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# Decision Support System for Software Risk Analysis during Software Development

Surbhi Anand
Assistance Prof
CT Institutes, Jalandhar,
Punjab,India.

Vinay Chopra
Assistance Prof
Daviet,Jallandhar,
Punjab,India.

## 1. Abstract

Software Engineering is a profession to provide high quality software to the customers. It is a systematic approach to analysis, design, implementation, maintenance and re-engineering of software. But there are many factors that affect the quality of software. These factors can cause various problems in the projects like increase in complexity, use of more resources, increase in time and budget of the project etc. If effects of risk factors are not estimated it will lead to the failure of the project. To avoid such situation from occurring it is important to estimate the possible effects of the risk factors on the software projects. So, during research it has been tried to find all possible risk factors and find out their interdependencies with each other and a decision support system is proposed to analyze software risks. The results of the tool will help the software developers to take important future decisions.

## 2. Introduction

Software engineering is a profession of providing high quality of software product to the customer [1]. Quality is major concern in the Software development process. Commonly the process involves finding out what the client wants ,composing this in the list of requirements, designing an architecture capable of supporting all of the requirements designing, coding, testing and integrating the separate parts, testing the whole deploying and maintaining the software. The quality of software is accessed by number of variables. This variable divided into external and internal quality criteria. External quality what a user experiences when running the software in its operational mode. Internal quality is code-dependent that are not visible to user [2]. Resources required accomplishing the software development effort. Customer never becomes ready to compromise with the quality [3]. If the quality degrades, it leads the project to failure. In fact, there are several risk factors which can lead the project to failure. Risks have no exact values. They are based upon uncertainties. In order to successfully manage software projects, we must learn to identify, analyze and control software risks [4]. Although controlling risks have a cost, but if the risks are not addressed and does indeed bite us. But there is no magic solution to overcome these risks [5]. Extensive research has been done to develop sophisticated tools that can analyze and provide accurate information for the choice of development of projects. Fuzzy Cognitive approach is used in this research as it is capable to deal with the concepts of complex systems with its features of simplicity, adaptability and capability of approximating abstractive structures. Fuzzy Cognitive Maps (FCMs) describe different concepts with different aspects in the behavior of complex systems. Therefore a software tool based upon FCM is developed for assessing software risks.

# 3. Software Risks

Risks are always uncertain. Risks do not have exact value. There is a list of evil things that always depress the software quality. But, we often assume that everything will go exactly, it is planned. So, Most of the factors that adversely affect the project attractiveness are called Risks, and generally risk is intangible and hard to measure. Due to the uncertain nature of risk, project managers must somehow determine the impact the risks will have on the project. Risk analysis has in its essence uncertainty and impreciseness. Any analysis made ignoring this uncertainty and impreciseness may cause information to be seriously misleading, therefore, contributing to large mistakes.The following is the list of risk factors which affects the software development process and finally leads the project to failure.The Following is the list of risk factors which can lead the software to failure[6-16].

| |
|---|
| Imprecise Requirements Analysis |
| Gold Plating |
| Adding people to late project |
| Friction between developer and customer |
| Planning to catch up later |
| Shortchanged quality assurance |
| Wishful thinking |
| Politics placed over substance |
| Insufficient risk management |
| Poor Management |
| Poor Team Cohesiveness |
| Market Competition |
| Uncontrolled employees problems |
| Lack of effective project sponsorship |
| Lack of user input |
| Code like hell programming |
| Politics placed over substance |
| Contractor failure |
| People Don't get work according to their Expertise |
| Time Constraints |
| Budgets Constraints |
| Environmental Failures |
| Dynamic nature of the Customer |
| Shortfalls in externally supplied Components |
| Noisy crowded offices |
| Research oriented development |

Table 1: Risk Factors

# 4. Fuzzy Cognitive Maps

Cognitive maps were initially introduced in 1976 by Robert Axelrod and were applied in political science .Fuzzy Cognitive Maps (FCMs) were first introduced by Bart Kosko in 1986 as an extension of cognitive maps. A Fuzzy cognitive map is a cognitive map within which the relations can be used to compute the "strength of impact" of various elements. The construction of an FCM requires human experience in the form of inputs and knowledge on the system under consideration [17]. Thus, FCMs integrate the accumulated experience and knowledge concerning the underlying causal relationships among different factors. Fuzzy Cognitive Maps are represented by graphs. FCMs models can be represented by a square matrix called Connection Matrix. Matrix is the combination of row and column in the table. Each cell in connection matrix stores the value of corresponding relationship. FCM has been used in various applications like , in the control related themes FCMs have been used to model and support plant control [18], to represent Failure Models and Effects Analysis for a system model [19,20,21] and to model the supervisor of control systems [22]. Fuzzy Cognitive Maps have been used for planning and making decisions in the field of international relations and political developments [23] and for analyzing graph theoretic behavior, been proposed as a generic system for decision analysis [24] and for distributed cooperative agents [25]. Fuzzy Cognitive Maps also have been used to analyze electrical circuits, to structure Virtual worlds.

