SCRUM PROJECT RISK IDENTIFICATION AND EVALUATION USING FUZZY LOGIC

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ABSTRACT: Agile Scrum is identified as the most widely used project management system in the current industry as it is able to easily adapt to changing business needs. As a result, there is a growing trend for using Scrum as a project management tool in many software development projects. The Scrum framework is a program that focuses on customer satisfaction through collaboration and communication. Therefore, Scrum is a method with some random features, compared to other project management methods. Risk Managements are key areas that significantly affect the success rate of Software development projects. Risk Management defines the ability to manage a project seamlessly in different situations. In several cases Scrum has given successful result but in some cases it was found not suitable for the specific project. In this research study we have identified some risk factors and its priortization.

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

INTRODUCTION: The Software Development Industry is the world's leading industry today. The success rate of software projects depends largely on the methods used to manage them. There are many well-known software project management methods available. Agile Scrum is identified as the most widely used project management system in the current industry as it is able to easily adapt to changing business needs. As a result, there is a growing trend for using Scrum as a project management tool in many software development projects[4][5][6]. The Scrum framework is a program that focuses on customer satisfaction through collaboration and communication. Therefore, Scrum is a method with some random features, compared to other project management methods. Risk Management is key areas that significantly affect the success rate of Software development projects. Risk Management defines the ability to manage a project seamlessly in different situations. The Scrum framework does not explicitly define any risk management capabilities in their ideas [6][7][9]. Scrum authors introduce Scrum as a risk-based approach that does not require explicit risk management practices. Based on that statement a number of studies have been conducted proving that Scrum has internal risk management capabilities for software projects. However, software projects following Scrum are still failing due to improper use of those risk management capabilities. Therefore, this study aims to

investigate the factors that contribute to the implementation of those risk management capabilities built into the real world context. To achieve the objective of the research, based on a comprehensive review of the literature and ideas of experienced Scrum users, a few factors have been identified that contribute to the effective implementation of risk management processes in Scrum projects [10][12][13].In this research paper Section 2 describes about the research study which have been conducted in the concerned field. Section 3 describes the research discussion in which identified scrum risk factors are explained in brief and data analysis has been done. Section 4; describe the outcome of the research and future work in this area to be done.

LITERATURE REVIEW: Scrum is defined by its creators Schwaber and Sutherland as a structural framework used to manage complex products that allow for the integration of multiple processes or strategies. Schwaber in 2004 argues that Scrum is a fast-track system or fast-paced project management framework. It's a project management process, and certainly not a way to do it; if it were, it would be very difficult. This study uses Scrum based on the description of its framework. Team roles, events, artifacts, and rules are part of Scrum. Roles are divided into Product Owner, Development Team, and Scrum Master [3][14]. Scrum teams are multi-tasking, able to complete a task without relying on people outside the team. Another feature of the Scrum team is self-organizing, which enables the team to define the best way to do the job without the guidance of an outsider [11]. Scrum describes five events, also known as festivals, all of which have a fixed time, which cannot be reduced or increased [21]. These events are designed to allow for transparency and evaluation of projects. If any event is not done, it will lead to less transparency and loss of opportunity to explore and familiarize you with the project. The Scrum life cycle is divided into several phases, usually two to four weeks in length, with repetitions called Sprints, which make it easier to monitor the product being processed and to identify barriers. Some authors describe the barrier as a project risk, while others argue that there is a difference between the two concepts [15][17]. Project risks can be defined as a set of factors or conditions that may be a threat to project success. It is important to estimate the risk, assess the likelihood of its occurrence, and its potential impact on the project [19]. According to Schwaber and Sutherland the Scrum framework uses a repetitive and complementary approach to improve forecasting and risk management. The authors claim that the use of Sprints also supports risk management, as it reduces risk within one calendar month of expense. However, some authors believe that Scrum and other older methods, in general, do not suggest specific risk support functions [16][17]. The Scrum only works to identify a risk and does not provide a way to analyze and manage it. This study uses the definition of the barrier proposed by Jakobsen and Johnson in 2008, as a problem that has occurred and hinders the continuity of the work. When risk management is implemented in Scrum projects, it creates barriers by implementing measures to prevent project risk from becoming obstacles. Apart from the importance of risk management to the success of the project, only a few scientific studies have been identified in a survey conducted in the following areas of knowledge: Web of Science, Scientific Electronic [19][20].

