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A Fuzzy based Fishbone Method for Goal-Oriented Requirements Analysis

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Abstract - Decision-making in requirements engineering plays a vital role in building quality software. Significant research is being applied in the requirements engineering field towards finding the reasons for high failure rates in software development. However, the industry still fails to produce quality requirements. Based on our literature review, we identifying that major contributing factor in getting a low rate of success is due unclear and imprecise requirements. In this paper, we proposed a novel fuzzy based fishbone method for decision making in Goal Oriented Requirements Engineering. It facilitates active stakeholder involvement in decision making process by integrating GORE with existing approaches in requirements engineering with respect to decision making. The main objective of this work is to present a formal framework to aid the decision making in a software development process, with ambiguous and vague data. GORE lays focus on the activities before the formulation of software system requirements. Finally, the proposed method improves the quality of decision making system and obtains high-quality products along with finer productivity.

Keywords: Requirements Engineering, Fuzzy set theory, Fishbone, GORE, Software quality.

I. INTRODUCTION

The failure of the software projects is one of the major concerns in software industry since many years. Many surveys have been done to investigate the projects failure statistics. A major contributing factor in getting a low rate of success is due unclear and imprecise requirements. In order to get high-quality products along with superior output, it is necessary to cautiously analyze, model, specify and supervise system necessities [1]. This would not only make simpler system design and accomplishment but also decrease the number of defects that are recognized afterward in the execution stage. Past two decades, requirement engineering has established itself as challenging activity within the software development life cycle. In fact more projects for software systems fail due to pitiable necessity engineering. Goal-oriented requirements engineering makes a good attempt to resolve these and other significant issues, understand stakeholder goals and their role in defining requirements by making use of goal models.

GORE lays focus on the activities before the formulation of software system requirements. The main activities usually present in GORE methods are: goal elicitation, goal analysis, goal refinement and goal validation. The main objective of this paper is to get better the quality of decision support system in goal-oriented requirements engineering. To achieve this objective, a new approach called fuzzy based fish bone methodology for Goal-Oriented Requirements Analysis is presented.

This paper is organized as follows: Section 2 presents the literature review. In section 3, the basic theory of fuzzy set theory is reviewed. In section 4, we state fuzzy based method for necessities engineering analysis. In section 5 to demonstrate how the projected method works under fuzzy cluster decision making. Finally, conclusions are drawn in section 6.

II. LITERATURE REVIEW

In spite of new and effective software engineering techniques, software system development projects are still prone to failure. It is a widely accepted that the failure in producing good requirements specifications during software development has a negative impact on the success of the project. The main problem of customary system analysis like structured or object-oriented:

- Traditional approaches treat requirements as processes and data.
- More emphasis on modeling and specification of the software.
- Traditional approaches are inadequate for building complex system.
- Nonfunctional requirements are generally not division of the necessities specification.

- Traditional approaches do not facilitate exploring alternate options to realize an objective.
- RE modeling research has focused very less on linking "requirements abstractions down to the design level".

Goal- Oriented Requirements Engineering makes good attempts to resolve these and other significant issues. Different methods have been designed under GORE literature which incorporates a set of tasks. This section gives summary of goal-oriented requirements engineering method. Several researchers advocate the use of fuzzy logic to deal with problems related to the prioritization and decision making in requirements engineering. Lai et al. proposed a fuzzy based method to rank the customer requirements in a competitive environment [3]. Zhu et al. proposed a fuzzy qualitative and quantitative soft goal interdependency graphs model for non-functional requirements correlation analysis in trustworthy software. In a comparable study, due to the vague theory often represented in decision making environments, Fuzzy TOPSIS and its extensions are developed Chen & Tsao et al. to solve ranking and justification problems [2]. Many techniques for decision making are found in Software Engineering literature. It includes Analytic Hierarchy Process (AHP) Thomas L. Saaty, Quality Function Deployment by Andreas Hierholzer et al. Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) by Chen S.J. and Hwang C.L, Multi-Criteria Preferential Analysis Requirements Negotiation (MPARN) by Joao Ramires et al., quality models and attribute by Donald Firesmith, Alexander Egyed and Paul Grünbacher, heuristic method for trade off analysis by Golnaz Elahi et.al, and conflict management in aspect oriented requirements engineering by Alberto Sardinha et al.

III. FUZZY SET THEORY

Fuzzy Logic is a powerful problem-solving methodology to deal with imprecision and information granularity. A fuzzy model is used when the scheme is not appropriate for analysis by straight method. Fuzzy Logic starts with the fuzzy set theory. It is a concept of classes with pointed limitations and preferred as an addition of the classical set theory. Classical concept with high considerate of the organization, so fuzzy logic is totally experiential and relies on knowledge rather than the technical thoughtful of the subject for modeling the difficult system.

