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Estimating the Effects of Gold Plating Using Fuzzy Cognitive Maps

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***Abstract*— The systems and software development industry is characterized by a paradigm of project failure. There are various factors that can lead to project failure .One such factor is gold plating. Gold plating can cause various problems in the projects like increase in project complexity, use of more resources, and increase in time and budget of the project and many more. If effects of gold plating are not estimated it will lead to the failure of the project. So, in order to estimate the effects of gold plating we have designed a tool based on fuzzy cognitive maps (FCM). With the help of this tool developer can know the effects of doing gold plating on the project and based on the output of the tool the developer can make subsequent decisions regarding the project.**

***Keywords*- gold plating, fuzzy cognitive maps, MATLAB, membership functions.**

I. INTRODUCTION

Software engineering is the engineering discipline through which software is developed [17]. It is a profession having the objective of providing high quality software to the customers within budget and schedule .But there are certain factors which affect the quality of software. One such factor is gold plating. Gold plating in software engineering refers to continuing to work on a project or task well past the point where the extra effort is worth the value it adds (if any). After having met the requirements, the developer works on further enhancing the product, thinking the customer would be delighted to see additional or more polished features, rather than what was asked for or expected. The customer might be disappointed in the results, and the extra effort by the developer might be futile [1]. Gold plating affects the project in many ways. It increases the complexity, time and budget of the project, increases the consumption of resources, leads to friction between developer and customer etc. This all lead to failure of the projects. To estimate the effects of gold plating fuzzy cognitive approach is used as it is capable of dealing with complex systems through its features of simplicity, adaptability and capability of approximating abstractive structures [2].

II. FUZZY COGNITIVE MAPS

Robert Axelrod initially introduced the Cognitive maps in 1976 by and they were applied in political science [3]. Bart Kosko in 1986 first introduced Fuzzy Cognitive Maps (FCMs) as an extension of cognitive [4]. 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 [5]. FCM has been used in various applications like in the control related themes FCMs have been used to model and support plant control [12], to represent Failure Models and Effects Analysis for a system model [13]-[15] and to model the supervisor of control systems [16]. Fuzzy Cognitive Maps have been used for planning and making decisions in the field of international relations and political developments [6] and for analyzing graph theoretic behaviour [7], been proposed as a generic system for decision analysis [8] and for distributed cooperative agents [9]. Fuzzy Cognitive Maps also have been used to analyze electrical circuits [10], to structure Virtual worlds [11].

III. PROPOSED WORK

We have proposed a tool for estimating the effects of gold plating on project failure. This tool is based on fuzzy cognitive maps. After doing literature survey we have found that there are number of factors which can arise if gold plating is done by the developer. Although the impact of factors can vary according to the organization. From the number of factors we have finally selected 15 input factors which can have direct or indirect impact on project failure and we have checked their impact on the 4 output factors. The weights of all the dependent factors are calculated using FIS rule viewer. Table 3.1 contains the list of input factors [18] and 3.2contains the list of output factors which will be adversely affected if the input factors arise.

Table 3.1

Sr. No.	Input Factors
1.	Omitting Necessary Tasks
2.	Short changed Quality Assurance
3.	Complexity
4.	People Do Not Get Work According to Expertise
5.	Planning to Catch Up Later
6.	More Work Pressure
7.	Coding Like Hell Programming
8.	Externally Supplied Components Influence
9.	Research Based Development
10.	Extra Efforts
11.	Undermined Motivation
12.	Adding People Late to Project
13.	Uncontrolled Employee Problems
14.	Lack User Support
15.	Lack Efficient Management

Table 3.2

Sr. No.	Output Factors
1.	Probability of Poor Team Work
2.	Probability of Technical Difficulties
3.	Probability of Poor Software Quality
4.	Probability of Project Failure

Using 30 different rules which are designed on the basis of interdependencies among factors, rule base is constructed. With the help of MATLAB, GUI based tool is developed on the basis of 30 rules in order to estimate the effects of gold plating on project failure. GUI based tool showing the impact on 4 output factors is given fig 1.

