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Stakeholder Prioritization in Requirement Engineering Process: A Case Study on School Management System

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Abstract Requirement elicitation is one of significant part of software engineering activity. It is very difficult to develop successful software without involvement of the quality stakeholder from the client side. Stakeholder prioritization is one of the indispensable processes in requirements engineering. When a project commences, there might be many stakeholders but minority of them would be the key person to collect software requirement. Now the question is among the stakeholder whose requirement is got the priority and based on what. After identifying the all stakeholders for a specific system, they may be prioritized in a convenient way which is stakeholder prioritization. There are common problems in the requirement phase like requirement overflow, insufficient stakeholder input, and wrong prioritization of requirement. Although, there are some techniques available for prioritizing the selected stakeholders but existing processes hold so many limitations and not adequate for all system. For that reason, existing processes are not sufficient to set the selected stakeholders' priority properly. The research study has been performed for offering a systematic way of stakeholder prioritization. We proposed a new approach which is based on 'fuzzy logic' for sorting the key stakeholders. It is essential to construct a model that does with some criteria, which are based on stakeholder's conducts considering a project for a specific organization. The parameters of those criteria will be filled up by numeric values, which will be organized by viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire, making discussion with all the individual stakeholders and so forth. As a result, a sorted list of stakeholders will be the output that is the desired stakeholders' prioritization list, where the technique of 'fuzzy expert system' is applied. Besides, a case study is gone through on school management system based on the proposed framework that provided for making a self- judgment on our current research paper of stakeholder prioritization process.

Keywords Stakeholder, Stakeholder Identification, Stakeholder Prioritization, Stakeholder Prioritization Model

1. Introduction

Requirements engineering is one of the most important part of software development life cycle. It is the stage where user and business needs of a system are identified and captured[1]. During this process, the stakeholders of the proposed project are identified because they are the key terms for collecting the requirements. Software requirement engineering process is largely depends on several stakeholders. Selecting the appropriate stakeholders from the right subject at the right time is one of the major factors of software success[2]. So stakeholder analysis is one of the critical issues of requirements engineering process.

A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives[3]. In an organization, there might be some stakeholders who have the power of making decisions about the project. This kind of stakeholders should be given on extra priority so that the involvement of key stakeholder on the project can be ensured.

Stakeholder prioritization is an important as stakeholder identification. When a project commences, there are many stakeholders who desired to be involved in the process[1]. But, all of them may not be essential for the project or may not concern as a key stakeholder. Whether, prioritization the key stakeholder is treated as a smart movement on the requirements engineering process.' Stakesource 2.0 prioritizes requirements using the stakeholders' rating on the requirements and their influence in the project[4].

This paper illustrates a framework based on 'fuzzy expert system' for prioritizing the different stakeholders. The mechanism of prioritization will be done by some criteria-designation, experience, influence, and so forth-which values will be filled up by viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire and so forth. The values of different criteria will be put into a table. Furthermore, the 'fuzzy logic' will be used to point out the best stakeholder so that the stakeholder

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can be sorted according to their parameters' values, which will be the desired result.

2. Background

Requirement engineering is the foundation of software development life cycle. Identifying, analyzing, specifying, managing, verifying and validating the system's requirements are the main purpose of requirements engineering. During the development of a project, the requirements are collected from the different stakeholders, so the initial stage of requirements engineering process is to understand the concept of stakeholder. The quality of the software depends on well-documented requirements. Moreover, missing the exact requirements may cause the software failure. The requirements engineering process must be done in a way where all the right stakeholders' involvements are ensured. But, yet stakeholder prioritization is one of the most critical issues. The existing system of stakeholder prioritization is not satisfactory to provide a comprehensive way. As a result the successful project submission is still being a risk.

