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Project Management Risk Sensitivity Analysis

Shenila Makhani *
National University of Computers and Emerging Sciences
Computer Science Department

Abdul Hafeez Khan*
Safeeullah Soomro*
Institute of Business &Technology, Biztek, Pakistan

ABSTRACT

In today's world, the fulfillment of project outcomes is extremely important. Once idea is finalized, its outcomes are decided on the initial basis and they are highly impact by the risk sensitivity analysis measures. If there would be a change in a single factor of these measures then it has the impact on the overall project and especially the outcomes which might be not achieved completely cent percent. Therefore, when we see around ourselves in the software industry or any other one I will find it commonly that these notions are not very common even it counts in one of the good practices but it involves a lot of prediction and calculation in the beginning of the project. Risk Sensitivity Analysis, this technique has been considered as a useful analytical procedure when it comes to the project evaluation and assessment. It will not evaluate the risk on any project completely and even so considered helpful in discovering the variables which are contributing a lot in the overall risk of the project but it will direct in a way which can be used to control the risk elements in a project. The objective of this research survey is to identify the data, techniques and the models and to evaluate these under the real world scenarios that demonstrate the usefulness of the research survey. It will demonstrate data for developing the risk reduction and risk management strategies and the new hypothesis for the identification and prioritization of future researches. The survey presents the findings from the research papers for the use of the risk sensitivity analysis factors by the different researchers who illustrated the application of the techniques at the practical level to asset in the risk management process which is attached with the various projects. Therefore, both the worth and the limitations of the techniques are explained.

1. INTRODUCTION

Project managers play very important role in the execution of the complete project whether it would be the initiation stage, planning stage, execution stage, monitoring and controlling or the closing stages of the project. With the changing market environment, they are managing the project efficiently and effectively with the integral relationship of time, constraint and the uncertainty. Therefore, it is extremely important that these constraints

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* Abdul Hafeez Khan : hafeez_te@biztekian.com
* Safeeullah Soomro : safeeullah.soomro@biztekian.com
* Shenila Makhani : shenila_makhani@yahoo.com

can be controlled and managed simultaneously because time, constraint and the uncertainty exist together whether the project managers like it or not. But one thing which is emerged very effectively is that a good project managers also a good risk manager.

2. RISK SENSITIVITY ANALYSIS

Since many years IT managers are in search of the methods which identify the projects that will serve the organization better and meet the overall strategic objectives of the company. BARRY W. BOEHM [2] because it's a common notion that the organization has the many projects as compared to the IT resources available them so they can complete them completely. Therefore, they must focus on the alignment of the objectives with the strategic objectives and planning of the organization. In this regard, different models are used but they are not allowing the fluctuations in the project parameters therefore, performing the sensitivity analysis is providing the project managers the better idea for the suspecibility of the projects to the risks. Sensitivity Analysis provides the insights to the IT project managers about the different project aspects where the parameters can be manipulated. Therefore, in this respect the projects contribute strongly to the organization's strategic goals and objectives along with the most important factors i.e. profits and cost saving.

3. RISK SENSITIVITY EXPOSURE

There are many approaches in the software process which makes it too easy for the software projects for making high risk commitment and they will regret on it later. For example; the sequential document driven waterfall process model or the code driven evolutionary development process model. Therefore, the software risk management discipline is an emerging discipline in order to formalize the practices and standards because its overall objective is to identify and eliminate the risk elements which immediately become the software operations which will require rework. [2] Because risk is defined as the loss or injury and the probability of it sometimes termed as risk impact or risk factors therefore, risk exposure is sometimes defined by the relationship

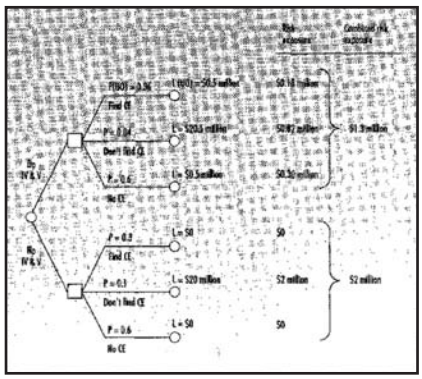
$$RE = P(UO) * L(UO)$$

Where

RE: Risk Exposure
P (UO): Unsatisfactory outcome probability
L (UO): Loss associated with the unsatisfactory outcome

It involves many participants like customers, the software engineers, the users and the people who maintain it. As shown in the figure 1 BARRY W. BOEHM [2].