RESEARCH DISCUSSION: In this research study of Risk evaluation in srcum project development method under Agile methodologoy we have idendified various factors like Scrum Project Risk factor, Scrum Team Communication Risk factors, Scrum Team Collaboration and Co-ordination Risk factors and Scrum Schedule Risk factors. We have identified one of the most important factor i.e. Scrum Project Risk Sub factor. Scrum Project Risk factor[1][2][4]. We have identified 9 sub factors of Scrum project risk as given Table 1:

TABLE 1: SCRUM PROJECT RISK SUB-FACTORS

S. No.	RISK ELEMENTS	ABBREVIATION
1	Higher Interdependency Between the Teams	PR1
2	Team Recognition for Every Sprint	PR2
3	Growth in Team Size or Development Site	PR3
4	Lower Initial Velocity	PR4
5	Difficult to Execute Fixed Price Projects	PR5
6	Unavailability of Business Analyst	PR6
7	Lack of Uniformity in Multisite Team's Capabilities	PR7
8	The Emergence of excessive Competition between Teams	PR8
9	The Emergence of excessive Competition between Scrum Masters and Product Owners	PR9

(i) **Higher Interdependency between the Teams:** If there is dependency between teams. Work will be delayed. This will increase risk of project.

(ii) **Team Recognition for Every Sprint:** Project work is divided into small tasks or modules and each module is assigned to one sprint. It is very import to recognize best team for sprint would reduce the risk.

(iii) **Growth in Team Size or Development Site:** when during scrum project development team size is increased or development sites are increased then risk is increased.

(iv) **Lower Initial Velocity:** At the starting of the scrum project initial velocity need to be high. If initial velocity is low, project may be at risk.

(v) **Difficult to Execute Fixed Price Projects:** For agile development mythology it is typical task to manage fixed cost project budget. If scrum project has fixed cost than risk factor will be high.

(vi) **Unavailability of Business Analyst:** If scrum project development organization does not have skilled business analyst or analyst is absent than risk factor will be high.

(vii) **Lack of Uniformity in Multisite Team's Capabilities:** adequate uniformity at multisite is important role to reduce risk factor in scrum project. Lack of uniformity will be problem for synchronization of project outcome.

(viii) **The Emergence of Excessive Competition between Teams:** Competition of always good for growth of any organization but excessive competition between scrum teams will increase risk level.

(ix) **The Emergence of Excessive Competition between Scrum Masters and Product Owners:** Scrum master and Project owners may be same or different. In the case of different scrum masters and project owners, there is need a balance of competition to reduce risk.