A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives[3]. Stakeholder can be anyone who has to take action for an organization or who has to be affected by the project. These kinds of definition are accepted in everywhere. But, yet it is not resourceful enough to sort out the stakeholder with their priority. For example, by using the term affect or affected anyone can easily understand who will be the stakeholder. But, it is too much difficult to find out who will be the right stakeholder for the project.

Professor Freeman proposed an initial division of interest groups of stakeholder. Such as Primary: those who are directly, significantly or potentially affected by the activities of the organization. Secondary: those indirectly affected or for whom the impact is not that relevant. This division is accepted all over the world. But there is no significant way of determining the direct and indirect effect of every stakeholder. A second way to prioritize interest groups consists in dividing them into three categories: 1. Key: those who are essential to the survival of the company. 2. Strategic: those associated with relevant threats or opportunities.3. Environment: those who are not included in any of the other two[3]. This method does not address how stakeholders are identified in remote regions despite acknowledging that locality and culture typically have an impact on a software product.

Mitchell et al. (1997) said that Stakeholder priority can be set by defining some attributes such as power, legitimacy and urgency. Stakeholders have *power* when they can influence other parties to make decisions the party would not have otherwise made. *Legitimacy* is determined by whether the stakeholder has a legal, moral, or presumed claim that can influence the organization's behavior, direction, process or outcome. *Urgency* exists under two conditions: "(1) when a relationship or claim is of a time sensitive nature and (2) when that relationship or claim is important or critical to the stakeholder[5]. The model of Mitchell would be more appropriate for stakeholder prioritization if they describe how to analyze the each attributes. Such as they define the each attributes (power, legitimacy and urgency) but there is no description of how to measure the influence, behavior, direction and relationship etc. of those attributes.

Individual stakeholders can be grouped loosely into the following four categories, with outreach strategies that are unique to each: High-Influence Challengers: Outreach efforts should focus on converting these individuals to champions. Failing that, plan countermeasures that could help to neutralize any actions they might take that could potentially harm or derail the program. High-Influence Champions: Proactively leverage the positive energy from these individuals to further program objectives and to build a strong foundation of support. Low-Influence Challengers: Maintain awareness of any actions that could potentially harm the program, but put less energy into converting these challengers to champions. Low-Influence Champions: Ensure that positive relationships are maintained, but put less energy into further cultivating these champions[6]. This prioritization method fails to appropriately structure the data for stakeholder value. This problem is often compounded by a failure to handle multiple stakeholder view points.

Projects have constraints which hinder project managers to include all possible stakeholders into a project. A kind of sorting process has to be established where certain aspects of the stakeholders enable them to be on top of the list. The sorting is called prioritization. Interpersonal skills are important to ensure an effective requirement engineering process[7, 8, 9]. The skills therefore can be used as the final measures to qualify the selected stakeholders as the best possible participant. Some possible prioritization techniques that can be adopted include the ones that are normally employed in prioritizing requirements such as Analytical Hierarchy Process (AHP)[10], Case-Based Ranking[11] and Hierarchical Cumulative Voting[12]. Existing stakeholder prioritization methods require substantial efforts from the requirement engineering when there are many stakeholders and these methods to identify and prioritize stakeholders do not scale well to large project.

Stakeholders normally have different concerns, objectives and responsibilities. When multiple stakeholders participate in a discussion, requirements often conflict. But yet there concept is unclear and proper prioritization process is still being a challenging part. So selecting the best stakeholder with a conceptual and understandable method is so much needed in requirements engineering. The method should be clear in concept and must be described each individual way of selecting and prioritizing the different stakeholders.

3. Research Strategy

In previous chapter, the importance for a new method is mentioned to prioritize stakeholders in large-scale software projects. It is necessary to show that a method that will use some criteria which are based on stakeholder behaviors considering a specific organization and 'fuzzy logic' can be used to prioritize stakeholders for a specific system. The strategy in this work is divided into four parts:

- Select a software project and study the project to identify lists of stakeholders for a specific organization.
- Build a framework which will help to prioritize stakeholders.
- Develop a method that will use 'fuzzy logic' for prioritizing the selected stakeholders.
- Develop a software tool that supports the above method; apply it to real projects by having practitioners use it in their projects.