Figure 1
Decision Tree For The Risk Exposure



The figure 1 shows the decision tree having the possibilities of the risk outcomes and the loss associated with it. It is an example to examine the risk exposure and the critical errors. This type of sensitivity analysis helps the project managers in dealing with many situations when probability of risk and the loss associated with the outcome is not precisely estimated. The risk exposure techniques support the project managers in the project estimation to some approximations but still it is considered as a very useful approach BARRY W. BOEHM [2]

3.1 Risk Identification Checklist

In a survey of many software projects having experienced project managers, it has been observed that many project managers and the system managers are using the check list in their projects for the identification and the resolution of the risk items BARRY W. BOEHM [2]. It proves to be a very good technique till date in order to avoid and resolving the risk sources as shown in the table 1.

Table 1
Risk Items in the Software Projects

Risk Items	**Risk Management Technique**
Personnel Shortfalls	Staffing with top talent, job matching, team building, key personnel agreements, cross training
Unrealistic schedules and budgets	Detailed multisource cost and schedule estimation, design to cost, incremental development, software reuse, requirement scrubbing
Developing the wrong function and properties	Organization analysis, mission analysis, operations concept formulation, user surveys and user participation, prototyping, early user's manuals, off nominal performance analysis, quality factor analysis
Developing the wrong user interface	Prototyping, scenarios, task analysis, user participation
Gold-plating	Requirement scrubbing, prototyping, cost benefit analysis, designing to cost
Continuous stream of requirement changes	High change threshold, information hiding, incremental development
Shortfalls in externally furnished components	Bench marking, inspection, reference checking, compatibility analysis
Shortfalls in externally performed tasks	Reference checking, audits, competitive design, prototyping, team building
Real Time Performance Shortfalls	Simulation, bench marking, modeling, prototyping, reference checking
Straining computer science capabilities	Technical analysis, cost benefit analysis, prototyping, reference checking

3.2 Risk Analysis and Prioritization

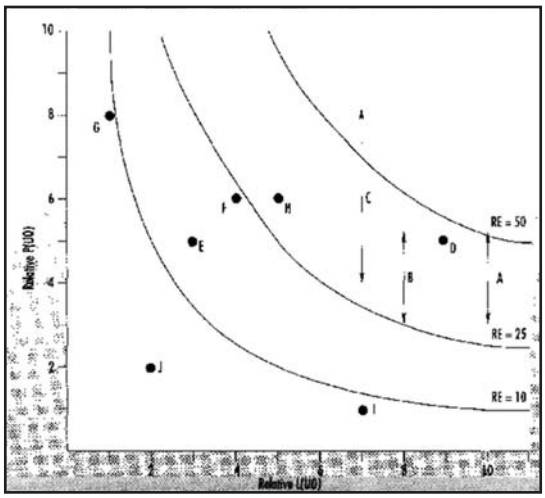
In the real world scenario, it is very common that in a project there are so many risks identified that it took so much time in investigating all of them. This is the reason that the actual need of risk analysis and risk prioritization is realized to the project managers [4]. Therefore, the most effective and the efficient technique for it is risk exposure but the problem associated with it is the accurate estimation of the probabilities and the lost associated with the unsatisfactory outcome during project management. The complete risk analysis activity involves benchmarking, prototyping, simulation which provides the better probability estimates as compared to the others but the disadvantage of them is that they are too expensive and extremely time consuming activities. The table 2 shows the risk exposure factors along with the graph respectively.