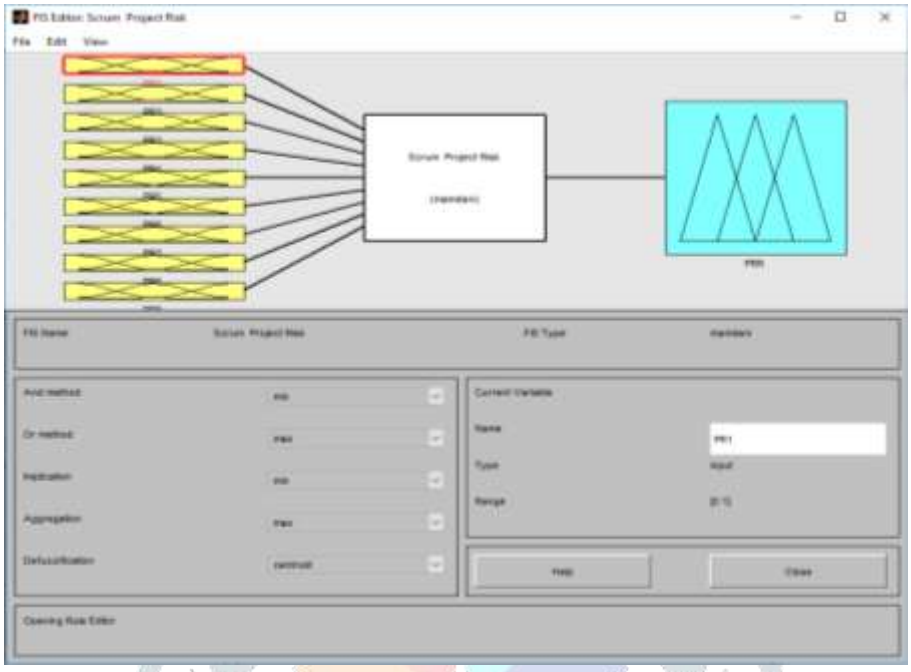

FIGURE 1: SCRUM PROJECT RISK EVALUATION BY FUZZY INFERENCE SYSTEM

The proposed model of Scrum Project Risk evaluator can be seen in Figure 1 in which 9 subfactors are identified. Based on the questioners and case studies rule base have been applied in Fuzzy Inference System using MATLAB simulator. Here, for the fuzzification and defuzzification process, we have chosen M*amdani* method and for association of subfactors in rule base AND method is preferred. In FIS editor, we have applied centroid method for the aggregation of rules in FIS editor. In Table 2, it is described that how the qualitative values band depends on the crisp input values and its membership function. Pictorial representation of the Table 2 is shown in given Figure 2, which shows the three triangles and each triangle represent low, medium and high qualitative values domain. We can see in Figure 2, vertical line shows the crisp membership function values and horizontal line shows the crisp input values. It can be observed in the figure 2 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. We have divided the qualitative values in seven bands that is extreme low, low, medium low, medium, high and extreme high.

