SCRUM PROJECT SCHEDULE RISK EVALUATION USING FUZZY LOGIC

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ABSTRACT: The risk of scrum project schedule errors implies that any schedule created at the beginning of a project will be unreliably expired at the end of that project, and should not be counted as an accurate prediction of completion date. With the uncertainty and invisibility of the software, it does not matter how much time and effort it takes to create a schedule at the beginning of a project, as the system will definitely change along the way. Adoption of risk management processes can help increase the success of a software project. As an important risk management process, risk reduction aims to reduce or eliminate risk. In this paper we have identified some schedule sub factors and its priority order.

KEYWORDS: AGILE SCRUM, PROJECT RISK, RISK FACTORS, FUZZY LOGIC, RULE BASE.

INTRODUCTION: Schedule risk is the risk of failure to meet schedule plans and the impact of that failure. It has been observed that less information is available in the early stages of the program, and editors should rely on personal experience, lessons learned, best practices, and expert ratings. As the process progresses through the acquisition cycle, more information becomes available. Schedules developed in the latest phases of the program are based on additional information and analysis, but this lacks complete certainty. Uncertainty introduces a risk factor in the planning process [15] [18]. Schedule Risk Assessment (SRA) is a way to analyse uncertainties in project schedules. Input and output uncertainties are related to duration of operation, start and end times, lags, and other parameters. Schedule risk analysis helps in determining, what is the probability that the current project will meet key milestones or other schedule objectives. Schedule risk analysis includes sensitivity analysis. The results of the schedule risk analysis show how project parameters such as project duration, start and end times are sensitive to uncertainty during work [1][7]. There are many mathematical methods that can be used to perform schedule risk assessments; however, the most common and accurate method is the imitation of Monte Carlo. During the risk assessment process using the Monte Carlo simulation, the schedule is calculated multiple times using the Critical Method (CPM). Although schedule risk involves creating a mathematical model, scheduling risk analysis should not be difficult. Risky Project software provides an easy way to accurately measure the effects of risky events and uncertainties in your project plan [11] [12]. Projects are rarely about perfection and pragmatic. It brings the result "good enough"[13][14].

WHAT IS FUZZY LOGIC? : Fuzzy Logic is a method of making a computer based on "degrees of truth" rather than the usual "truth or false" (1 or 0) the rational mind on which the modern computer is based. The concept of fuzzy logic was first developed by Lotfi Zadeh of the University of California at Berkeley in the 1960's. Zadeh was working on a computer problem in native language. Indigenous language like many other activities in life and in the world is not easily translated into complete 0 and 1 terms. We may want to feed the computer in a certain state of qualitative values. It may be helpful to see the fuzzy mind-set as a real way of thinking [5]. In this paper Section 2 described about the research in this field has been accomplished. Sections 3 describe about the risk sub factors identification which affects the schedule of the project completion in scrum method. This section reveals the sub factors sensitivity also. Section 4 of this paper is conclusion and future work needed to be done in this area.

