IDENTIFICATION AND EVALUATION OF ORGANIZATIONAL FACTOR TO ENHANCE AGILITY IN AGILE SOFTWARE DEVELOPMENT PROCESS

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ABSTRACT: Agile practices are activities or actions that are used during software development to improve the quality and productivity of the resulting software. The few more sub factors which play an important role to enhance the agility of the organization have been identified. The impact of organizational sub factors on agile software development projects has been determined. The fuzzy inference system has been used to evaluate the quantitative values and hence to determine the sensitivity of the organizational sub factors and its role in enhancing the organizational agility.

KEYWORDS: AGILITY SUB FACTORS, QUALITATIVE VALUES, TRIANGULAR FUNCTION, FUZZY INFERENCE SYSTEM.

INTRODUCTION: Agile organizations are being tested for fast and ever-changing business environment and customers with full knowledge of continuous growing expectations in order to cut down on time and get the best resources as much as possible. During the development of any software, there are always some challenges that need to be addressed due to the uncertainty. This is because from the start of the developing business, it is difficult to say whether the needs of the project are properly identified. It is also possible that the needs will change during development. Such problems can be resolved through the use of agile development methods and one of the reasons why many companies have announced the adoption of agile methods and try to enhance the agility in their organization. Agile-related professionals make strong and compelling claims about the benefits of using Agile [1][2][3]. Agile Software Development (ASD) provides a repetitive way for efficient and effective software development. Agile Software Development process contains a set of rules and regulations for self-organizing groups. In Software development, the promoter plays an important role in developing personal and technical skills. Motivation is an important factor in achieving the scope of a project by defining business objectives [5][9]. Quality analysis has been done to

achieve this goal. This systematic review of the literature will gather information available from the Motivation and the Demotivation. In ASD, due to its recurring behavior rate of failing projects is less than SDLC but when it comes to personal and technical skills, there is a need for motivation and demotivation factors which affect ASD[10][17]. These motivation and demotivation serve as the umbrella of activities throughout the project which is why there is a need to control factors of demotivation in order to maximize motivation features thereafter. The effective management is the key to the success of a project and can reduce the failure rate by up to 70% with reference to their total cost. ASD has many mechanisms that follow a single agile manifesto of continuous development throughout the life cycle. From 10 to 15 years ago, ASD showed significant progress in the software industry and surpassed the existing SDLC model due to its success stories which is why there is a revival of the agile industry worldwide. In upcoming time it will be an acceptable method in its flexible ambience. Existing texts show, that is, they do not have the details of formal ASD literature and there is a need for formal literature reviews to fill this gap. This study combines existing factors of motivation and demotivation to create a detailed list. Data is available in a distributed format and needs to be collected for systematic review [8][12]. In the early 1990s, several lightweight software process models introduced such as XP, Scrum, and FDD. As software features have become the competitive edge of products, the ability to quickly launch and test relevant features has become an important skill. In New Product development (NPD) added projects; these agile methods are now widely used. Initially, older methods emerged to meet the needs of smaller organization and flexible software teams. But now a day, for major projects and organizations become more interested in implementing it, there are a number of efforts to develop effective methods, such as Industrial more used methods XP and Scrum. However, in large-scale product development projects, initial predictions of agile approaches are not met, and additional requirements and organizational conditions must be met in order to achieve the full benefits of agility. The development of successful software Process improvement (SPI) in such areas of the NPD requires a broader understanding of agile organizations and their permissive features as well as factors that prevent large companies from achieving agility[4][7]. After the introductory section we have described literature review in section 2 which reveals about the work details which have been done so for in the field of agile software organization agility. Section 3; describe the research procedure and implementation of existing knowledge base in the said area. Section 4, describe about the crisp data collected from the rule viewer. In this section we applied the test for sensitivity analysis of the sub factors. Finally section 5 gives the concluding remark and future research direction.