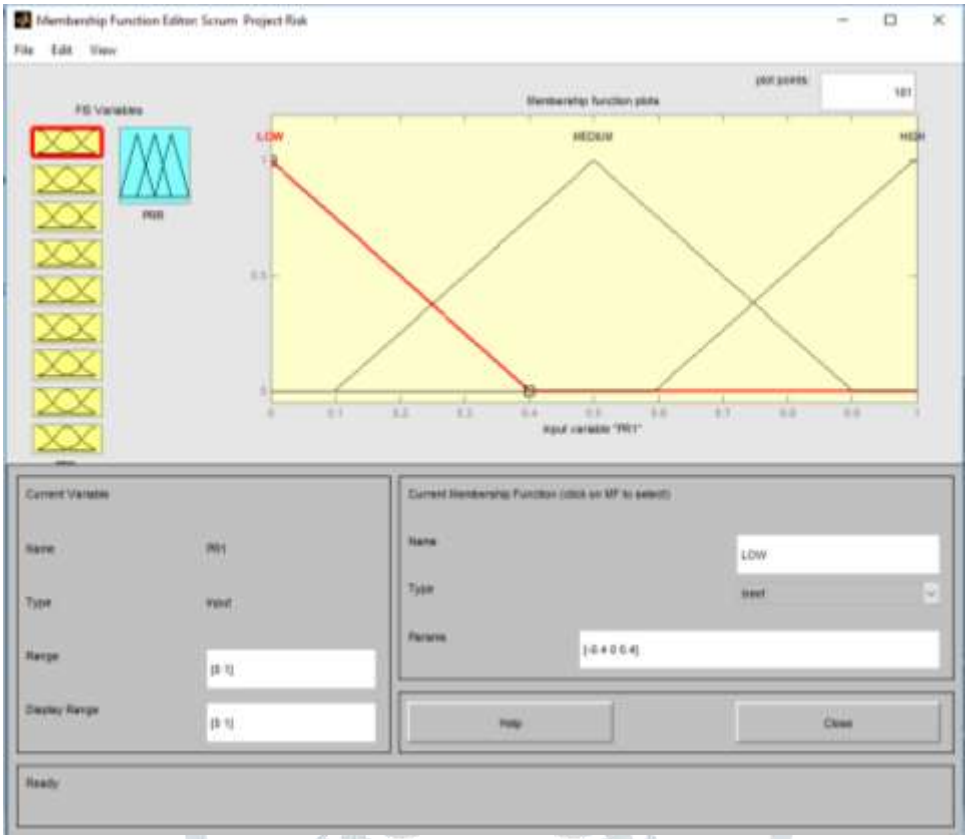

FIGURE 2: TRIANGULAR FUNCTIONS FOR FUZZIFICATION/DEFUZZIFICATION PROCESS

TABLE 2. FUZZY MEMBERSHIP FUNCTION WITH CRISP INPUT

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

We have formulated 16 rules on the basis of some case studies and it has been observed that when Higher Interdependency Between the Teams (PR1) is Medium, Team Recognition for Every Sprint (PR2), Growth in Team Size or Development Site (PR3), Lower Initial Velocity (PR4) are High, Difficult to Execute Fixed Price Projects (PR5), Unavailability of Business Analyst (PR6), Lack of Uniformity in Multisite Team's Capabilities (PR7), The Emergence of excessive Competition between Teams (PR8) and The Emergence of excessive Competition between Scrum Masters and Product Owners (PR9) are Medium than Scrum Project Risk factor (PRR) is Medium.

TABLE 3. RULE BASE SCRUM PROJECT RISK SUB-FACTORS

S.No.	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PRR
1	H	M	L	H	H	L	L	H	H	H
2	L	L	L	L	L	L	L	L	L	L
3	M	H	H	H	H	M	M	M	M	M
4	M	M	M	L	L	L	L	L	L	L
5	L	L	L	L	L	H	H	H	H	M
6	M	M	M	M	M	H	H	H	H	M
7	L	M	M	L	L	L	M	M	M	L
8	L	L	H	H	M	M	L	L	L	L
9	H	H	L	L	L	L	L	L	L	M
10	M	H	H	L	L	L	L	M	M	M
11	L	L	L	M	M	M	H	L	L	L
12	H	L	L	L	L	L	L	L	L	L
13	M	M	L	L	L	L	L	M	M	L
14	L	L	M	M	H	L	M	M	L	M
15	L	L	M	H	H	M	L	L	L	L
16	H	H	H	H	H	L	L	L	L	M

In another case it has been observed when Higher Interdependency Between the Teams (PR1), Team Recognition for Every Sprint (PR2) are High, Growth in Team Size or Development Site (PR3), Lower Initial Velocity (PR4), Difficult to Execute Fixed Price Projects(PR5), Unavailability of Business Analyst (PR6), Lack of Uniformity in Multisite Team's Capabilities (PR7), The Emergence of excessive Competition between Teams (PR8) and the Emergence of excessive Competition between Scrum Masters and Product Owners (PR9) are Low than Scrum Project Risk factor (PRR) is Medium. Similarly, in another case it has been observed when Higher Interdependency Between the Teams (PR1), Team Recognition for Every Sprint (PR2), Growth in Team Size or Development Site (PR3), Lower Initial Velocity (PR4), Difficult to Execute Fixed Price Projects(PR5) are High, Unavailability of Business Analyst (PR6), Lack of Uniformity in Multisite Team's Capabilities (PR7), The Emergence of excessive Competition between Teams (PR8) and

The Emergence of excessive Competition between Scrum Masters and Product Owners (PR9) are Low than Scrum Project Risk factor (PRR) is Medium. We have created 16 rules from different allied literature and questionnaire which are based on the tacit knowledge of Scrum Method under agile software project development professionals. In the given Table-2 which shows 9 Scrum project Risk 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 [8]. Finally we will try to aggregate the qualitative value of rule base using the centroid method in fuzzy logic to convert the values in quantitative form. For this we have used MATLAB FIS simulator.

FIGURE 3. SCRUM PROJECT RISK RULE BASE FIS EDITOR

These sub factors possess qualitative values and we can understand that with the help of qualitative values we cannot make any decision precisely. To overcome this problem I have developed the model for quantification of the sub factors.