LITERATURE REVIEW: Researchers have widely discussed scheduling estimation issues for years. Liu and Shih [15] proposed a framework of schedule constraints named critical resource chain where three scenarios of schedules were successfully analysed, an (Resource Constrained Project Scheduling Problem) RCPSP-based schedule with the goal of minimized overall schedule duration, and an RCPSP-based schedule considering a time–cost trade-off. Lu and Lam [13] introduced the problem of how to incorporate the effects of multiple resource calendars on CPM scheduling, and presented a new method for accurately assessing the effect of an activity in extending the total project duration. Kim and de la Garza [10] proposed the resource-constrained critical path method (RCPM), and evaluated the RCPM's performance by comparing it with five related previous studies, which (and this comparison) showed that RCPM performed well in identifying resource links and alternative schedules, compared to other studies provided in Wiest [20], Woodworth and Shanahan [2], Bowers [6] and Lu and Li [14]. Christodoulou [16] applied Ant Colony Optimization artificial agents to a resource-constrained network and utilized that method in examining the effects of resource availability constraints to critical path calculations and project completion time [17]. Castro et al. [8] defined a new rule for the resolution of the slack allocation problem in a PERT network, a new rule for the allocation of slack in a PERT network based on the duration of the activities, which allowed a schedule to be made at any point during the execution of a project, then a schedule can be planned at the beginning of the project or be adjusted once a delayed or a time-saving process appeared [1][3][4]. Nasir et al. presented a new model named Evaluating Risk in Construction–Schedule Mode which used a neural network to evaluate schedule [9]. In this paper, firstly, construction schedule risks were identified through a literature review through the expert review and a group review by a team of experts. Secondly, cause effect relationships among these risks were identified through an expert survey. Thirdly, probabilities for various combinations of risk variables were obtained through an expert interview survey and incorporated into the model. The model was tested using 17 case studies with very good results [12][20].

RESEARCH DISCUSSION: In Scrum Schedule Risk sub factor under agile methodology is one of the important factors analysing Risk. In this research study various sub factors like Frequent Change Requests from Customers and Stakeholders, Unreliable estimates, Large amount of "off the books" work, uncertain quality and Matrixed team members given in Table 1[18][19].

TABLE 1 : SCRUM SCHEDULE RISK SUB-FACTORS		
S. No.	**RISK ELEMENTS**	**ABBREVIATION**
1	Frequent Change Requests from Customers and Stakeholders	SF1
2	Unreliable Estimates	SF2
3	Large Amount of "Off The Books" Work	SF3
4	Uncertain Quality	SF4
5	Matrixed Team Members	SF5

(i) **FREQUENT CHANGE REQUESTS FROM CUSTOMERS AND STAKEHOLDERS:** It has found that if there is frequent change request in their schedule from customers and stakeholders then risk increases. So it is necessary to manage/ avoid their request to change the schedule.

(ii) **UNRELIABLE ESTIMATES:** If there is not proper estimate in schedule of project and team does sticks with schedule then risk involves.

(iii) **LARGE AMOUNT OF "OFF THE BOOKS" WORK:** There is important to minimize the "off the books" work. Every work should be on the record and schedule then it is possible to minimize the risk in project.

(iv) **UNCERTAIN QUALITY:** during requirement analysis there is a need to identify the quality level so that time can be managed and work can be scheduled. It will reduce the risk in scrum project.

(v) **MATRIXED TEAM MEMBERS:** Matrix management is an organizational structure in which some individuals report to more than one supervisor. In this case it is essential to manage matrix properly to enhance productivity and reduce risk.

The proposed model in Figure 1, five sub factors and identified rule base have been applied in Fuzzy Inference System using Matlab simulator. In this study of scrum schedule risk analysis, for the fuzzification and defuzzification process, we have chosen Mamdani method and for the association of sub factors in rule base AND method is preferred. We have applied centroid method for the aggregation of rules in FIS editor which can be seen in the Figure 2.