LITERATURE REVIEW: There is no single definition of universal agility. The concept was introduced in agile production by Preiss in 2005. The agile production books and literature offer many possible explanations and definition with respect to different in scope and viewing. However, all definitions often include basic concepts of agility and flexibility in response to changes in changing market conditions. The fact that the definitions of agility vary widely indicates that the concept is complex and multi- dimensional (that is, not just about responding to changes). For the investigation purpose, we have taken the definition of Conboy and

Fitzgerald [2][4]. The term 'agility' was accepted in the software development industry independently. Now a day, many agile software process models and methodologies for it are available with proper documentation. And almost all models share some of the common principle; even there is no common way to define agile software processes. Therefore, it is not clear method to compare different methodologies. This question has been answered elsewhere. One type of agility method is proposed by Schwaber in 2001. All software problems of project cannot be solved by software procedures [21]. Agile software process models have different assumptions and requirements, based on the project location and features. Due to these foundations, many companies must first reconsider their organization and management principles so that they can successfully adopt any of the agile software solutions [14]. As, for example, Cockburn has shown, different software projects have their own agile limitations in different areas. The main problem is to match the software process with the actual requirements, and make changes to the system where necessary. This, of course, it cannot be practically possible without a proper understanding of a person's business, product, and organization. The organization should support the agility environment. For example, the Industrial XP proposes a test of suitability for this Industrial XP 2005. Pikkarainen and Passoja learned how to evaluate the effectiveness of agile software development processes [10][11][12]. Agility focuses more on the project level software process in software development. But in manufacturing area, the role of agility is in 3 dimensions.

(i) Agile Product
(ii) Agile Competitive Environment
(iii) Agile Business.

It is noteworthy, that in Agile manufacturing it is the noble idea of making the process faster without thinking that business and product can make very little sense. Reversing this idea leads to the conclusion that thinking about a business with an organization that allows for product strength and speed can be a huge benefit to any agile software company. Obviously, if we want the whole company should work in an agile way then it is not sufficient to focus only on the team and the size of the project level, there is a need of typical application of agile software methodologies. For example Sharifi and Zhang proposed a methodology and framework for agility acquisition in software development industries. The company should first understand how agile it is right now, and how agile it needs to (agile drivers). The necessary agility skills (e.g., responsiveness, flexibility) can be acquired by different providers from organization, technology, people, and innovation [14][15][16].

RESEARCH DISCUSSION: In this research study we have idendified eight subfactors of agile organization which plays important role to enhance agility with the help of allied leterature review, questionare, interviews etc. During research studies various sub factors like Strategy, Technology, People , Tasks, Informal organization, Size, Environment, Managerial perceptions, team distrubution, management support, risk management, leadership, culture, co-located teams, organization maturity and other factors have been observed and we are discussing in this research study only eight subfactors of organizational factor after

finding that these subfactors plays important role to enhance the organizational agility. Table-1 shows the subfactors name and its abbriviation[18][19][20].

TABLE 1. ORGANIZATIONAL FACTORS FOR AGILITY ENHANCEMENT

S. No.	FACTORS	ABBREVIATION
1	Management Support	OF1
2	Team Distribution	OF2
3	Facility with Agile Style Work Environment	OF3
4	Leadership	OF4
5	Risk Management	OF5
6	Organization Maturity	OF6
7	Co-located Teams	OF7
8	Culture	OF8

(1) **Management Support:** This is very crucial subfactor of organisation. If management support is high then certainly agility is expected to become high. Proper management support will enhance the agility.

(2) **Team Distribution:** This is another important factor which effects agility. It has following benefits : It Reduces operating costs. It helps in proximity to customers or internal business units. It helps in accessing to a wide range of people and special skills. But draw back can also be seen at higher ends like team distrubution losses of automatic face-to-face contact and distance to customers or internal business units. It reduces the time zones for time interaction. Proper team distribution helps in agility enhancement [6].

(3) **Facility with Agile Style Work Environment:** A Agile workplace is a type of workplace designed for complete flexibility. Unlike the traditional office, an agile workplace encourages employees to move around freely in the office, using any space that suits their purpose at the time.

(4) **Leadership:** Agile leadership is a management style that incorporates the application of Agile software development principles into running teams. This plays an import role in agility enhancement.

(5) **Risk Management:** For any project better risk management gives strength in productivity. 'Risk' is any unexpected situation that may affect the customer, processes, technologies, team and resources involved in the project.

(6) **Organization Maturity:** Matuarity of an orgnaization is outstanding factor which is responsible for agility enhancement.

(7) **Co-located Teams:** Co-loacated groups consist of members working in the same local area, preferably in the same building, under ideal conditions in one room (group space). Actually it enhances communication and improves reliability which promotes trust and mutual respect [13].

(8) **Culture:** The Agile culture is one that favors collaboration and cooperation and undermines democracy, governance and bureaucracy. We find this also for agility enhancement factor.