At first, by selecting a project for a specific organization will nominate a list of stakeholder. Stakeholders can be discrete individuals, corporate, or collective social units, such as employees within a department, departments within a corporation, and private companies in a city[13]. Next, after organizing a list of stakeholders, a visit has to perform to make a survey for setting the stakeholders' prioritization. By viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire, making discussion with all the individual stakeholders and so forth, the prioritization's model will be filled up with value putting. Then, relational groups will make among those criteria which are related with each other by verbal meaning for a specific organization. According to the 'fuzzy logic', the union and intersection operation will be performed among the relational groups. Finally, a sorted list can be made based on stakeholders' values. According to these values, priority can be set among those stakeholders selected to your proposed system.

The analysis was performed on previous background. The review was based on articles concerning stakeholders' prioritization in the domain of requirement engineering that were published within several years. The articles searched through the online. The searching covered both journal and proceeding articles. There were about fifty articles found. However, about fifteen articles were chosen to be analyzed because they suited best with the interest of this study.

4. A New Approach for Prioritizing Stakeholder

Software development life cycle largely depends of several stakeholders as they provide the potential requirements for a specific project. During the starting point of a project, there might be many stakeholders but every one of them would not be essential for the project or there might be someone who has some extra impact on the project. These kinds of stakeholders must be sorted to set their priority for successfully designing right requirements for the system. Software development team may experience many problems during prioritizing the all possible stakeholders to the project. This paper will offer a framework, based on 'fuzzy logic', which helps to prioritize the stakeholder.

To prioritize the selected stakeholders, we propose a new approach which contains some criteria (**Table 1:** Stakeholder Prioritization Model) - designation, experience, interpersonal relationship, power, domain knowledge, technology skill, influence, interest, did you use like it, how much efficient and goal. Initially, the parameters of those criteria will be measured by viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire, making discussion with all the individual stakeholders and so forth.

Next, the values of those parameters will be filled up according to the Value Matrix's table. Then, the comparison will be performed between the criteria by following the 'fuzzy logic' for relationship with each other so that some groups can be formed by taking similar kinds of criteria for your proposed system. After that, each group will be examined by union and intersection operation. Union operation will performed for fetching the best result from similar kinds of criteria where only the highest value's criteria will be considered and the intersection operation will be performed for fetching the best result from all of the criteria. Moreover, taking the results from the both operation of those groups will put into another table for further intersection operation which will provide the best stakeholders' values.

Finally, according to the stakeholders' values, you can prioritize the selected stakeholders for a specific system. If more than one stakeholder's values represent same mark, you can consider the designation, the position according to specific organization, to set the priority of those stakeholders. We believe that after applying this framework, you can prioritize the selected stakeholders easily which will support you to gather right requirements of proposed system. By collecting potential requirements from prioritized stakeholders, you can design your large project successfully.

5. Stakeholder Prioritizing Criterion Analysis

Prioritizing the selected stakeholders of a specific organization, we define some criteria – designation according to the organization, experience within that organization, domain knowledge about overall business strategy, power to the proposed project, interest to the project, technology skill, possibility to be influenced or make influence to the system, using experience on this kind of system, overall goal about that project and relationship status with internal employees. The explanations of those criteria are given below:

Table 1. Stakeholder Prioritization Model

SL No.	Stakeholder Name	Designation	Experience	Interpersonal Relationship	Power	Domain Knowledge	Technology Skill	Influence	Interest	Did You Use Like It?	How Much Efficient?	Goal
Number of Stakeholder	Name of the person	Position of the person according the organization or official title	Years of working experience in this organization	Label of relationship among the internal employee	How much authority exert to the system?	State of overall business knowledge	Average knowledge about modern computing system	How much influence will exert or will be exerted?	How much eagerness to the system?	Have any experience on the current system?	The advantageous from the system	Expectation to the system