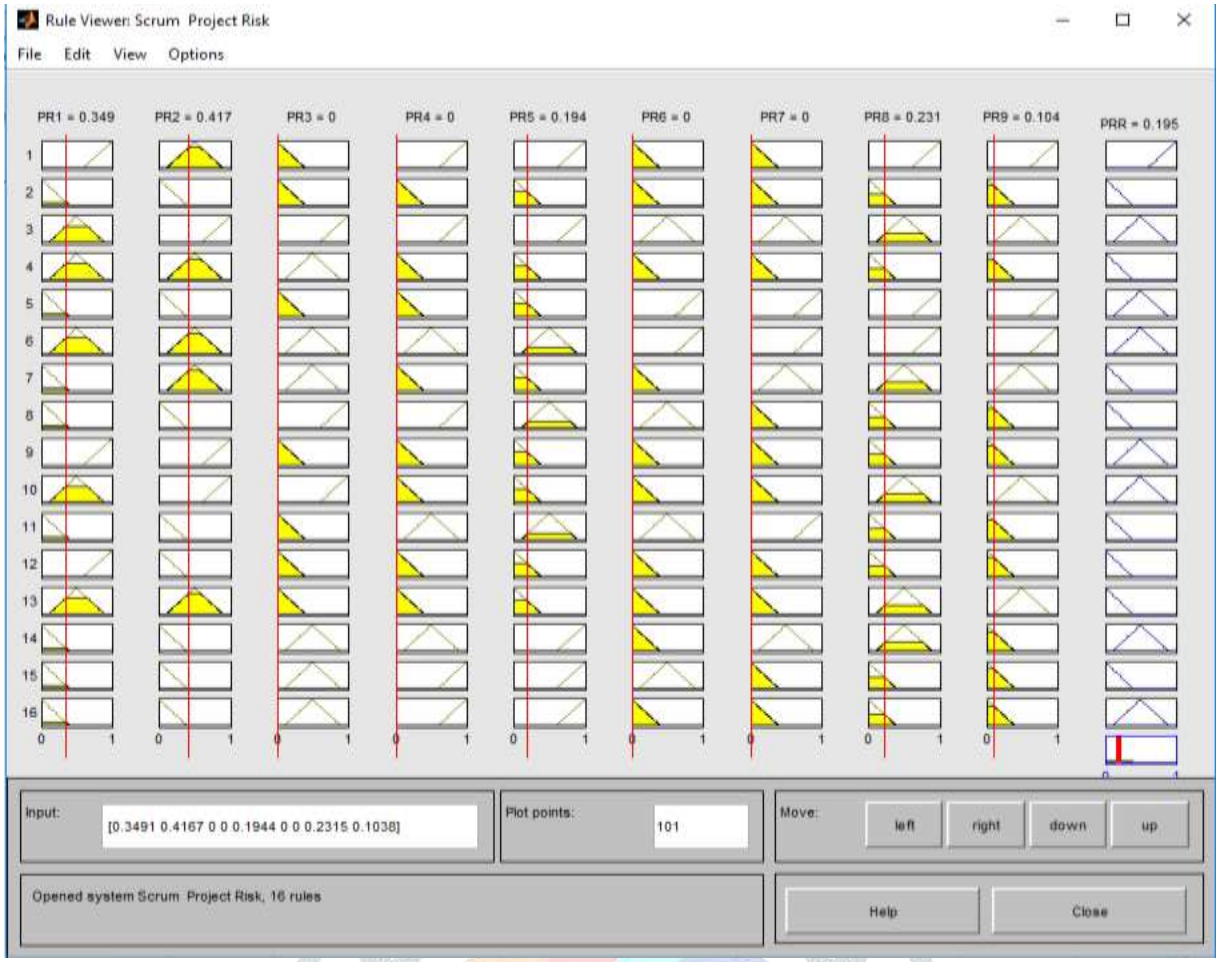

FIGURE 4. FUZZY INFERENCE SYSTEM RULE VIEWER

We have used the FIS Editor which manages high-level program issues: As the number of entries is too high, or the number of membership activities too large, it can also be difficult to analyze FIS using other GUI tools. The Member Activity Editor has been used to describe the conditions of all membership activities associated with each variable. The Rule Editor is for editing a list of rules that define system behavior. Rule Viewer is used for viewing, the crisp values of organisational factors and sub factors. We can find 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 based applied in the fuzzy inference editor. In the Rule Viewer when we slide the ruler and value of Higher Interdependency Between the Teams (PR1=0.349), Team Recognition for Every Sprint (PR2=0.417), Growth in Team Size or Development Site (PR3=0.0), Lower Initial Velocity (PR4=0.0), Difficult to Execute Fixed Price Projects(PR5=0.194), Unavailability of Business Analyst (PR6=0.0), Lack of Uniformity in Multisite Team's Capabilities (PR7=0.0), The Emergence of excessive Competition between Teams (PR8=0.231) and The Emergence of excessive Competition between Scrum Masters and Product Owners (PR9=0.104) are Low than Scrum Project Risk factor (PRR) is 0.195. In the Rule Viewer when we slide the ruler and value of Higher Interdependency Between the Teams (PR1=0.1545), Team Recognition for Every Sprint (PR2=0.0455), Growth in Team Size or Development Site (PR3=0.2455), Lower Initial Velocity (PR4=0.1545), Difficult to Execute Fixed Price Projects(PR5=0.1182), Unavailability of Business Analyst (PR6=0.3000), Lack of Uniformity in Multisite Team's Capabilities (PR7=0.1696), The Emergence of