Fuzzy set $\bar{A}$ in the universe of information U can be defined as a set of ordered pairs and it can be represented mathematically as

$$\bar{A} = \{(y, \mu_{\bar{A}}(y)) \mid y \in U\}$$

Here $\mu_{\bar{A}}(y)$ = degree of membership of y in {A}, guess values in the range from 0 to 1,

i.e., $\mu_{\bar{A}}(y) \in [0, 1]$ $\mu_{\bar{A}}(y) \in [0, 1]$

When universe of information U is discrete and finite then,

$$\bar{A} = \{ \mu_{\bar{A}}(y1) + \mu_{\bar{A}}(y2) + \mu_{\bar{A}}(y3) + \ldots\ldots\}$$
$$= \{\textstyle\sum_{i=1}^{n} \mu_{\bar{A}}(yi)\}$$

When universe of information U is continuous and infinite then

$$\bar{A} = \{\int \frac{\mu \bar{A}(y)}{y}\}$$

The association function of the fuzzy set is a crisp (real-valued) function. Zadeh also defined fuzzy sets in which the membership functions themselves are fuzzy sets. Those sets can be clear as a kind m fuzzy sets whose association values are type m − 1, m > 1, fuzzy sets on [0, 1]. Hirota state a fuzzy set membership function as point wise a probability distribution i.e a probabilistic set A on X is defined by defining function μ_A:

$\mu_A : X \times \Omega \in (x, \omega) \rightarrow \mu_A(x, \omega) \in_C$ and (Ω_C, B_C) = [0, 1] are Borel sets

For a finite fuzzy set $\bar{A}$, the cardinality $|\bar{A}|$ is defined as

$$|\bar{A}| = \textstyle\sum_{x \in X} \mu_{\bar{A}}(x)$$

The set functions of group together, connection and complementation are defined in terms of feature functions as follows:

- Union: $\mu_{A\cup B}(x) = \max(\mu_A(x), \mu_B(x))$
- Intersection: $\mu_{A\cap B}(x) = \min(\mu_A(x), \mu_B(x))$
- Complement: $\mu_{\text{not } A}(x) = 1-\mu_A(x))$
- Set addition: $A \subset B$ if and only if $\forall x$ (for all x) $\mu_A(x) = 1$ implies $\mu_B(x) = 1$
- Set Equality: A = B if and only if $\forall x$ (for all x) $\mu_A(x) = \mu_B(x)$.

Fuzzy logic has been developed in lots of applications including home appliance, customer electronic goods, transfer systems, automobiles and engineering processes.

IV. FUZZY-BASED FISHBONE METHODOLOGY

The key success of successful software progress has forever accurate prerequisite framing from stakeholder's messages and with consumer minds. There is always certain amount of uncertainty involved in undertaking software engineering activities since these relate in many ways to software projects. Software projects may have several risk, assumption and conflicting requirements associated with them. Such type of problems can be better solved using fuzzy logic. Goals that may be calculated in a fuzzy approach are stakeholder's satisfaction, on time deliver, budget transfer, meet quality requirements, team happiness, and convey all high-priority operations in the primary release. The proposed Fuzzy-based Fishbone Methodology helps stakeholders in analyzing contradictory necessities in terms of targets and constraints of attainment to a crunchy best decision value against which a suitable priority can be assigned to the inconsistent requirement. Therefore, the objective of this work is to present a proper structure guided by fuzzy goals to be used in the necessities prioritization job.

Fuzzy approach works based on degree of truth rather than usual true or false. It works as a theoretical structure which caters to the indecision in the knowledge illustration. Fuzzy logic seems closer to the way our brains work. We collective data and shape a number of incomplete truths which aggregate further into higher truth. The operational process of fuzzy logic system in step by step procedure is shown in figure 1 [7]:

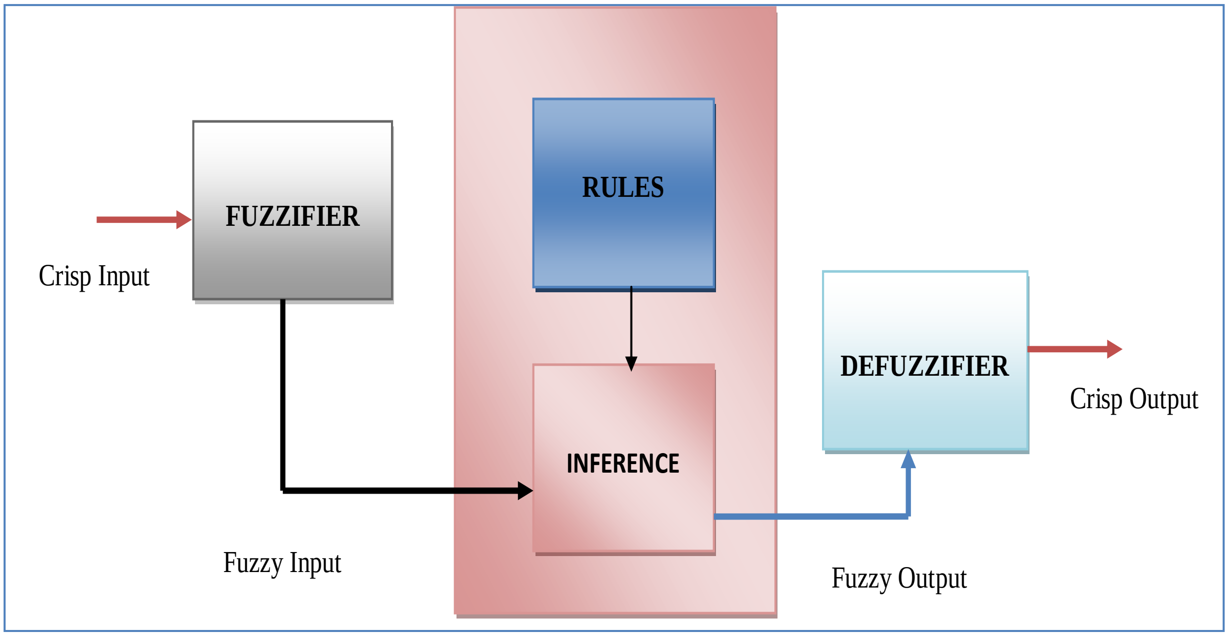

Figure 1. Fuzzy based Fishbone Methodology

- **Fuzzification:** In this concept membership quantity is processed for every input variable with esteem to its linguistic word.
- **Rule matching:** In this concept, the firing strength of personality rule is measured.
- **Fuzzy Inference:** The proposal of rules according to dismissal strengths and rule conclusions are strong-minded in fuzzy inference.
- **Fuzzy Aggregation:** It integrates recommendation from personal rules into an overall implied fuzzy set.
- **Defuzzification:** It involves strength of mind of a crisp value based on roundabout fuzzy sets derivative from the rules, as last outcome.

The Fishbone methodology specifies a set of goals, services and requirements engineering processes. The set of goals are specified by stakeholders and the set of services are provided by developers. The role of project stakeholders is to specify requirements and the role of developers is to understand, develop and provide services according to the requirements specified to implement requirements process. The accountability of project stakeholders is to give, clarify, state and prioritize requirements. The responsibility of developers is to spend the time to recognize and understand those necessities to offer services. Thus this methodology supports both goals as well as service oriented application systems. The tail of the fishbone specifies the major target of the system to be developed or in other words specifies the problem statement. The head of fishbone is the prototype model which is end result of n number of increment development rounds for requirements engineering processes.

After analyzing the various techniques and experimental result of various authors in literature survey we developed the comparatively study of widely used techniques with their silent features. Table 1 shows the strength and limitation of widely used techniques. The proposed fuzzy based approach for requirement analysis involves n-1 comparisons as compared to other technique and suitable for large scale projects. This procedure is simple to realize and the necessities are prioritized using fuzziness as fuzzy inference system. The proposed Fuzzy based Fishbone Methodology is presented in the following:

Step 1: Identify stakeholders and their goals

Stakeholder's identification is an important activity of requirements engineering. Therefore, the first step of our method is to identify the primary and secondary stakeholders. Primary stakeholders include those who are central to any project initiative. Secondary stakeholders include developers, experts, operators etc. Requirements analyst identifies the high level objective of the primary stakeholders.

Step 2: Identify functional Requirements (FR) and non functional requirements (NFR)

In goal oriented requirements Engineering process, AND/OR graph is constructed by decomposing the high level objective of stakeholders, say G, into sub goals or requirements. This graph is used to identify the functional and non functional requirements. In AND decomposition, if all of the sub goals or requirements are achieved, their parent goals can be achieved or satisfied. On the other hand side, in OR decomposition, the achievement of at least one sub goals or requirements leads to the achievement of its parent goal.

Step 3: Collect decision maker's fuzzy assessment

In this step, expert's opinions regarding the importance of each requirement are obtained in the form of linguistic variable such as, very good, good, medium etc. In this step, we collect the experts' fuzzy assessments and express their opinions on the importance of each requirement.

