leaders rating on Question Number Vs Rating. X axis contain 1 to 9 questions and Y axis contains 0 to 5 rating for Team leaders. In this figure Communication and project design questions are more uncertainty compare to other questions. Funding problem is less uncertainty in all the projects.

Table 2: Rating given by the team members

Project Number / Question Number	1	2	3	4	5	6	7	8
1	2	1	2	4	3	0	3	2
2	3	2	3	2	4	2	3	2
3	3	1	1	2	3	2	2	2
4	4	4	4	2	2	3	2	2
5	1	0	0	1	0	0	0	1
6	1	1	0	2	2	2	1	1
7	1	0	0	1	0	1	2	0
8	1	0	1	1	2	2	1	2
9	1	2	1	3	1	1	1	2

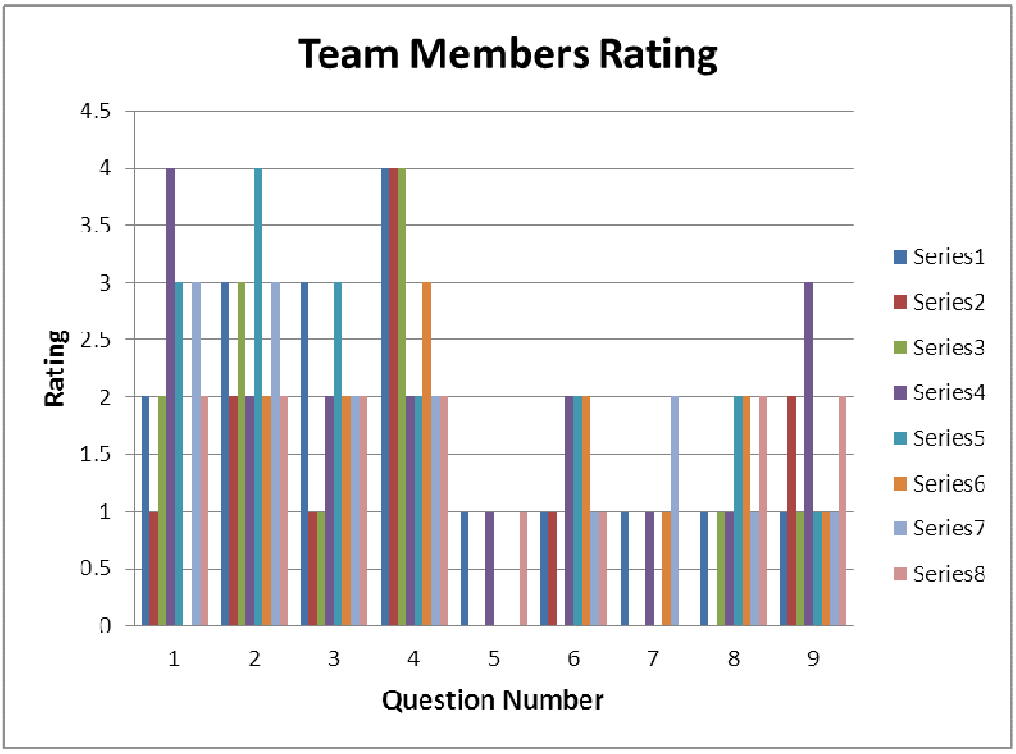

Fig 2: Rating given by Team members

The above figure shows Team Members rating on Question Number Vs Rating. X axis contain 1 to 9 questions and Y axis contains 0 to 5 rating for Team Members. In this figure Funding and Resources shows less Uncertainty and Management. Project design questions have more uncertainty when compared to other phase's questions. Funding problem has less uncertainty in all the projects.