# 5. Proposed Work

For estimating the effects of risk factors selected for the research, we have proposed fuzzy cognitive based tool. From the literature survey we have found that there are number of factors which can have direct or indirect impact on the project failure. Although the impact of various factors can vary according to the organization. From the number of factors 15 input factors are selected and we have checked their impact on the 4 output factors. The weights of all the dependent factors are calculated using FIS rule viewer. The following data contains the list of input factors output factors which will be adversely affected if the input factors arise.

| **Input Factors** |
|---|
| Poor Management |
| Extreme Influence of external challenges |
| Deadline Pressure |
| Lack of commitment |
| Gold Plating |
| Lack of Training /Experience |
| Lack of personal motivation |
| Increased Likelihood of nonbonding |
| Market Competition |
| Difficulty in achieving in goals |
| Less Salary |
| Corruption |
| Change in Customer Requirements |
| People don't get work according to Expertise |
| Shortfalls in externally supplied components |

Table 2: Input Factors

| Output Factors |
|---|
| Chances of risk at Team Cohesiveness |
| Chances of risk at S/W Quality |
| Chances of risk at Project Success |
| Chances of risk at Technical Strength |

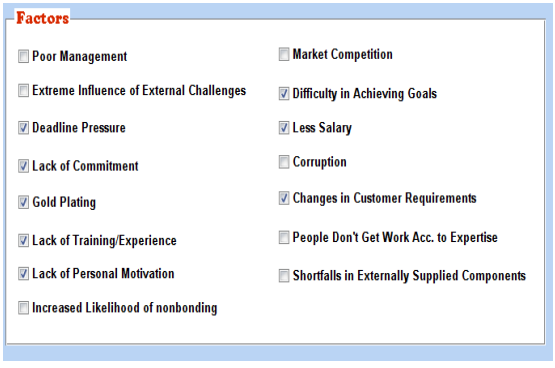
Table 3: Output Factors

With the selection of input and output parameters, Using MATLAB, GUI based tool is developed according to the 30 different added rules as shown in Figure 1.

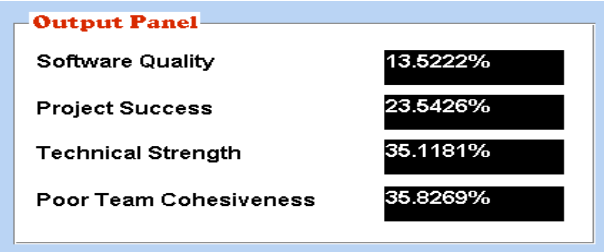

Figure 1: Proposed Tool

## 6. Experimental Results

**Case 1:** IF Deadline Pressure, Lack of Commitment ,Gold Plating, Lack of training, Lack of personal Motivation, Difficulty in achieving goals, less salary, changes in customer requirements are ON, the tool predict the output based upon the weights assign to each factor. The following diagram shows the different ON factors and the output panels shows the chances of Poor software quality will be 13.5222%, chances of risk on project success would be 23.5426 %, chances of risk at technical strength would be 35.1181 % and finally the chances of poor team cohesiveness would be 35.8269 %.

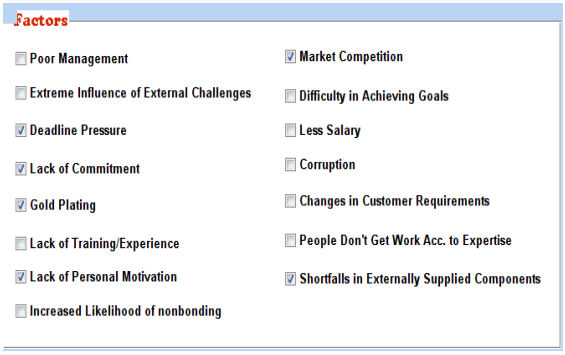



Case 1: Input Data

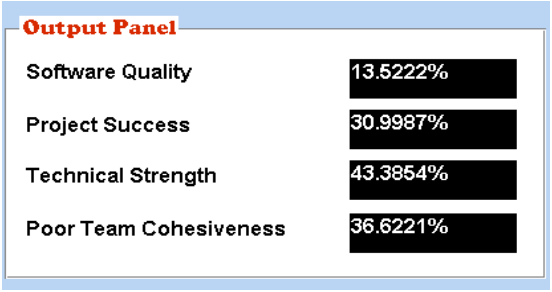



**Case 1: Output Data**

Case 2: IF Deadline Pressure, Lack of Commitment ,Gold Plating, Lack of training, Lack of personal Motivation, Market Competition, Shortfalls in externally supplied components are ON, the tool predict the output based upon the weights assign to each factor. The following diagram shows the different ON factors and the output panels shows the chances of Poor software quality will be 13.5222%, chances of risk on project success would be 30.9987 %, chances of risk at technical strength would be 43.3854 % and finally the chances of poor team cohesiveness would be 36.6221 %.




**Case 2: Input Data**




**Case 2: Output Data**

## 7. Conclusion

Researchers are still working to get the more and knowledge of how risk factors can be measured and integrated into the project management process. So that negative impacts can be avoided or we can plan out how to tackle such kind of risks during the management of the development process. Risk analysis is a structured mechanism to provide the visibility of threats to project success. Researchers are concerned by sharing which risk factors does directly and which risk factors does not directly affect among multiple projects will help upcoming software projects to

avoid reiterating the issues of the past. As researchers are working in the area of risk management and as more and more data is collected, the refined the models and techniques will become in the future. In reality, this is a practically impossible task, both from the amount of information required and the difficulty of extracting/estimating the required probability information of risk occurrence. Still, we have proposed software tool for risk analysis with limited parameters. This model can be extended to analyze different factors of large scale projects in the coming future.

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