excessive Competition between Teams (PR8=0.1696) and The Emergence of excessive Competition between Scrum Masters and Product Owners (PR9=0.1875) are Low than Scrum Project Risk factor (PRR) is 0.1740. In the Rule Viewer when we slide the ruler and value of Higher Interdependency Between the Teams (PR1=0.1545), Team Recognition for Every Sprint (PR2=0.1182), Growth in Team Size or Development Site (PR3=0.2818), Lower Initial Velocity (PR4=0.0000), Difficult to Execute Fixed Price Projects(PR5=0.0.10000), Unavailability of Business Analyst (PR6=0.1364), Lack of Uniformity in Multisite Team's Capabilities (PR7=0.0804), The Emergence of excessive Competition between Teams (PR8=0.0268) and The Emergence of excessive Competition between Scrum Masters and Product Owners (PR9=0.0268) are Low then Scrum Project Risk factor (PRR) is 0.1700.

DATA ANALYSIS: We collected the quantitative data from the MATLAB simulator. some samples are shown in given Table 4, with the help of this data sample we can understand the impact of sub factors precisely to estimate or evaluate the scrum project risk. we have collected more than 400 crisp data records and set up the neural network training process using the MATLAB AI simulator. Finally AI Simulator pridicted the sensitivity of the scrum project risk sub factors. Table 5, shows the sensitivity of the sub factors and prioritization order. Risk prioritization order always helps in risk management process.

TABLE 4. SCRUM PROJECT RISK SUB-FACTORS QUANTITATIVE VALUE

S. No.	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PRR
1	0.6818	0.4455	0.9727	0.4273	0.5182	0.5909	0.4732	0.3839	0.3661	0.5000
2	0.6818	0.8091	0.9727	0.9182	0.8636	0.5909	0.4732	0.3839	0.3661	0.5000
3	0.2273	0.2455	0.1000	0.1909	0.1364	0.0000	0.7411	0.5804	0.7946	0.1950
4	0.2273	0.2455	0.1000	0.1909	0.0000	0.2818	0.7411	0.5804	0.7946	0.1950
5	1.0000	0.0000	0.0000	0.2091	0.0000	0.1545	0.0000	0.0000	0.0000	0.1550
6	0.7727	0.0000	0.0000	0.2091	0.0000	0.1545	0.0000	0.0000	0.0000	0.1570
7	0.5909	0.0000	0.0000	0.2091	0.0000	0.1545	0.0000	0.0000	0.0000	0.5000
8	0.5909	0.1545	0.4091	0.2091	0.0000	0.1545	0.0000	0.0000	0.0000	0.1840
9	0.5909	0.1545	0.4091	0.1000	0.3909	0.1545	0.0000	0.0000	0.0000	0.1950
10	0.7364	0.1545	0.1545	0.1000	0.3909	0.1545	0.0000	0.0000	0.0000	0.1950
11	0.7364	0.1545	0.0000	0.0000	0.0000	0.1545	0.0000	0.0000	0.0000	0.1650
12	0.0000	0.1545	0.0000	0.1909	0.0000	0.1545	0.0000	0.0000	0.0000	0.1510
13	0.0000	0.1545	0.0000	0.3364	0.0000	0.1545	0.0000	0.0000	0.0000	0.1820
14	0.0000	0.1545	0.0636	0.3364	0.0000	0.1545	0.0000	0.0000	0.0000	0.1820
15	0.1727	0.2636	0.0636	0.3364	0.0000	0.1545	0.0000	0.0000	0.0000	0.1820
16	0.2636	0.0000	0.1727	0.0000	0.1909	0.2455	0.1875	0.1875	0.0982	0.1660
17	0.1364	0.1545	0.1727	0.0000	0.0000	0.0000	0.0000	0.0982	0.0982	0.1430

