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CONDITIONAL PROBABILITY APPROACH TO ASSESS
COST RISKS IN SOFTWARE ENGINEERING



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Short Profile

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ABSTRACT:

Major Risks in Software Engineering can broadly be classified as Requirements risks, Cost risks, Scheduling risks , Quality risks and Business risks. Among these Cost risks play a vital role in Software Engineering. Many traditional tools are existing to assess Cost risks in a scientific manner after or during execution of projects but these Cost risks can be assessed approximately by using Conditional Probability Concepts , before execution of the project , which yield nearer results around the neighbourhood of the actual calculated values. Thus costs can be assessed a priori in order to minimize the losses . This method works as a blue print to the entire project in terms of costs.

KEYWORDS

conditional probability, probability of an event, software risks, project cost.

INTRODUCTION :

In Software Engineering Cost Risks [1] [4][5] may broadly be classified as follows :

1. Estimation in projects may fail
2. Schedule may be unrealistic
3. Hardware may not function well
4. Testing and monitoring may not be efficient
5. Size and complexity of architecture may be of higher degree
6. Human errors in general cause risks
7. Change of Management, Technology, Personnel and Environment.
8. Reassessment of management cycle may not be proper.

There may be some hidden and indirect risks which may accidentally occur during project execution. Here in this paper these are not taking into consideration [4][5] for calculations.

Conditional Probability : A powerful concept in Probability which finds the Probability of an event in the scope of another event which has already happened. If A & B are two events then $P(A/B) = P(A \cap B) / P(B)$, $P(B) > 0$, where A and B are dependent events, event B has already happened [2][3]. Similarly $P(B/A) = P(A \cap B) / P(A)$, $P(A) > 0$, here event A has already happened. If A and B are Independent events then $P(A \cap B) = P(A) * P(B)$. It is possible to predict an approximate value of an event that is to be happened by the help of this concept.

This concept helps to take some preventive possible measures in order to reduce the risk of certain things that can be happened during the execution of any project. Importantly most of the possible major risks can be predicted in advance before the execution of any project. An important thing to be underlined is that it always provides approximations.

In software engineering one small risk may cause another major risk which results in more cost expenditure, man power, delay in project schedules etc., It is always inevitable to consider all known risks irrespective of their degree of effect. It is an a priori approach in Software Engineering to estimate cost risks. Comparing to other tools it is an easier tool in terms of its implementation, cost occurred and time taking.

Even though it is not possible to discuss each and every cost risk of any project, but an attempt is made how the risk can be predicted [1][4][5]. These risks can be any one of the following :

1. Software requirement Risks
2. Software Cost Risks
3. Software scheduling Risks
4. Software Quality Risks
5. Software business Risks

Here in this paper the focus is on Software cost Risks (even though it is possible to discuss all the above risks). All possible Software cost risks can broadly be divided as follows [1][4][5] :

1. Lack of good estimation in projects

- 2.Unrealistic schedule
- 3.The hardware does not work well
- 4.Human errors
- 5.Lack of testing
- 6.Lack of monitoring
- 7.Complexity of architecture
- 8.Large size of architecture
- 9.Change of Extension of requirements
- 10.The tools that do not work well
- 11.Change of Employees
- 12.Change of Management
- 13.Change of Technology
- 14.Change of Environment
- 15.Lack of reassessment of Management cycle

Here cost risks are assumed in terms of Crores of Rupees(1 crore = Rs.1,00,00,000). Probability of each event is between 0 and 1, i.e., each event takes a real number between 0 and 1. An event is about to happen means it lies between 0 and 1. For Probability calculations purpose, it can be assumed that