Table 2
Factors Of Risk Exposure

Unsatisfactory Outcome	Probability of Unsatisfactory Outcome	Low caused by unsatisfactory Outcome	Risk Exposure
A. Software error kills experiment	3-5	10	30-50
B. Software error loses key data	3-5	8	24-40
C. Fault tolerance features causes unacceptable performance	4-8	7	28-56
D. Monitoring software reports unsafe condition as safe	5	9	45
E. Monitoring software report safe condition as unsafe	5	3	15
F. Hardware delay causes schedule over run	6	4	24
G. Data Reduction software error cost extra work	8	1	8
H. Poor user interface causes inefficient operation	6	5	30
I. Processor memory insufficient	1	7	7
J. Database management software uses derived data	2	2	4

It can be shown in the form of graph respectively. BARRY W. BOEHM [2] it plots each unsatisfactory outcome with respect to a set of constant risk exposure contours.

Figure 2
Risk Exposure Factors And The Probabilities Of Unsatisfactory Outcome



As BARRY W. BOEHM [2] mentioned that from table 2 and figure 2 three points emerged.

- Projects often focus on factors having either a high P(UO) or a high L(UO) but these may not be the key factors with a high risk exposure combination. One of the high P(UO) comes from item G but the fact that these errors are recoverable and not mission critical leads to a low loss factor and a resulting low RE of 7.
- The RE quantities also provide a basis for prioritizing verification and validation and related test activities by giving each error class a significant weight. Frequently all errors are treating with equal weights, putting too much testing effort into finding relatively trivial error.
- There is often a good deal of uncertainty in estimating the probability or loss associated with an unsatisfactory outcome. The amount of uncertainty is itself a major source of risk which needs to be reduced as early as possible.

3.3 Risk Item Reviews

I think that the risk item oriented reviews can save some time of the managers and reduces the frequency of surprises to the management and provide some time to the project managers to spend on those high priority issues which needs consideration. It may involve the following steps:

1. The most significant risk item should be ranked.
2. A schedule should be established for the higher management reviews on the project progress.
3. The meeting should begin with the summary of the previous meeting
4. The meeting should be focused on resolving the risk items.

This process is very easy and inexpensive and contributes a lot in the process improvement. It also helps in familiarization of the risk management principles and practices with the project managers and it focus on the critical success factors which are very important for the project managers to analyze in the software project.

4. ANALYTICAL HIERARCHY PROCESS

It is a decision aiding method having the goal of prioritizing the risk items on the basis of the judgments of the decision makers. Along with this, the consistency of the decision making process is also considered. As we all know that the decision of the decision maker depends upon the various factors in which knowledge and experience are the most important one therefore, Analytical Hierarchy process completely agrees with the behavior of the decision maker. It is a very easily understood way and also provides flexibility in analyzing the project risks to the managers. This decision analysis methodology is multi criterion therefore; it allows subjective as well as objective factors during the process execution in order to make the precise decision. This is the reason that the managers are getting the rationales on the basis of which they can easily make the decisions. Kamal M. alSubhi Al Harbi [3].

4.1 Multiple Criteria Decision Analysis Approach

In any environment, project managers are the key persons who face many problems specially in the decision making process because the elements involved in the problems are very large and they have the integral relationship which is very complex in itself and it is not easy for them to solve it linearly. Therefore, the values of human and their judgment system are interrelated. It is extremely important for the project managers to make sound decisions for the project therefore, it has been observed that some managers required the formal training and some get it through their experience. The approach of multi criteria decision making is the major part of the decision analysis theory.

Kamal M. alSubhi Al Harbi[3] mentioned that "Focus of the MCDM method is to help decision makers to learn about the problems they face, to learn about their own and other parties' personal value system to learn about organizational value and objectives and though exploring them in the context of the problem to guide them in identifying the course of action"

There are two types of problems which are encountered during the decision making process in the software project management i.e. evaluation problem and the design problem.