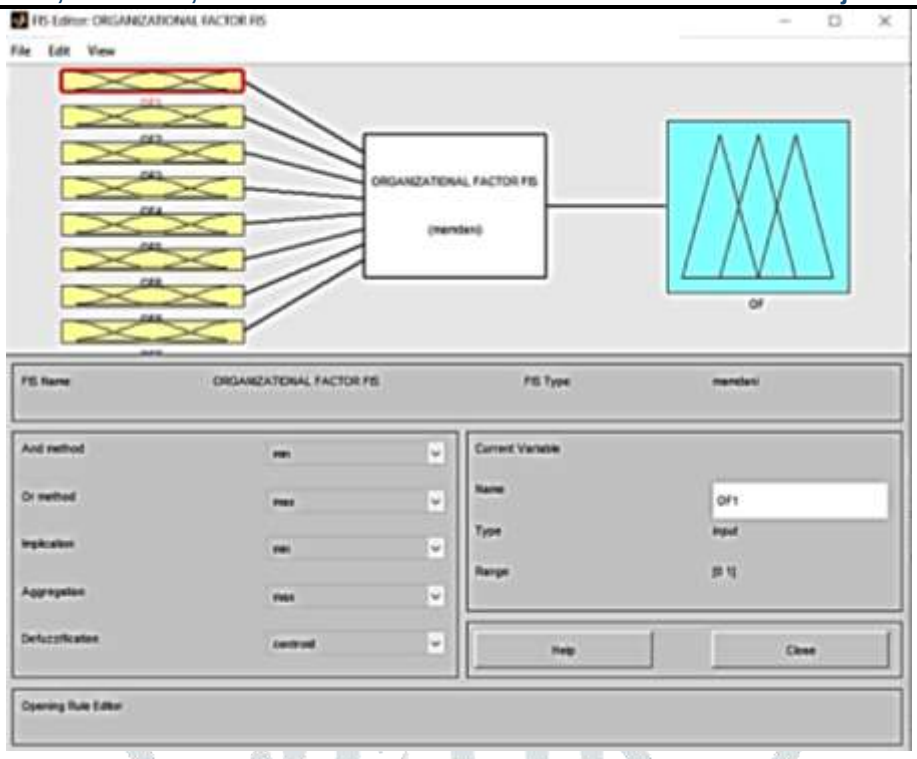

FIGURE 1. ORGANIZATIONAL AGILITY ENHANCEMENT MODEL USING FIS

The proposed model can be seen in Figure 1 in which 8 subfactors and identified rule base have been applied in Fuzzy Inference System using **MATLAB** simulator. In this study, for the fuzzification and defuzzification process, we have chosen M*amdani* method and for the association of subfactors in rule base AND method is preferred. We have applied centroid method for the aggregation of rules in FIS editor.