- 1.Probability (Lack of good estimation in projects) = P(A).
- 2.Probability (Unrealistic schedule) = P(B)
- 3.Probability(The hardware does not work well) = P(C)
- 4.Probability(Human errors) = P(D)
- 5.Probability(Lack of testing)=P(E)
- 6.Probability(Lack of monitoring)=P(F)
- 7.Probability(Complexity of architecture) = P(G)
- 8.Probability(Large size of architecture) = P(H)
- 9.Probability(Change of Extension of requirements) = P(I)
- 10.Probability(The tools that do not work well) = P(J)
- 11.Probability(Change of Employees) = P(K)
- 12.Probability(Change of Management) = P(L)
- 13.Probability(Change of Technology) = P(M)
- 14.Probability(Change of Environment) = P(N)
- 15.Probability(Lack of reassessment of Management cycle) = P(Q)

Now taking the minimum cost of any project (handled by MNCs) into consideration , cost risks can be approximated(in crores of Rupees) as :

- 1.P(A) = 0.3 i.e., Lack of Good estimation leads to a loss of Rs.30 lakhs, i.e., by the end of project the cost may be increased by Rs.30 Lakhs than the actual cost.
Like this Probabilities of the above said risks can be mentioned as :
- 2.P(B) = 0.30

3. $P(C) = 0.20$
4. $P(D) = 0.01$
5. $P(E) = 0.02$
6. $P(F) = 0.03$
7. $P(G) = 0.02$
8. $P(H) = 0.02$
9. $P(I) = 0.01$
10. $P(J) = 0.02$
11. $P(K) = 0.06$
12. $P(L) = 0.15$
13. $P(M) = 0.04$
14. $P(N) = 0.03$
15. $P(Q) = 0.02$

Assume that Management is suddenly changed during the implementation of the project. Now change of Management ($P(L)$) may mainly affect in the following cases :

1. Change of Employees ($P(K)$)
2. Change of Technology ($P(M)$)
3. Change of Environment ($P(N)$)
4. Lack of reassessment of Management cycle ($P(Q)$)
5. Change of Extension of requirements

(P(I))

Here change of Management already happened, i.e., $P(L)$ is occurred. Now it is possible to estimate this affect on Employees, Technology, Environment, Reassessment of Management cycle, Extension of Requirements etc.,

Sudden change in the Management means Management may remove some employees in the organization. It is possible to approximate its impact on the project outcome.

Assume that Probability (Management and Employees) = 0.04, i.e., $P(K \cap L) = 0.04$. Now the impact of change of employees during the implementation of the project can be predicted as $P(K/L) = P(K \cap L) / P(L)$, where $P(L) > 0$. Thus the impact of employees on the project out come when Management is suddenly changed is $P(K/L) = P(K \cap L) / P(L) = 0.04 / 0.15 = 0.27$. i.e., there is nearly a burden of Rs.27 lakhs upon the project by the time it is completed. Thus it always gives an approximation to the future impact. In this way, it always helps the project management to reduce the risk in advance.

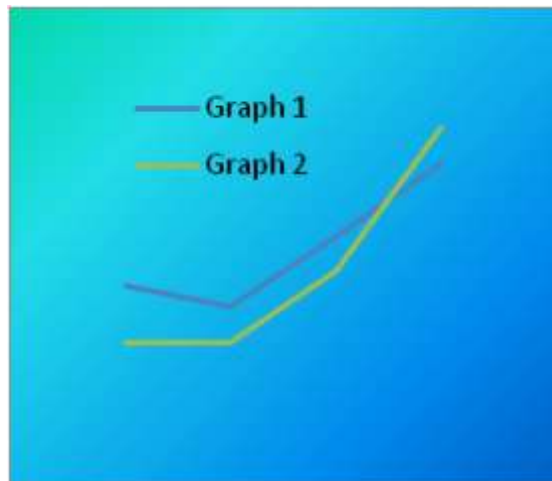
Management ($P(L)$) may change the present existing technology ($P(M)$) of the project. Assume that (how it is assumed in the previous case) Probability (Management and Technology) = 0.03, i.e., $P(L \cap M) = 0.03$. $P(M/L) = P(L \cap M) / P(L)$, where $P(L) > 0$. Thus the impact of technology on the project out come when Management is suddenly changed is $P(M/L) = P(L \cap M) / P(L) = 0.03 / 0.15 = 0.20$. i.e., there is nearly a burden of Rs.20 lakhs upon the project by the time it is completed.