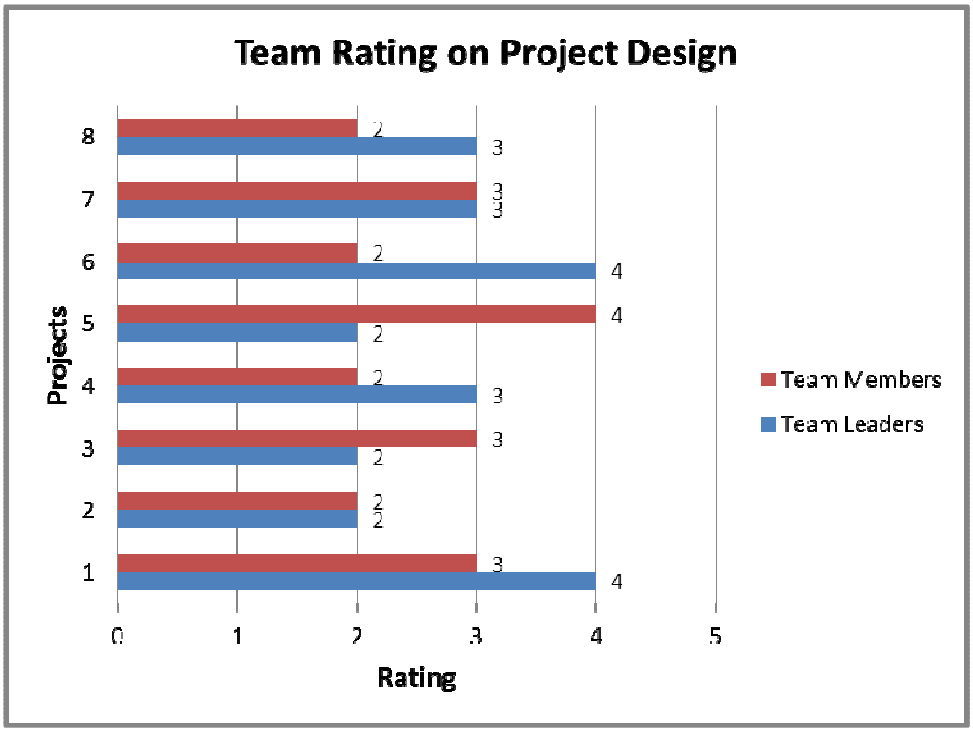

Fig 3: Rating given by Team leaders and Team members for Project Design

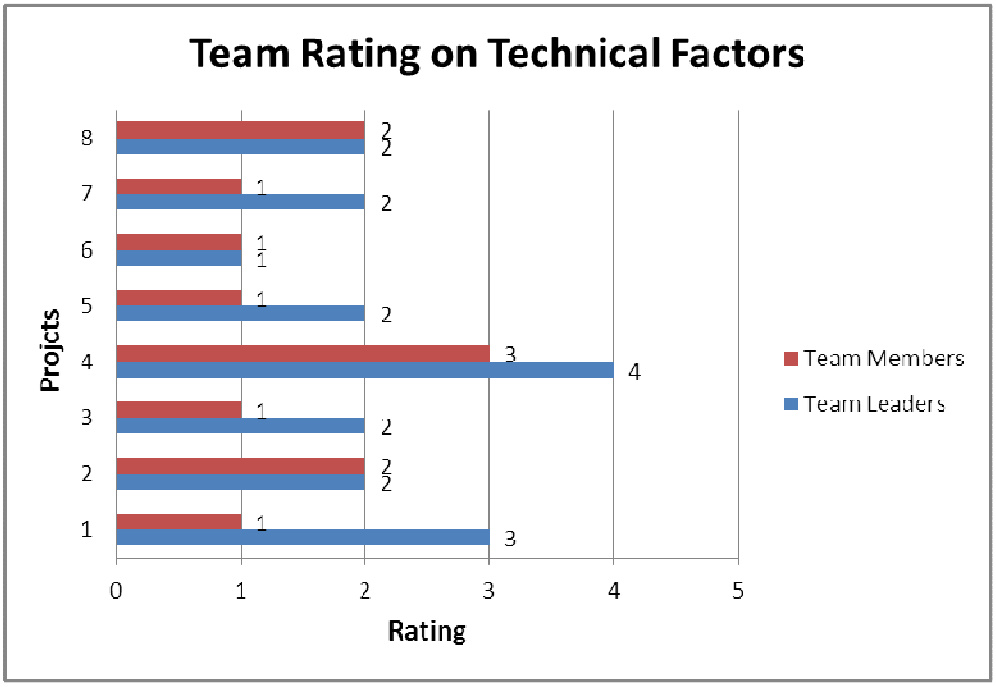

Fig 4: Rating given by Team leaders and Team members for Technical Factors

IV. EMPIRICAL RESULTS

Hypothesis Statement: To reduce the cost challenges in cost estimation over uncertainty factors that arises in the project and program planning. If an uncertainty is raised, those factors should be managed in software cost estimation, thus cannot be avoided.