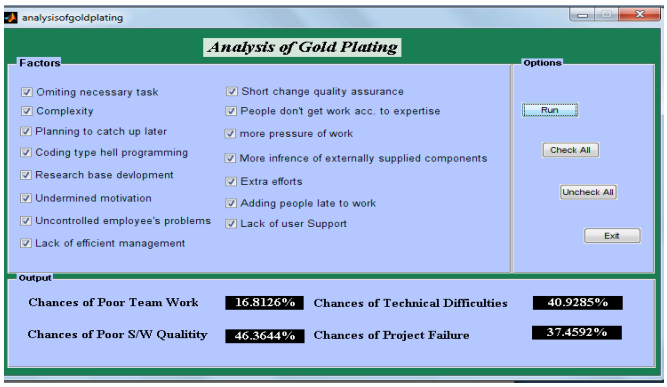

Fig 1:GUI Based Tool

IV. DESIGN METHODOLOGY

In order to estimate the effects, we have considered five different effect levels of gold plating i.e. “Very Low”, “Low”, “Medium”, “High”, and “Very High”. It is assumed that the effects of gold plating upon project failure may vary from organisation to organisation, depending upon the factors considered at different situations. Inputs are represented by fuzzy sets to design fuzzy system. Fuzzy sets are represented by the Membership functions. Membership functions of the system are as shown in fig 2.

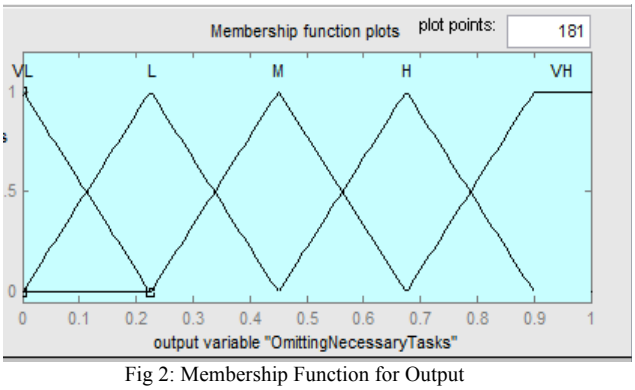

Fig 2: Membership Function for Output

We have used different types of membership functions for designing the fuzzy inference system in MATLAB. For input factors, we have used triangular-shaped built-in membership functions. For output factors, we have used triangular-shaped built-in and trapezoidal-shaped built-in membership functions.

The trapezoidal-shaped membership function is given in Eq. (1)[19]

$$f(x,0.669,0.892,0.9,1)=\begin{cases}0, x \le 0.669\\ \dfrac{x-0.669}{0.892-0.669}, 0.669 \le x \le 0.892\\ 1, 0.892 \le x \le 0.9\\ \dfrac{1-x}{1-0.9}, 0.9 \le x \le 1\\ 0, 1 \le x\end{cases} \quad (1)$$

Rules are designed after representation of inputs and outputs of fuzzy sets in membership functions. For example in the case of Uncontrolled Employee Problems which can lead to Poor Team Work, its rule is as given below:

If (UncontrolledEmployeeProblems is Yes) then (PoorTeamWork is M) (0.75)
If (UncontrolledEmployeeProblems is Yes) then (PoorTeamWork is H) (0.25)

Similarly, in the case of Lack of Efficient Management which can lead to Omitting Necessary Tasks, its rule is given below

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If (LackOfEfficientManagment is Yes) then (OmittingNecessaryTasks is H) (0.5)
If (LackOfEfficientManagment is Yes) then (OmittingNecessaryTasks is M) (0.5)

V.IMPLEMENTATION PROCEDURE

Fuzzy interference system showing the mapping of inputs and outputs is given in fig 3. The names of the inputs, outputs and processing method can be changed.

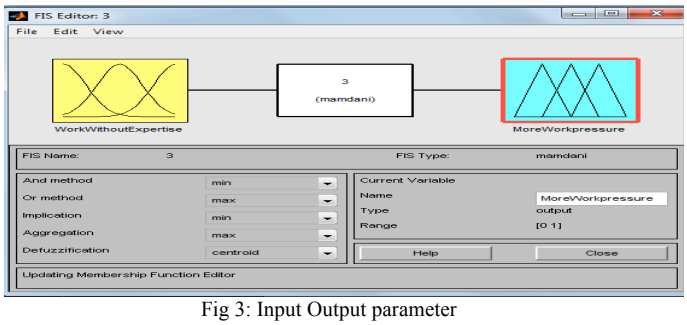

Fig 3: Input Output parameter

Membership function editor showing input and output variables along with their range and chances of occurrences i.e. either the variable is yes or no are given in fig 4.