Management (P(L)) may change the present existing environment (P(N)) of the project and the company. Assume that (how it is assumed in the previous case) Probability (Management and Environment) = 0.01, i.e., $P(L \cap N) = 0.01$. $P(N/L) = P(L \cap N) / P(L)$, where $P(L) > 0$. Thus the impact of environment change on the project out come when Management is suddenly changed is $P(N/L) = P(L \cap N) / P(L) = 0.01 / 0.15 = 0.07$. i.e., there is nearly a burden of Rs.07 lakhs upon the project by the time it is completed.

By this way cost risk affects of other factors can also be calculated. Here only cost affects on any software project, when there is a sudden change in the Management of the company, is predicted. The same procedure can be adopted for other Software risks such as

1. Software requirement Risks
2. Software scheduling Risks
3. Software Quality Risks
4. Software business Risks

Difference between Conditional Probability method and other softwares used for estimating Risks :

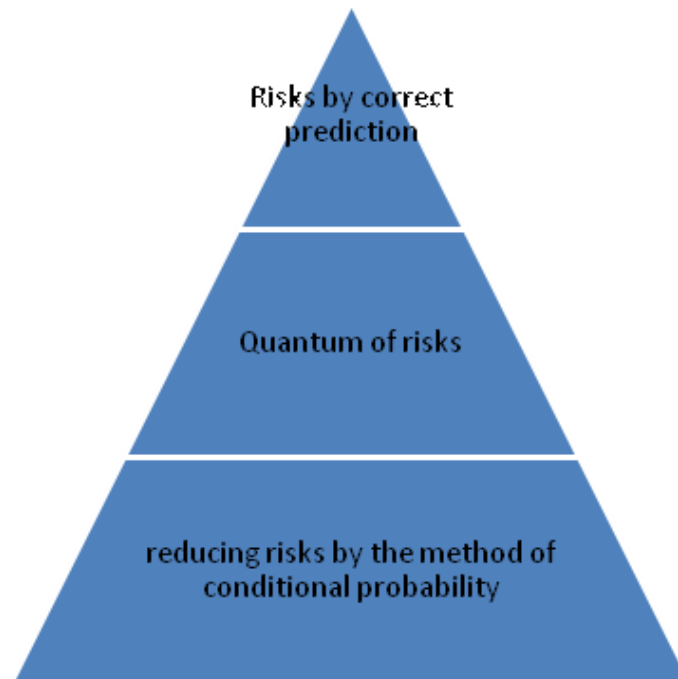


Quantum of Risks on x – axis
Cost of the project on y-axis

Here Graph 1 indicates the quantum of risks identified by using conditional probability method. and Graph 2 indicates the range of risks detected directly by special softwares. The above graph indicates a slight difference between the output of two graphs. This indicates that a lot of expenditure can be saved if conditional probability method is adopted for at least possible risks.

This method always helps in estimating an approximation value of the case. But in most of the cases it is practically proved that the approximations that are calculated on the basis of Conditional Probability concepts are nearly same as those are estimated by using other software tools. But it is a manual task to estimate all these values. It is the most cost effective tool that can be applied not only to Software but also to any other field.

It can easily be seen as follows how the degree of risks can be reduced effectively by this cost free method:



CONCLUSION

It is a very fundamental method of estimating project risks by taking all the possible risks into consideration. But some risks may occur during the implementation of the project. They may be considered as no major risks. These are not taken into consideration in this paper. But the same approach is applicable to them. This paper can further be advanced as calculating the impact of each risk on other all possible risks.

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