Table 2. Value Matrix

SL No.	Title	Value	Title	Value	Title	Value	Title	Value	Title	Value	Title	Value
1	Top Most	10	Absolutely High	10	Excellent	10	10Years	10	Exactly Match with Actual Requirement	10	Yes	10
2	Top Middle	9	Very High	9	Very Good	9	9Years	9	Related with Actual Requirement	5	No	0
3	Miserable Top	8	High	8	Good	8	8Years	8	Not Match with Actual Requirement	0		
4	Upper Middle	7	Moderate High	7	Quite Good	7	7Years	7				
5	Middle	6	Medium	6	Average	6	6Years	6				
6	Lower Middle	5	Moderate Low	5	Below Average	5	5Years	5				
7	Upper Lower	4	Poor	4	Not Bad	4	4Years	4				
8	Lower	3	Low	3	Bad	3	3Years	3				
9	Miserable Lower	2	Normal	2	Miserable Bad	2	2Years	2				
10	Most Lower	1	Very Low	1	Very Bad	1	1Year	1				

Designation: Designation means the official title that express position of employees according to a specific organization. First of all, you have to take into consideration which category's organization you are going to consider for your proposed system. After knowing the value of each position of the organization, you can create a grading structure where you can allot certain points to each grade and respectively you can place the job titles in that particular grade. Here, we pointed out some generic positions of an organization which are top most, top middle, miserable top, upper middle and so forth. According to these positions, we put some specific numeric values up to 10.

Experience: How long are you working for that organization? It's means the working duration of the selected stakeholder for a specific organization. You can collect comparatively better requirement from a more experience employee than a less experience employee. Here, we consider for up to10 years working duration. According to working duration, we set numeric values up to 10.

Interpersonal Relationship: Interpersonal relationship enables employees share ideas, brainstorm, cooperative, coordinated relationships and come up with decisions that one brain could not come up with. Interpersonal skills are important because it supports you interact with others and how you perceive others. Here, we try to measure the interpersonal relationship by high, medium, low and so on, and according to these parameters, we set numeric values up to 10.

Domain Knowledge: Domain knowledge is knowledge about the environment in which the target system operates. Domain knowledge refers to a broad-based understanding of a particular system. It is now becoming very important in the project management. It doesn't mean being an expert practitioner in the area in question; it only means having some fundamental knowledge of the area where you want to envelop your system. Measuring the domain knowledge, we consider some parameters like high, medium, low and so on.

Power: In the context of an organization, your personal power directly impacts your ability to influence change the requirements of a proposed system. Power refers to the possession of authority and influence over others. There are many sources of power such as authority, knowledge, skill, expertise, relationship, confidence, courage and etc. To measure the power, we set some parameters like high, medium, low as so on.

Technology Skill: The technological skill refers to ability accomplishing computer-related duties. It also refers the practical experience on a technology based organization which offers advance skill in the use of computer. Technological skill offers some special field like business modeling, database design, project management, IT architecture, IT security, messaging, data mining, web development, IT optimization, networking and so on. For stakeholder assessment success, we define some parameter as like high, medium, low, and so on.

Influence: Influence means that exert induce or effect on development of a project. Influence is being able to affect an action. If you can create, alter, inspire or change project's requirement, you have influenced them. Administrators hope to influence project team exerting decisions to meet their goals and services. To have influence, one must establish 4 criteria with those they hope to influence: trust, authority, the 'so what', and a connection. For stakeholder assessment success, we define some criteria as like high, medium, low, and so on.

Interest: Interest means the feeling of wanting to give your attention to the project or of wanting to be involved with and to discover more about the project. By confirming the level of interest about the desired project, we can understand that our proposed system is more or less amenity to clients. For stakeholder assessment success, we define some criteria as like high, medium, low, and so on.