4.1.1 Evaluation Problem

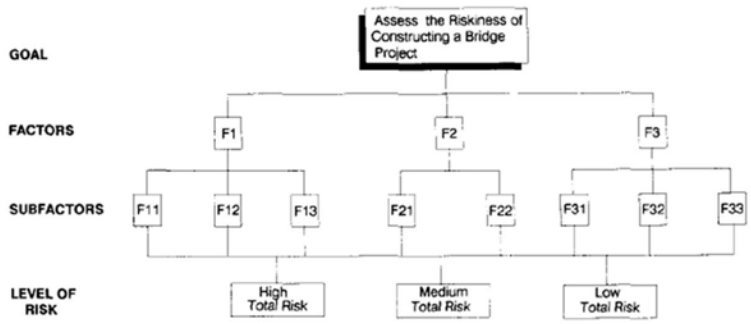
Kamal M. alSubhi Al Harbi[3] mentioned that the evaluation problem is concerned with the assessment of, and potential choice between, discretely defined alternatives
4.1.2 Design Problem
Kamal M. alSubhi Al Harbi[3] mentioned that the design problem is concerned with the recognition of a preferred alternative from a potentially infinite set of alternatives implicitly defined by a set of constraint

4.2 Group Decision Making Approach

Group decision making is one of the practices which is highly appreciated because when different people of various set of knowledge and experience having different skill set and attitude combine together and break the problem into hierarchy and share their knowledge and expertise then the issues can be more comprehensively understood and issues can be identified more easily. Kamal M. alSubhi Al Harbi[3]. This approach can be applied by following some steps:

1. The organization will involve those participants in the group decision making who have the common interest and who can keep an eye on the organizational objectives. In this approach all the members of the group are participating in the decision making process and share the common goal so, everyone can take the ownership of the decision and become the stake holder of it.
2. Expert choice is an interesting part of the group decision making approach. It minimizes the most difficult problem of the group and diverts the attention of the group towards a strong member. Through this the group will focus on the specific problem and the solution of it and the thinking and dominance of the people have no influence over it. It will give the opportunity to those people who are used to speak up freely can participate in the discussion.
3. If the group is using the expert choice then it forms the hierarchy of the problem and modifies it in order to make its better understanding. As shown in figure 3 Kamal M. alSubhi Al Harbi[3].

Figure 3
AHP Risk Assessment Model



On the basis of these labels, the judgment is given and priority is assigned as shown in the figure 4 Kamal M. alSubhi Al Harbi[3]

Figure 4
Judgment Matrix and Weight of Figures

JUDGMENTS MATRIX AND WEIGHTS OF FACTORS

With Respect to Goal	F1	F2	F3	Relative Importance
F1	1	3	6	0.635
F2	1/3	1	5	0.287
F3	1/6	1/5	1	0.078

On the basis of the above mentioned judgment matrix, sub factors and the level of risks are calculated as shown in figure 5.

Figure 5
Priorities of Factors, Sub Factors and the Level of Risk

PRIORITIES OF FACTORS, SUB-FACTORS, AND LEVELS OF RISK

Factors		Sub-factors		Levels of Risk		
				High	Medium	Low
F1	0.635					
		F11	0.150			
				0.099	0.031	0.020
		F12	0.433			
				0.041	0.121	0.271
		F13	0.052			
				0.005	0.017	0.030
F2	0.287					
		F21	0.082			
				0.008	0.019	0.055
		F22	0.205			
				0.040	0.147	0.018
F3	0.078					
		F31	0.022			
				0.005	0.015	0.002
		F32	0.049			
				0.035	0.010	0.004
		F33	0.007			
				0.002	0.005	0.001
Likelihood of level of risk				0.235	0.364	0.401

4. Group meeting can be a better option for this approach. Although there are many techniques available which can be used for the decision making in a group but meeting should be the part of it.