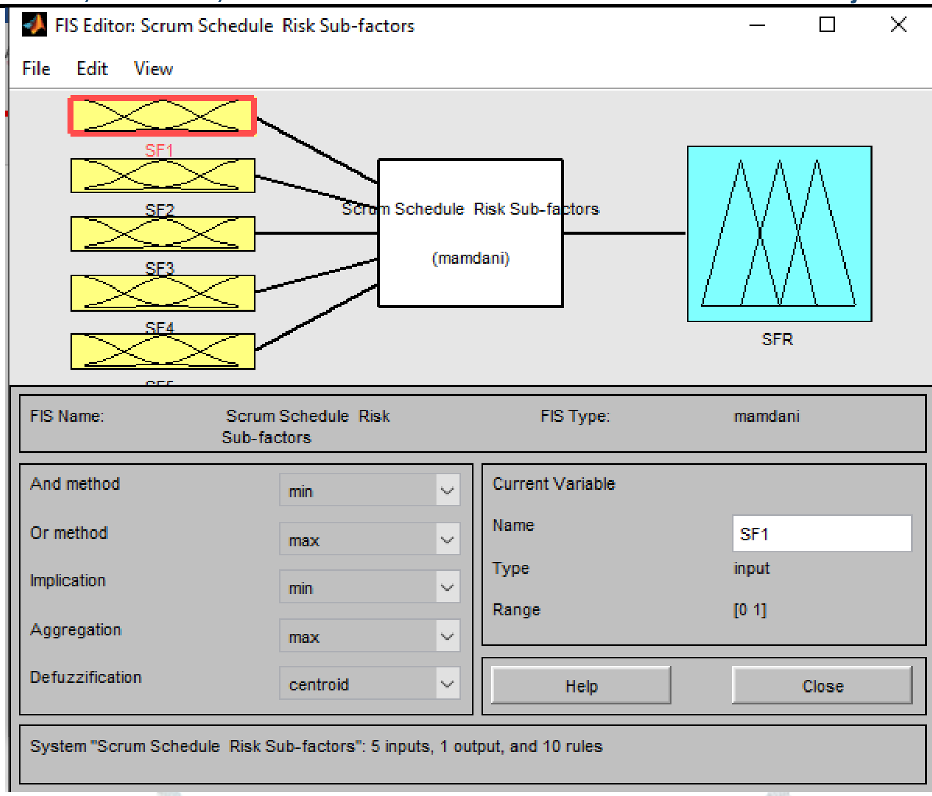

FIGURE 1: SCRUM SCHEDULE RISK SUB FACTOR ANALYSIS MODEL USING FIS

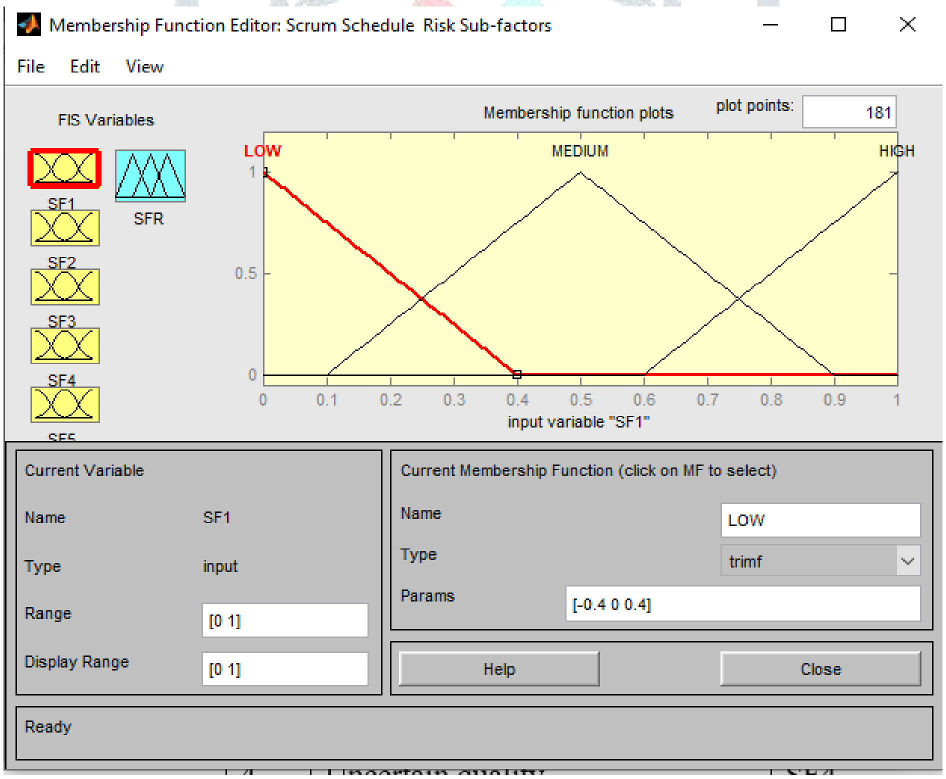

FIGURE 2: TRIANGULAR FUNCTION FOR FUZZIFICATION AND DE-FUZZIFICATION PROCESS

In Table 2, we have described about the qualitative values band which depends on the crisp input values and its membership function. Pictorial representation of the Table 2 is shown in given Figure 2, talks about the three triangles. Each triangle represents low, medium and high qualitative value domains. In Figure 2, vertical line shows the crisp membership function values and horizontal line shows the crisp input values. If input value is 0 then its membership function value is 1 then it can be assumed that its qualitative value would be Extreme low. qualitative values are divided in seven bands that is extreme low, low, medium low, medium, medium high and extreme high for the implementation of proposed model.

TABLE 2: FUZZY MEMBERSHIP FUNCTION WITH CRISP INPUT FOR RISK

S. No.	INPUT VALUE	LOW	MEDIUM	HIGH	QUALITATIVE VALUE
1	0	1	0	0	Extreme low
2	.1	.75	0	0	Low
3	.2	.5	.25	0	Low
4	.3	.25	.5	0	Medium Low
5	.4	0	.75	0	Medium
6	.5	0	1	0	Medium
7	.6	0	.75	0	Medium
8	.7	0	.5	.25	Medium High
9	.8	0	.25	.5	High
10	.9	0	0	.75	High
11	1	0	0	1	Extreme High