18	0.2636	0.0000	0.1727	0.0000	0.0000	0.0000	0.0000	0.0982	0.0982	0.1660
19	0.1364	0.1545	0.1727	0.0000	0.0000	0.0000	0.3304	0.2946	0.1696	0.1810
20	0.2273	0.5182	0.8091	0.2455	0.1000	0.0000	0.0982	0.2589	0.0000	0.1760

TABLE 5. SCRUM PROJECT RISK SUB FACTORS SENSITIVITY ANALYSIS

S. No.	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PR8	PR9	PRR
1	1	0	0	0	0	0	0	0	0	.172
2	0	1	0	0	0	0	0	0	0	.202
3	0	0	1	0	0	0	0	0	0	.143
4	0	0	0	1	0	0	0	0	0	.131
5	0	0	0	0	1	0	0	0	0	.346
6	0	0	0	0	0	1	0	0	0	.239
7	0	0	0	0	0	0	1	0	0	.202
8	0	0	0	0	0	0	0	1	0	.143
9	0	0	0	0	0	0	0	0	1	.294

SENSITIVITY PRIORITIZATION OF SUB FACTORS:

PR5 > PR9 > PR8 > PR6 > PR2 > PR7 > PR1 > PR3 > PR4 > PR3

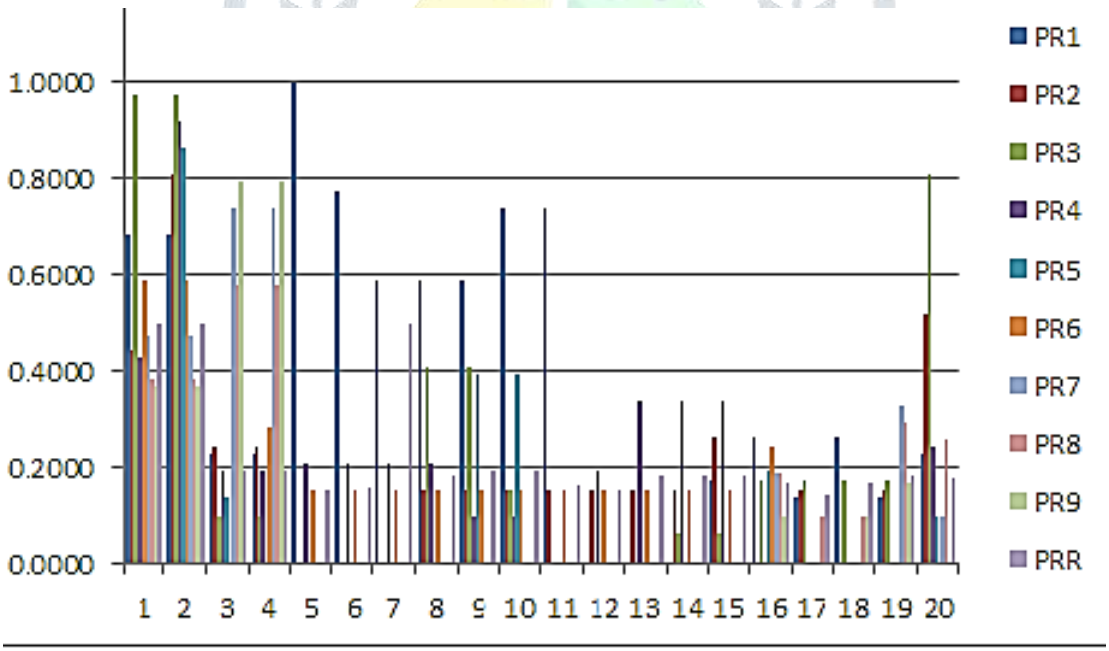

Figure 5. Scrum Project risk sub factors and Project risk evaluation

CONCLUSION: In this research paper 9 scrum project risk subfactors identified and qualitative value of the subfactors have been transformed into quantitative form which would be very beneficial for the precise risk prediction. The sub factor PR5 which is 'Difficult to Execute Fixed Price Projects' is more sensitive. As we

know about the agile software development process always welcoming the change in customer requirement therefore fixed price project is a major constraint for agile development project. In future more risk sub factors can be identified and few more rule base can be enhanced due to rapid change in the hardware and software technology.

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