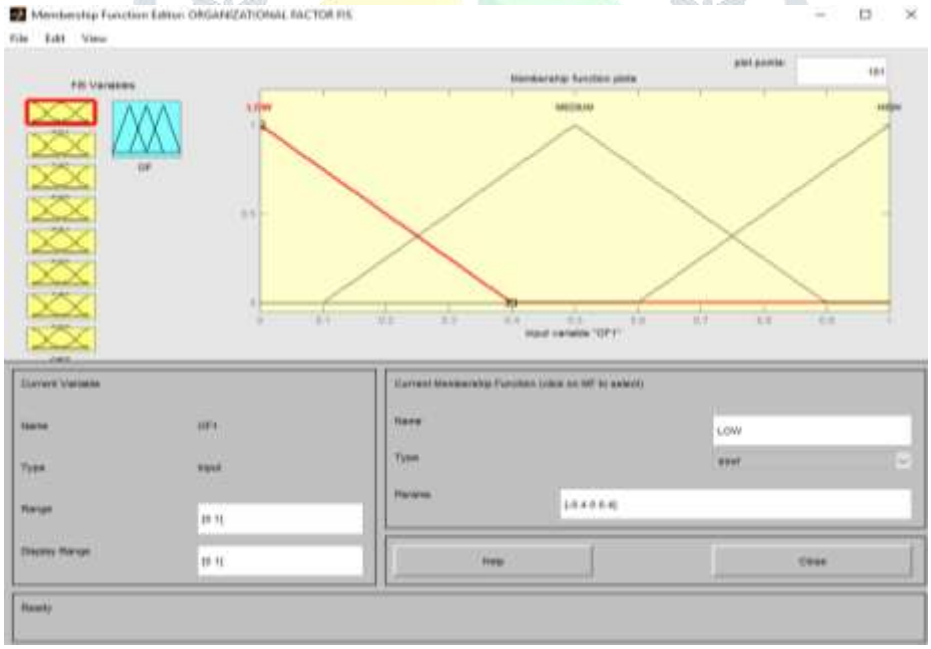

FIGURE 2. TRIANGULAR FUNCTION FOR FUZZIFICATION AND DE-FUZZIFICATION PROCESS

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

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 band that is extreme low, low, medium low, medium, medium high and extreme high. We have formulated 17 rules on the basis of some case studies and it has been observed that when Management support (OF1), Team distribution(OF2) are High, Facility with agile style work environment (OF3), Leadership (OF4) and Risk management (OF5) are Medium, Organization maturity (OF6), Co-located teams (OF7) and Culture (OF8) are High then organization factor (OF) goes High. In another case it has been observed when Management support (OF1) and Team Distribution (OF2) are Low, Facility with agile style work environment (OF3), Leadership (OF4), Risk management (OF5), Organization maturity (OF6), Co-located teams (OF7) and Culture(OF8) are Medium then organization factor (OF) goes Medium. When Management support (OF1) and Team Distribution (OF2) are Medium, Facility with agile style work environment (OF3), Leadership (OF4), Risk management (OF5), Organization maturity (OF6) ,Co-located teams (OF7), Culture (OF8) are High then organization factor (OF) goes High.

TABLE 3. RULE BASE ORGANIZATIONAL FACTORS FOR AGILITY ENHANCEMENT

S. No.	OF1	OF2	OF3	OF4	OF5	OF6	OF7	OF8	OF
1	H	H	M	M	M	H	H	H	H
2	L	L	M	H	M	H	L	L	L
3	M	M	L	M	M	H	H	M	M
4	H	H	H	H	M	M	L	L	M
5	M	M	M	H	H	H	L	M	H
6	H	L	L	L	M	L	M	L	L
7	L	L	M	M	M	M	M	M	M
8	H	H	H	H	H	M	L	H	H
9	M	M	H	H	H	H	H	H	H
10	L	H	H	H	L	H	H	H	L
11	M	L	M	M	M	L	M	M	M
12	H	M	M	M	L	M	M	M	M
13	M	M	H	H	H	M	L	L	H
14	L	L	L	M	M	M	M	H	M
15	H	L	M	H	L	H	M	M	M
16	H	H	H	H	H	H	H	H	H
17	L	L	L	L	L	L	L	L	L

In the given Table 3 which shows 8 organizational 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 Figure 3.

FIGURE 3. RULE BASE EDITOR OF ORGANIZATIONAL SUBFACTORS

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 we have developed the model for quantification of the sub factors [11]. 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 Rule Editor is 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.