To continue this research we have formulated 10 rules on the basis of some case studies and it is clear that when Frequent change requests from customers and stakeholders (SF1) is High, Unreliable estimates (SF2) is Low, Large amount of "off the books" work (SF3) is High, Uncertain quality (SF4) and Matrixed team members (SF5) are Low than Scrum Factor of Risk (SFR) is Medium. In other case it has been observed that when Frequent change requests from customers and stakeholders(SF1), Unreliable estimates(SF2) and Large amount of "off the books" work(SF3) are Low, Uncertain quality(SF4) and Matrixed team members(SF5) are Medium than Scrum Factor of Risk (SFR) is Low. In other case it has is clear that when Frequent change requests from customers and stakeholders(SF1), Unreliable estimates(SF2) and Large amount of "off the books" work(SF3) are Medium, Uncertain quality(SF4) and Matrixed team members(SF5) are High than Scrum Factor of Risk (SFR) is High. In the Table 3, five scrum schedule risk sub factors possess the value in qualitative form Low (L), Medium (M) and High (H) on the basis of these qualitative values; we have performed case studies and created the rule base for the same. Finally, by using the centroid method we have aggregated the qualitative values of rule base in quantitative form. For this we have used Matlab FIS simulator as shown in the Figure 3.

TABLE 3 : RULE BASE SCRUM SCHEDULE RISK

S. No.	SF1	SF2	SF3	SF4	SF5	SFR
1	H	H	H	H	H	H
2	H	L	H	L	L	M
3	L	L	L	M	M	L
4	M	M	M	L	L	L
5	H	H	L	L	L	M
6	L	L	L	L	L	M
7	M	M	M	H	H	H
8	L	H	H	H	L	L
9	M	M	H	H	H	M
10	H	H	M	L	L	L