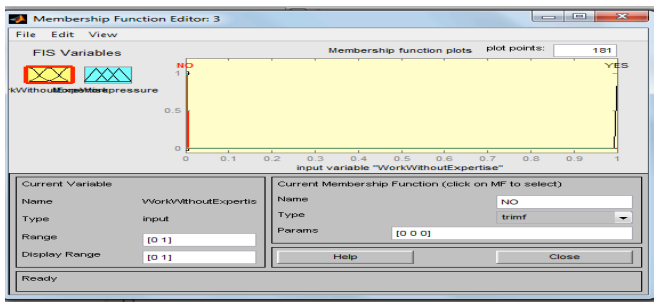

Fig 4: Memebership Function Editor

Rule editor which helps to add, change and delete rules is shown in fig 5. 30 rules are designed in this editor Rule viewer which computes the interdependencies among the various dependent factors is shown in fig 6.

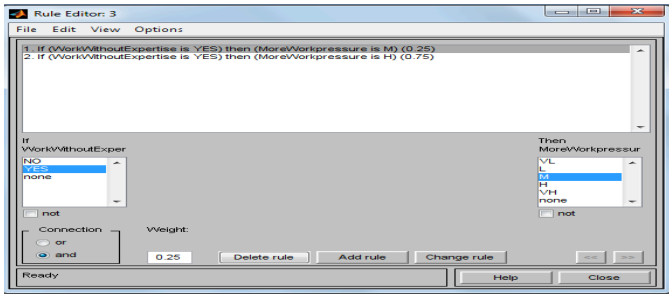

Fig 5:Rule Editor

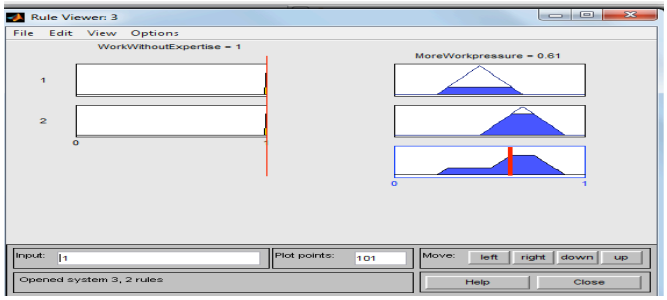

Fig 6: Rule Viewer

Fig 7 represents the tool showing the impact on 4 output factors when certain input factors like omitting necessary tasks, coding like hell programming, research based development, undermined motivation, more work pressure etc. arise due to gold plating. The tool calculates percentage impact on the output factors due to the input factors.

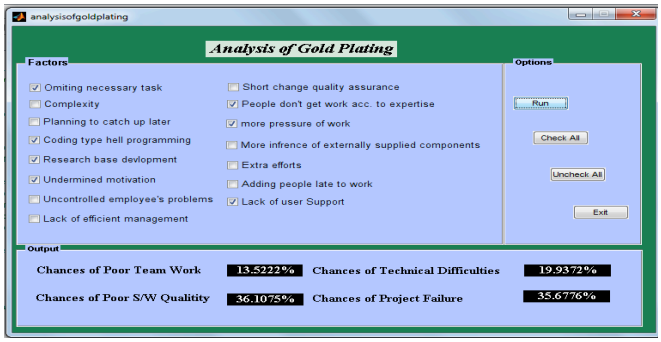

Fig 7: Effects of Gold Plating

VI.CONCLUSION

Gold plating means after having met the requirements, the developer works on further enhancing the product, thinking the customer would be delighted to see additional or more polished features, rather than what was asked for or expected. The customer might be disappointed in the results, and the extra effort by the developer might be futile. Also, gold plating if done can cause various problems in the project and can ultimately lead to failure of the project if its effects are not estimated. So, this paper presents a tool which will help the developer to estimate gold plating effects on the project and will help the developer to make the further decisions regarding the project based on the output produced by the tool.

In future, an expert system in neural network can be designed that will estimate the effects of gold plating on the projects.

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