5. LATEST RESEARCH

Risk management is the study to analyze and manage technical, economic, political and social uncertainties. Risk management is most crucial, essential and critical activity of project management and must address the above mentioned complexities and uncertainties for successful completion of Projects [16]. A project is temporary struggle rather than

permanent are formed by peoples within or across organizations to complete particular tasks on certain date, within specified amount and with expected level of performance.. Steiner in 1969 defines "Projects generally involve large, expensive, unique or high risk undertakings". These three criteria of success meeting cost, schedule and performance targets has become widely used. These tasks consumed 70% of Project Manager Efforts, and required essential trade-offs between them for wining condition. However, many researchers experience that defining success is not that easy. The Project Management Institute (PMI) USA arranged a whole conference only for discussion on difficulties of measuring success as the accomplishment of project objectives, including two elements: (i) Firstly the changes in objectives during project. Avots [18] suggests that schedule is most important early in the project, during the project cost becomes most important, and after the project, only technical performance is remembered.

(ii) Secondly, the how many stakeholders seeking success. It is experienced that 'success' and 'failure' can be very close, and many huge projects are become successful from failure by fortuitous circumstances. The necessity of Risk Management for project management has been widely recognized. Once the project start, risk management needs to be an on-going process, only risk analysis is not sufficient.

The Project Manager must make up a project management infrastructure, and risk management must be fit in it. There are three basic kind of management structure: functional, project and matrix, the matrix structure is very accepted. Gobelli and Larson [19], performed a detailed survey on 547 companies and describe the three different forms of management structure and statistics were taken comparing project structure with whether cost/time/technical targets were met; functional management turned out worst on all of these characteristic, and matrix structures (the balanced matrix and 'project matrix') best. Gray et al. and Might[12] also describe similar surveys, and found same results. Dinsmore [20] discusses the only the suitability of matrix structure for large projects ($1b plus). Matrix structure provides organizational flexibility to the huge projects. In the Risk management the Risk Register is often the starting- point [21]. A full discussion of how the Risk Register can help, and in fact is central to, the three kinds of analyses described above, and to two types of plans: the contractual allocation of risk and the preparation of Risk Management Plans. The first set, structured contractual preparation is more recognized and established [22]. Busby [23] suggests a good example, and such analysis is vital for any company planning to be a prime contractor [24].

This analysis structure should be included in risk management infrastructure [21] which generally must be fit into the matrix organization presented above. Morris [26], points out that major projects generally initiate with a centralized structure, turn into decentralized, and finish centralized, and that throughout decentralized phase, a large management superstructure is required to maintain project integrity. Although no universal structure is available for all projects, Busby [23] presents some useful pointers, and Ireland and Shirley [27] gives some comments on an integrated risk management system. [28] describes sets of pro-formas and reporting techniques for software projects. Further than that, Charette also gives importance to general process of risk management throughout the project. An significant characteristic of managing risk is the maintenance of risk databases to keep knowledge of where risks can occur. Databases may be formal or informal, do be for specific domains, and are utilized for planning and tendering. Many of these, are commercial-in-confidence, mainly in extremely competitive industries such as the oil industry. Two examples of databases of project risks are Niwa and Okuma [30] who depict a well-structured database (with a structure reminiscent of a Risk Register) in use at Hitachi, and its worth of the database for knowledge-transfer on project risk; and Ashley [31], who presents a number of examples of expert systems based on risk-knowledge.

6. CONCLUSION

The project managers are responsible for the project execution and its deliverables. It is extremely important that they should analyze the risk in the project initiation stage. When the risk has been exposed at the initiation stage then it will become easy to deal with them and develop the contingency plans. The risk exposure technique is very useful in highlighting the risk in beginning of the project. I found the analytical hierarchy process extremely useful for the brainstorming and especially for the investment of time by the project managers. It would give a direction that if in the software industry, these practices would be following then the loss associated with the unsatisfactory outcome can be minimized. Therefore, there is a need to apply some risk reduction measures while executing the projects in order to deliver the hundred percent outcomes to the customers. The Project Managers has to see beyond the risk analysis techniques towards the risk management because at the end the project manager is performing the role of risk manager also. One more thing is that, it is good to adopt the good practices of other industries to the software industry for the improvement of the process and the project manager can invest their time qualitatively in these activities.

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