Did You Use Like It? This term refers has any real life using experience similar to proposed system. By that term, you can understand that the weight of stakeholder's experience which is related to your system. For measuring of this criterion, we set Boolean expression as like yes or no and put numeric value up to 10.

How Much Efficient? Using this term, we can realize that proposed system is effective for stakeholders or not. Surveying stakeholders carrying this question, we can gather such kind of information which will help us for more effectively design the project. To measure this term, we apply some parameters as like good, average, bad, and so forth and according to these parameters, we set numeric values up to 10.

Goal: The term goal refers what are the expectations of stakeholders to the proposed system? A goal is not the same as the word 'want'. It's something, a person might like to think about from time to time, but he has no intention of trying to get one. From expectation of the stakeholders, we can realize that how much they appreciate to the proposed project? For example, if the expectation of any stakeholder meets our project's actual requirement which can be implementing, we set the value of that stakeholder by 10.

6. Value Matrix Analysis

To measure the stakeholders' values, we set some parameters so that you can easily prioritize your selected stakeholders for proposed system. To measure the designations' values, the parameters of positions will be noted according to the specific organization. Here, we set an example to help you for setting parameter-top most, top middle, miserable top, upper middle, middle, lower middle, upper lower, lower, miserable lower and most lower-of your desired organization's position. You can modify those parameters according to your organization. According to these parameters, we set values up to 10 so that you can easily measure the stakeholders' values.

Measuring the term experience, we consider 1 to 10 years based on working duration for a specific organization and

put numeric number 1 to 10 into the Value Matrix's table. Measuring the term how much efficient, we considered some parameters based on positive or negative approach such as excellent, very good, good, quite good, average, below average, not bad, bad, miserable and very bad, and put numeric number 1 to 10 into that table.

To compute the criterion goal, we defined three similar parameters as following - if stakeholders' expectation will directly match with actual requirement then we will set 10, if it's similar to original requirement, the value will be 5, and if it's not related to the actual requirement, the mark will be zero. To compute the criterion 'did you use like proposed system', we defined Boolean parameters as following- if any stakeholder is experienced using such type of system then we will set 10, and if the stakeholder did not use that kind of system then the mark will be zero. Others criteria will be measured by value matrix parameters such as absolutely high, very high, high, moderate high, medium, moderate low, poor, low, normal and very low. According to these parameters, we put marks up to 10. When you will make any survey then just follow this Value Matrix's table so that you can easily prioritize your selected stakeholders.

7. Fuzzy Operation

The following Fuzzy Operation's table (**Table 3:** Fuzzy Operation) represents the stakeholders' prioritization technique. Initially, after putting the parameters' values into prioritization model by surveying, you have to consider those kinds of criteria, similar to each other by verbal meaning, according to 'fuzzy logic' to make some groups. Analyzing the criteria will support you to make relationship among those groups.

8. A Case Study on School Management System

For the purpose of a real life experience on our thesis, a survey has been made on a school named 'Gouripur S.A High School, Daudkandi, and Comilla'. They want to implement a project which is based on school management. To gather the actual requirements, we visited that school physically. We tried to fetch the actual information by viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire, making discussion with all the individual stakeholders and so forth. During interview session, we experienced some problems. For example, same requirements are found from different stakeholders, which conflict us to specify the requirements. That's why; we need to be set the priority of those stakeholders so that we can get over from that kind of trouble. According to survey we put parameters' values to the prioritizations model and marking them based on Value Matrix's table (**Table 5:** Value Matrix with Values).

According to survey, we put parameters' values to the prioritization model and marked them based on Value Matrix's table. During the visiting time, we analyzed the position of the employees on that organization. We set the employee with their designation according to their organization to establish the position of specific stakeholders. Then the value is set into the table according to the stakeholders' designation of that organization and the range of the value is 1 to 10. 10 points put for the person who occupies the highest position of the organization and 1 put for the person who occupies the lowest position of the organization. For example, the 10 was marked with the Managing Committee of the school who is the top management position in 'Gouripur S.A High School, Daudkandi, Comilla' and 1 is for the student who is in the most bottom position. According to designation, we put values of other criteria which are marked based on the Value Matrix's table.