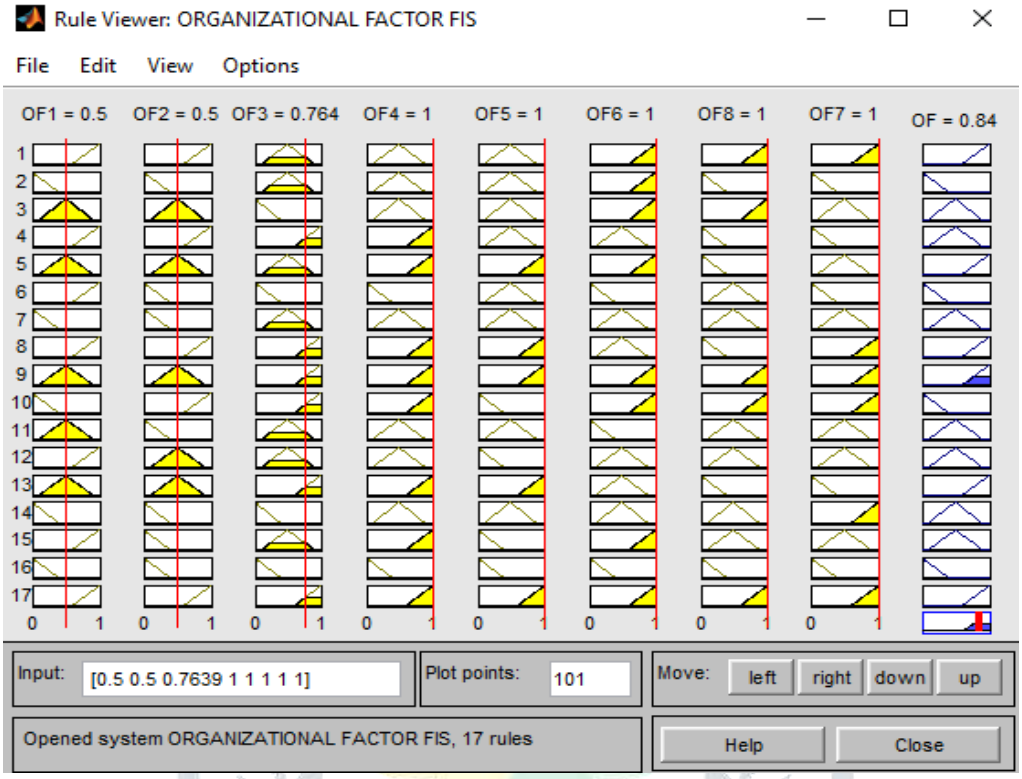

FIGURE 4. RULE VIEWER OF ORGANIZATIONAL SUBFACTORS

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 base applied in the fuzzy inference editor. In the Rule Viewer when we slide the ruler and value of Management Support (OF1=.5) and Team Distribution (OF2=0.5), Facility with agile style work environment (OF3=0.764), Leadership (OF4=1), Risk management (OF5=1), Organization maturity (OF6=1) Co-located teams (OF7=1), Culture (OF8=1) then organization factor (OF) =0.84. In other case in the Rule Viewer when the value of Management Support (OF1=.3) and Team Distribution (OF2=0.2059), Facility with agile style work environment (OF3=0.1667), Leadership (OF4=0), Risk management (OF5=0), Organization maturity (OF6=0) Co-located teams (OF7=0), Culture (OF8=0) then organization factor (OF) =0.1540. In other case in the Rule Viewer when the value of Management Support (OF1=.89) and Team Distribution (OF2=0.3235), Facility with agile style work environment (OF3=0.1), Leadership (OF4=1), Risk management (OF5=.85), Organization maturity (OF6=1) Co-located teams (OF7=1), Culture (OF8=1) then organization factor (OF) =0.8050.

DATA ANALYSIS:

TABLE 4. CRISP VALUES OF ORGANIZATIONAL AGILITY ENHANCEMENT SUBFACTORS

S. No.	OF1	OF2	OF3	OF4	OF5	OF6	OF7	OF8	OF
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1300
2	0.1100	0.0882	0.0294	0.1500	0.0100	0.1300	0.0000	0.0294	0.1440
3	0.1700	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1480
4	0.0300	0.2059	0.1667	0.0000	0.0000	0.0000	0.0000	0.0000	0.1540
5	0.2700	0.2451	0.1863	0.6700	0.0000	0.7900	0.0300	0.2059	0.5000
6	0.8300	0.6176	0.8529	0.3300	0.2900	0.6500	0.8500	0.8137	0.5240
7	0.6500	0.8137	0.2059	0.6700	0.3300	0.7100	0.9700	0.6373	0.5300
8	0.7500	0.6176	0.3431	0.3300	0.5900	0.6300	1.0000	0.6373	0.5360
9	0.1100	0.1667	0.2059	0.1500	0.0100	0.1300	0.1500	0.0294	0.5400
10	0.8900	0.3235	1.0000	1.0000	1.0000	0.8500	1.0000	1.0000	0.8050
11	0.4100	0.8922	0.8333	0.9300	0.8900	0.8900	1.0000	0.7353	0.8050
12	1.0000	0.8725	0.6961	0.5300	0.3900	0.9100	1.0000	0.6569	0.8160
13	1.0000	1.0000	1.0000	1.0000	1.0000	0.6700	1.0000	1.0000	0.8190
14	0.7700	0.8137	0.6176	0.6700	1.0000	1.0000	0.2300	0.6373	0.8190
15	0.8900	0.8922	0.8333	0.9300	0.8900	0.8900	1.0000	1.0000	0.8530
16	0.6100	0.5000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8620
17	0.9700	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8690
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8700
19	0.2300	0.3235	0.0882	0.0900	0.3100	0.2500	0.0000	0.2451	0.1790
20	0.0300	0.1078	0.2843	0.2100	0.3300	0.0000	0.0000	0.0000	0.1810