To evaluate or prove the Hypothesis statement t-test and F-testing is implemented. Most practitioners who use hypothesis test use the t-Test and F-Test to determine differences in mean and variation respectively. The [1] findings of our study indicate factors that a software organization should consider when they attempt to conduct successful software process improvement initiatives.

t – TEST

A t-test is any [12]statistical hypothesis test in which the test statistic follows a t distribution if the null hypothesis is supported. It can be used to determine if two sets of data are significantly different from each other, and is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling term is unknown and is replaced by an estimate based on the data.

This test is only used when both:

- the two sample sizes (that is, the number, n, of participants of each group) are equal;
- It can be assumed that the two distributions have the same variance.

Violations of these assumptions are discussed below.

The t statistic to test whether the means are different can be calculated as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{X_1X_2} \cdot \sqrt{\frac{2}{n}}}$$

Where,

$$S_{X_1X_2} = \sqrt{\frac{1}{2}(S_{X_1}^2 + S_{X_2}^2)}$$

Here $S_{X_1X_2}$ is the grand standard deviation (or pooled standard deviation), 1 = group one, 2 = group two. The denominator of t is the standard error of the difference between two means. For significance testing, the degree of freedom for this test is 2n − 2 where n is the number of participants in each group.

F – TEST

An F-test is any statistical test in which the test statistic has an F-distribution under the null hypothesis. It is most often used when comparing statistical models that have been fitted to a data set, in order to identify the model that best fits the population from which the data were sampled. [10]Exact F-tests mainly arise when the models have been fitted to the data using least squares. The [11] hypothesis states that the means of several normally distributed populations, all having the same standard deviation, are equal. This is perhaps the best-known F-test.

The formula for the F-test statistic is

$$F = \frac{\text{explained variance}}{\text{unexplained variance}},$$

or

$$F = \frac{\text{between-group variability}}{\text{within-group variability}}.$$

The "explained variance", or "between-group variability" is

$$\sum_i n_i(\bar{Y}_{i\cdot} - \bar{Y})^2/(K-1)$$

Where, $\bar{Y}_{i\cdot}$ denotes the sample mean in the i^{th} group, n_i is the number of observations in the i^{th} group, $\bar{Y}$ denotes the overall mean of the data, and K denotes the number of groups.

The "unexplained variance" or "within-group variability" is

$$\sum_{ij}(Y_{ij} - \bar{Y}_{i\cdot})^2/(N-K),$$

Where Y_{ij} is the j^{th} observation in the i^{th} of K groups and N is the overall sample size.

Some of the observations of the questionnaire were shown here for reference. It shows the t-test and F-test values of the management and staff experience.

Table 3: t–test and F-test value for Project Design

	t – VALUE	**F - VALUE**
Variance	0.609375	0.484375
Standard Deviation	0.78062475	0.695971
Values	0.581907912	1.258065
Level of Significance	5%	5%
Table Value	2.145	3.79

Table 4: t–test and F-test value for Technical Factors

	t – VALUE	**F - VALUE**
Variance	0.6875	0.5
Standard Deviation	0.829156	0.707107
Values	1.711486	1.375
Level of Significance	5%	5%
Table Value	2.145	3.79

The median load times for the two tests were nearly identical. However, the variance is not. From the observations the t-value and F value were found approximately equal proving the hypothesis statement.

V. CONCLUSION

This paper discusses about project team leaders and team members rating the questionnaire prepared based on the uncertainty factors, collected in eight different projects. A method to identify uncertainties in a simpler fashion will allow those with little experience to complete the tasks in allocated time without much involvement of the experienced staff members. This questionnaire contains major uncertainty factors like Management, Project design, Communication, Staff experience, Funding problems, User's response, Resources, Price changes and Technical factors. By managing uncertainty, can recognize the problem caused and analysed. The analysed problem should be minimized and rectified. Applying good management practices would help to avoid these uncertainty factors, and leading to project success. The hypothesis statement states that uncertainty factors influence the project success and also it affects the change in cost of project when not taken care. So this study proves that uncertainty factors can influence the cost estimation of the software phases effecting that uncertainty should be included as one of the variable in cost estimation.

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