Table 3. Fuzzy Operation

No.	Group Wise Operation	Output	Final Output (completing intersection operation)	Comment
1	Influence U Power	Highest value will be preferred.	Common value of all criteria will be preferred.	If more than one value will similar then you can consider the designation to set the priority of those stakeholders.
2	Interest U Goal U How Much Effective?	Highest value will be preferred.		
3	Technology Skill U Did Use It?	Highest value will be preferred.		
4	Interpersonal Relationship U Experience	Highest value will be preferred.		
5	Domain Knowledge ∩ Designation	Common value will be preferred.		

Table 4. Stakeholder Prioritization Model with Values

SL No.	Stakeholder Name	Designation (Position)	Experience (years)	Interpersonal Relationship	Power	Domain Knowledge	Technology Skill	Influence	Interest	Did You Use Like It?	How Much Efficient?	Goal
01	Mohammad Hasem Sarker	Managing Committee(10)	4Years(4)	High(8)	Absolutely High(10) (10)	High(8)	Moderate High (7)	High(8)	Absolutely High(10)	No(0)	Excellent(10)	Not Exceed Deadline(10)
02	A.K.M Dellwar Hossain	Headmaster(9)	30Years(10)	Absolutely High(10)	Absolutely High(10) (10)	Absolutely High(10)	High(8)	Absolutely High(10)	Absolutely High(10)	No(0)	Very Good(9)	Reduce Cost(10)
03	Md.Selim Talokder	Assistant Headmaster (8)	7Years(7)	High(8)	High(8)	Absolutely High(10) (10)	Very High(9)	Very High(9)	Very High(9)	Yes(10)	Excellent(10)	Increase Productivity(5)
04	Mr.Saha-Alam	Senior Teacher(7)	20Years(10)	Moderate High(7)	Moderate High(7)	Very High(9)	Absolutely High (10)	Absolutely High(10)	Absolutely High(10)	No(0)	Average (6)	Ensure Quality(5)
05	Mrs.Tahamina Akter	Teacher(6)	5Years(5)	Medium (6)	Poor (5)	Medium (6)	Very High(9)	Medium (6)	High(8)	Yes(10)	Excellent(10)	Increase Performance(5)
06	Md.Monir Hossain	Demonstrator(5)	3Years(3)	Medium (6)	Normal (3)	Normal (3)	High(8)	Poor (5)	Moderate High(7)	Yes(10)	Good(8)	Easy to Use(5)
07	Ismail-Hossain	Librarian(4)	18Years(10)	Very High(9)	Not Bad(4)	Poor(5)	Poor (5)	High(8)	Moderate High(7)	Yes(10)	Excellent(10)	Easy to Use(5)
08	Komol Dev	Accountant(3)	20Years(10)	Absolutely High(10)	Normal (3)	Moderate High(7)	Medium (6)	High(8)	Very High(9)	No(0)	Excellent(10)	Easy to Use(5)
09	Kalo Sarker	Staff(2)	30Years(10)	Absolutely High(10)	Miserable (2)	Miserable (2)	Miserable (2)	Normal (3)	Very Low(1)	No(0)	Average (6)	Easy to Use(5)
10	Mansura Akter Sumi	Student(1)	4Years(4)	Medium(6)	Very Bad (1)	Very Bad (1)	Very High(9)	Poor (5)	Absolutely High(10) (10)	Yes(10)	Excellent(10)	Increase Performance(5)