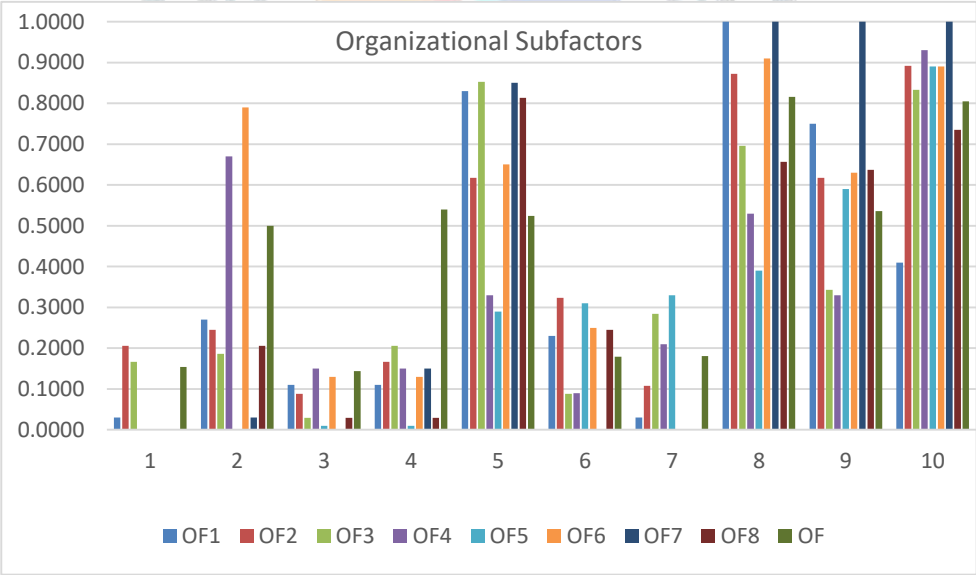

FIGURE 5 : EVALUATION OF ORGANISATIONAL SUBFACTORS

Figure 5 shows agility enhancement subfactors strength in which we can see that subfactor OF1 (Management Support) has more strength (value =.319) than others where as OF2 (Team Distribution) has lowest strength i.e. (value=.211) which is described in detail with the help of range sensitivitiy analysis using MATLAB simulator.

SENSITIVITY ANALYSIS: we have used range sensitivity analysis to find the sensitivity of the agile organization subfactors. In Figure 4, we can see the MATLAB rule viewer, To find out the most sensitive sub factor, we keep the value of seven subfactors at extreme low (0) and one subfactor whose sensitivity is to be detected, we keep it at extreme high (1) and finally we observe the sensitivity result. The result of sensitivity analysis we can see in given Table 5. we found in this analysis that subfactor OF1 (Management Support) is more sensitive than rest seven subfactors. The priority order of the sensitivity of subfactors are shown in given Table 5.

TABLE 5. SENSITIVITY ANALYSIS OF ORGANIZATIONAL SUB FACTORS

S. No.	OF1	OF2	OF3	OF4	OF5	OF6	OF7	OF8	OF
1	1	0	0	0	0	0	0	0	0.319
2	0	1	0	0	0	0	0	0	0.211
3	0	0	1	0	0	0	0	0	0.311
4	0	0	0	1	0	0	0	0	0.297
5	0	0	0	0	1	0	0	0	0.293
6	0	0	0	0	0	1	0	0	0.289
7	0	0	0	0	0	0	1	0	0.290
8	0	0	0	0	0	0	0	1	0.257

Subfactors Sensitivity Order: OF1 > OF3 > OF4 > OF4 > OF5 > OF7 > OF8 > OF2

CONCLUSION: This research reveals about the agility subfactors which plays major role in enhancing organizational agility. Using the range sensitivity analysis it has been observed that 'Management Support'sub factor is very sensitive and 'Facility with agile style work environment' is slightly less sensitive than 'Management Support'. it can be verified from different studies that 'Management Support' and 'Facility with agile style work environment' are highly expected than other factors to manage the agile software project efficiently and enhancing the organizations agility too. In this research area several research possibilities are ahead because of rapid changing of software and harware technology. In future in this research work few more subfactors can be identified and few more rule base can be enhanced.

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