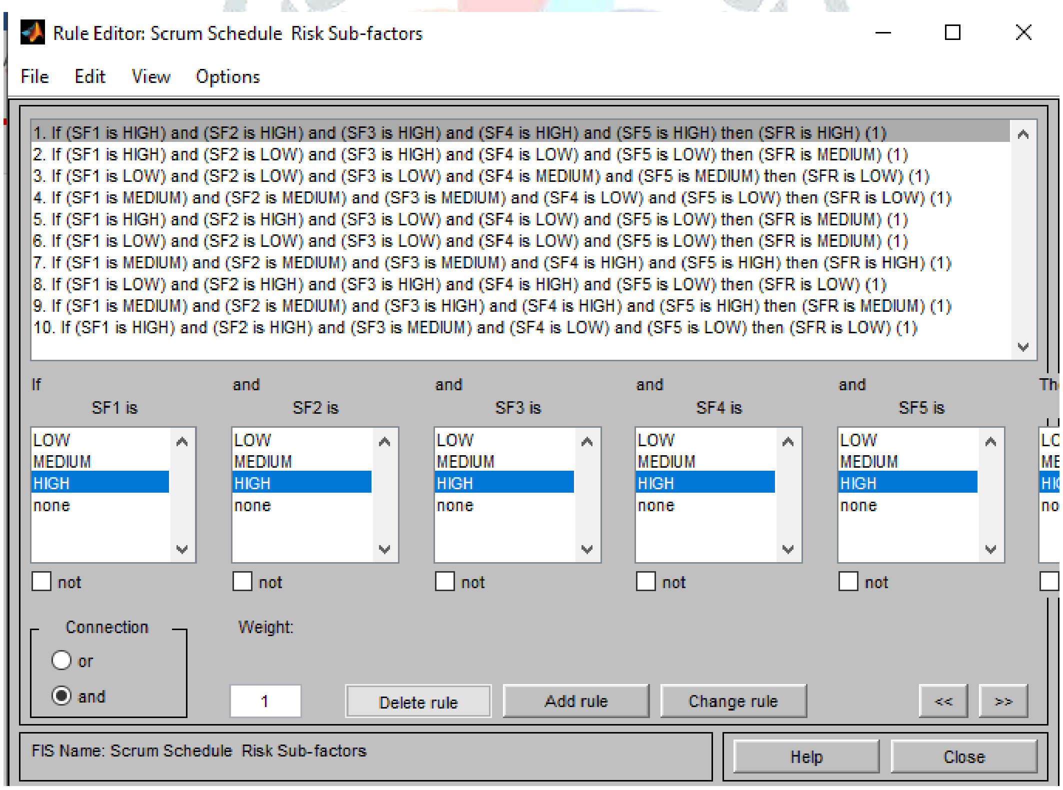

FIGURE 3: RULE BASE EDITOR OF SCRUM SCHEDULE SUB FACTOR

Since above sub factors are holding qualitative values but with the help of qualitative values we cannot make any decision precisely. For solving this problem we have developed the model for quantification of the sub factors [11]. We have used the FIS Editor which manages high-level program issues and best suited for this research. Since no of entries is much more and the number of membership activities too large, it can also be difficult to analyze FIS using other GUI tools. The Rule Editor has been used for editing a list of rules that define system behavior. Rule Viewer is used for viewing, the crisp values of organisational agility and sub factors.

FIGURE 4: RULE VIEWER OF SCRUM SCHEDULE SUB FACTOR

We have found the new values by moving slider which are given with each subfactor in the given figure and finally we get the result on the basis of rule base applied in the fuzzy inference editor. In the Rule Viewer (Figure 4) when we slide the ruler and value of Frequent change requests from customers and stake holders (SF1=.7747), Unreliable estimates (SF2 = .9611), Large amount of "off the books" work (SF3 = .9278), Uncertain quality (SF4 = .9725) and Matrixed team members (SF5 = .8056) than Scrum Factor of Risk (SFR) = .8420. In other case, when we slide the ruler and value of Frequent change requests from customers and stake holders (SF1 = .8407), Unreliable estimates (SF2 = 1.0000), Large amount of "off the books" work (SF3 = 1.0000), Uncertain quality (SF4=1.0000) and Matrixed team members (SF5 = .9167) than Scrum Factor of Risk (SFR = 0.8540). In other case, when we slide the ruler and value of Frequent change requests from customers and stake holders (SF1=.7747), Unreliable estimates (SF2=.6167), Large amount of "off the books" work (SF3 = .2500), Uncertain quality (SF4 = .2363) and Matrixed Team Members (SF5 = .1050) than Scrum Factor of Risk (SFR) = 0.2450.