Table 5. Value Matrix with Values

SL No.	Title	Value	Title	Value	Title	Value	Title	Value	Title	Value	Title	Value
1	Managing Committee	10	Absolutely High	10	Excellent	10	10Years↑	10	Exactly Match with Actual Requirement	10	Yes	10
2	Headmaster	9	Very High Very High	9	Very Good	9	9Years	9	Related with Actual Requirement	5	No	0
3	Assistant Headmaster	8	High	8	Good	8	8Years	8	Not Match with Actual Requirement	0		
4	Senior Teacher	7	Moderate High	7	Quite Good Quite Good	7	7Years	7				
5	Teacher	6	Medium	6	Average	6	6Years	6				
6	Demonstrator	5	Poor	5	Below Average	5	5Years	5				
7	Librarian	4	Low	4	Not Bad	4	4Years	4				
8	Accountant	3	Normal	3	Bad	3	3Years	3				
9	Staff	2	Low	2	Miserable	2	2Years	2				
10	Student	1	Very Low	1	Very Bad	1	1Year↓	1				

Table 6. Fuzzy Operation with Interest, Goal and How Much Effective

SL No.	IN= Interest	G= Goal	HME = How Much Effective?	B= IN U G U HME
1	10	10	10	10
2	10	10	9	10
3	9	5	10	10
4	10	5	6	10
5	8	5	10	10
6	7	5	8	8
7	9	5	10	10
8	8	5	10	10
9	7	5	6	7
10	7	5	10	10

Table 7. Fuzzy Operation with Interpersonal Relationship and Experience

SL No.	IR = Interpersonal Relationship	E= Experience	D= IR U E
1	8	4	8
2	10	10	10
3	8	7	8
4	7	10	10
5	6	5	6
6	6	3	6
7	9	10	10
8	10	10	10
9	10	1	10
10	6	4	6

Table 8. Fuzzy Operation with Power and Influence

SL No.	P = Power	I= Influence	E = P U I
1	10	8	10
2	10	10	10
3	8	9	9
4	7	10	10
5	5	6	6
6	3	5	5
7	4	8	8
8	3	8	8
9	2	3	3
10	1	5	5

Table 9. Fuzzy Operation with Technology Skill and Did You Use Like It

SL No.	TS= Technology Skill	DYU = Did You Use Like It?	C= TS U DYU
1	7	0	7
2	8	0	8
3	9	10	10
4	10	0	10
5	9	10	10
6	8	10	10
7	5	10	10
8	6	0	6
9	2	0	2
10	9	10	10

After setting the all parameters with their appropriate values, all of the criteria must be sorted to provide a sequence number of priorities stakeholders. After the complication of analyzing stakeholders' profiles, we found a table of ten stakeholders. The table contains all the parameter as like the Value Matrix's table with proper marking which is formed during the time of interview and consulting with the employee. In the process of sorting, similar kinds of criterion must be grouped with each other so that we can minimize the overall result by following the fuzzy inference rule.

Table 10. Fuzzy Operation with Designation and Domain Knowledge

SL No.	D =Designation	DK = Domain Knowledge	A= D ∩ DK
1	10	8	8
2	9	10	9
3	8	10	8
4	7	9	7
5	6	6	6
6	5	3	3
7	4	5	4
8	3	7	3
9	2	2	2
10	1	1	1

Table 11. Setting Prioritization

SL No.	A	B	C	D	E	R = A ∩ B ∩ C ∩ D ∩ E
1	8	10	7	8	10	7(3)
2	9	10	8	10	10	8(1)
3	8	10	10	8	9	8(2)
4	7	10	10	10	10	7(4)
5	6	10	10	6	6	6(5)
6	3	8	10	6	5	3(7)
7	4	10	10	10	8	4(6)
8	3	10	6	10	8	3(8)
9	2	7	2	10	3	2(9)
10	1	10	10	6	5	1(10)