TABLE 4: SCRUM PROJECT SCHEDULE RISK QUANTITATIVE VALUE

S.No.	SF1	SF2	SF3	SF4	SF5	SFR
1	0.7747	0.85	0.85	0.6648	0.9167	0.593
2	0.7747	0.85	0.7389	0.7747	0.8056	0.674
3	0.6099	0.3944	0.3167	0.1374	0	0.15
4	0.6099	0.3944	0.3167	0.3242	0.2056	0.179
5	0.2143	0.1859	0.2273	0.1104	0.05844	0.455
6	0.2143	0.4167	0.487	0.1104	0.05844	0.17
7	0.2143	0.1859	0.2532	0.1623	0.1883	0.45
8	0.3831	0.09615	0.2273	0.2143	0.2403	0.443
9	0.1753	0.3782	0.2273	0.2143	0.2403	0.309
10	0.1753	0.3782	0.3182	0.3571	0.2403	0.367

Table 4, shows the some sample of quantitative values collected from the FIS rule viewer and given in Figure 5, and shows the graphical presentation of the schedule risk sub factors in given figure shows the strength and

TABLE 5: SENSITIVITY ANALYSIS OF SCRUM SCHEDULE SUB FACTOR

S. No.	SF1	SF2	SF3	SF4	SF5	SFR
1	1	0	0	0	0	.402
2	0	1	0	0	0	.0717
3	0	0	1	0	0	.110
4	0	0	0	1	0	.454
5	0	0	0	0	1	.504
SENSITIVITY ORDER: SF5 > SF4 > SF1 > SF3 > SF2						

weakness of the sub factors which affects more the scrum project schedule risk.

Table 5, shows the sensitivity analysis of the sub factors. The sensitivity analysis has been conducted using the range sensitivity analysis, for range sensitivity analysis we keep a single sub factor value at extreme high (1) and rest sub factors at extreme low (0). Thus we can see in given table that sub factor SF5 (Matrixed Team Member) sub factor is more sensitive and SF2 (Unreliable estimates) is lowest sensitive out of five sub factors. Sensitivity prioritization order is given in table which helps in risk management.

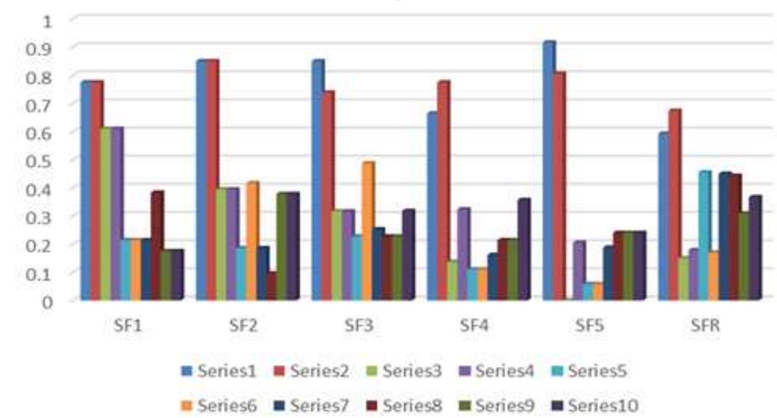

Figure 5. Scrum project schedule risk and sub factors quantitative representation

CONCLUSION: In this research we have identified five schedule risk sub factors and evaluated the quantitative values for the schedule risk management precisely. In this research we have identified more sensitive sub factors and their prioritization order. We can see that 'Matrixed Team Members' is the highly sensitive sub factor than other four sub factors. In future few more sub factors can be identified and few more rule base can be enhanced as the software and hardware technology is growing and changing rapidly.

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