Table 12. Prioritized Stakeholder

SL No.	Name (Sorted Stakeholders)
1	A.K.M Dellwar Hossain (Headmaster)
2	Md.Selim Talokder (Assistant Headmaster)
3	Mohammod Hasem Sarker (Managing Director)
4	Mr.Saha-Alam(Senior Teacher)
5	Mrs.Tahamina Akter(Teacher)
6	Ismail-Hossain(Librarian)
7	Md.Monir Hossain(Demonstrator)
8	Komol Dev(Accountant)
9	Kalo Sarker(Staff)
10	Mansura Akter Sumi(Student)

Fuzzy inference (expert system) system is used in this solution for providing the maximum and minimum values from several groups. A 'union' operation is performed for maximum and 'intersection' for minimum values. The importance of this expert system is it can provide combination of output based on several inputs.

In response of sorting, firstly, we considered the 'designation' and the 'domain knowledge'. We took all the values of both of these criteria and performed an 'interaction' operation on them. We compared all the values of designation and domain knowledge with interaction operation and finally took the lowest value from them. We

placed the lowest values in 'A'. Then, the interest, goal and how much effective parameter's values are taken for another 'union' operation. After finding the highest values from these parameter's the final output is set in 'B'. According to this process, we applied on rest of the criteria by making several groups and the final outcomes are placed in 'C','D','E'.

After completing the first stage of sorting procedure we formed five terms of values 'A', 'B', 'C', 'D', 'E'. From these terms, we considered the most common values of the parameters, and we performed an 'intersection' operation on them. Finally, we found the sorted list of ten stakeholders' value.

However, we experienced a problem for same kind of values for several stakeholders. We found the value '8' for 'Headmaster (A.K.M Dellwar Hossain)' and 'Assistant Headmaster (Md. Selim Talokder) and '3' for 'Demonstrator (Md. Monir Hossain)' and 'Accountant (Komol Dev)'. To solve this kind of problem, we considered the 'designation' of those stakeholders. As a result, having a better value of designation than that of Assistant Headmaster, the Headmaster was prioritized first, and 'Demonstrator' observes more values of designation than the 'Accountant', so demonstrator was prioritized before the Accountant. Thus, a sorted list of stakeholder was formed from 'Gouripur S.A. High School, Daudkandi, Comilla'.

9. Result

The above procedure illustrates the stakeholder prioritization's framework. The whole process of the framework consist several states. At first, you have to analyze about a specific organization which is selected for surveying. Next, parameters will be noted into Value Matrix's table according to the criteria of the model. Then, the parameter will be marked by proper values which are formed by viewing stakeholders' profiles, conducting interview session, doing a survey based on questionnaire, making discussion with all the individual stakeholders and so forth. After that, the 'fuzzy logic' will be used to make comparisons between the equivalent parameters so that the stakeholders can be organized with their proper eligibility for becoming the most prioritizes stakeholders among the organization. Finally, the output of that framework will be a sorted list of candidates who are eligible to be involved in requirement engineering process. We hope that you will get your desired output. Using this framework can be a great opportunity to a software development team for successfully developing a large-scale project.

10. Discussion

The paper defines the importance of stakeholders in requirements engineering process. Without understanding the proper concept of stakeholder, it is difficult to complete a project successfully. Once the stakeholder identification process has been done, the priority must be set with the stakeholders. The thesis will perform to solve the stakeholder prioritization process. The paper provides a framework for stakeholder prioritization process. The framework contains the data of different stakeholders in a chart so that the selected stakeholder can be marked by their characteristics over the organization and the project also. The framework provides a 'fuzzy logic' based solution for finding a sequence number of key stakeholders. A listed number of prioritize stakeholders will be the final output of this framework. Though, the framework provides a manageable solution for stakeholder prioritization process, there are still some area where it can be further explored. In future, the logic of stakeholders data can be further well-organized. There is a plan to develop an application for the framework. The application will take the data as input and will provide the result as output. Moreover, the framework will be applied for several case studies so that the limitations can be identified and hope we will also offer better solutions in future research works.

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