Step 4: Apply extent fuzzy AHP for pair wise comparisons among requirements

In this step, we adopt the extent fuzzy AHP. Let FR = $\{fr_1, fr_2, \ldots, fr_n\}$ be a set of FR and NFR = $\{nfr_1, nfr_2, \ldots, nfr_m\}$ be a set of NFR. Here n equal to the number of FRs and m equals to the number of NFRs. According to the method of extent analysis each FR is taken and extent analysis is performed for each NFRs respectively. Therefore, the m extent analysis values for each FR are obtained as follows:

$M^1_{gi}, M^2_{gi}, M^j_{gi}$, i= 1,2,…,n, where all the M^j_{gi} (j = 1,2,…,m) are TFNs. The value of fuzzy synthetic extent with respect to the ith FR is defined as:

$$S_i = \sum_{j=1}^{m} M^j_{gi} \odot \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{gi}\right]^{-1}$$

To obtain $\sum_{j=1}^{m} M^j_{gi}$ the fuzzy addition operation of m extent analysis values for a particular matrix is performed as:

$$\sum_{j=1}^{m} M^j_{gi} = \left(\sum_{j=1}^{m} a_j, \sum_{j=1}^{m} b_j, \sum_{j=1}^{m} c_j\right)$$

and to obtain $\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{gi}$, the fuzzy addition operation of M^j_{gi} (j = 1, 2,…, m) values is performed such as:

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{gi} = \left(\sum_{i=1}^{n} a_i, \sum_{i=1}^{n} b_i, \sum_{i=1}^{n} c_i\right)$$

and then the inverse of the above vector can be calculated as:

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{gi}\right] = \left[\frac{1}{\sum_{i=1}^{n} a_i, \sum_{i=1}^{n} b_i, \sum_{i=1}^{n} c_i}\right]$$

Let $A_1 = (a_1, b_1, c_1)$ and $A_2 = (a_2, b_2, c_2)$ are two TFNs. The degree of possibility of A_1 and A_2 is defined as follows:

$$V(A_1 \geq A_2) = \sup_{x \geq y}[\min(\mu A_1(x), \mu A_2(y))$$

When a pair (x, y) exists such that $x \geq y$ and $\mu A_1 9x) = \mu A_2(y) = 1$ then we have $V(A1 \geq A2) = 1$, Since A1 and A2 are convex fuzzy numbers, we have that:

$$V(A1 \geq A2) = 1 \text{ iff } b_1 \geq b_2$$

$$V(A1 \geq A2) = hgt(A_1 \cap A_2) = \mu A_1(d)$$

Where d is the ordinate of the highest intersection point D between μA_1 and μA_2. When A1 = (a1, b1, c1) and A2 = (a2, b2, c2), the ordinate of D is given by:

$$V(A_1 \geq A_2) = hgt(A_1 \cap A_2) = \frac{(a1-b1)}{(b2-c2)-(b1-a1)}$$

To compare A_1 and A_2, both the values of $V(A1 \geq A2)$ and $V(A2 \geq A1)$ are required. The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers A_i (i = 1, 2,…, k) can be defined by

$V(A \geq A_1, A_2, \ldots A_k = V[(A \geq A_1)$ and $(A \geq A_2)$ and,…. and $(A \geq A_k)$

$= \min V(A \geq A_i)$, i = 1, 2, . . ., k.

If $d(X_i) = \min V(S_i \geq S_k)$ for k = 1,2,….n, $k \neq i$.

Then the weight vector (WV) is given by:

$$WV' = (d'(X_1), d'(X_2), \ldots, d'(X_n))^T.$$

where X_i (i=1,2,….,n) are n FR. Via normalization, the normalized WV:

$$WV = (d'(X_1), d'(X_2), \ldots, d'(X_n))^T.$$

Step 5: Compute fuzzy group preferences from the fuzzy individual preferences

For the prioritization of requirements on the basis of various criteria's, we aggregate fuzzy performance rating through all decision maker by means of extended addition and scalar multiplication to form a comprehensive performance matrix P, in which performance rating:

$$P_{ij} = (1 \backslash n) \odot (P^1_{ij} \oplus P^2_{ij} \oplus, \ldots \oplus P^n_{ij}$$

is a triangular fuzzy number of the form:

$$(P_{1ij}, P_{2ij}, P_{3ij}) = \left(\frac{1}{n}\sum_{k=1}^{n} P^k_{1ij}, \frac{1}{n}\sum_{k=1}^{n} P^k_{1ij}, \frac{1}{n}\sum_{k=1}^{n} P^k_{1ij}\right)$$

Now calculate the fuzzy weight through all Decision Makers (DM) by means of extended addition and scalar multiplication to form a comprehensive Weighted Vector (WV). Once we have obtained the comprehensive performance and weight matrix then apply the following steps :

Step 5.1: Aggregate fuzzy ratings with fuzzy weights by means of extended multiplication to form a weighted, comprehensive decision matrix D, in which

$d_{ij} = P_{ij} \odot W_j$ is a fuzzy number with parabolic membership functions in the form of:

$(\lambda_{1ij}, \lambda_{2ij}, \lambda_{3ij}/d_{ij}/\Delta_{1ij}, \Delta_{2ij}, \Delta_{3ij})$;

Where $\lambda_{1ij} = (W_{2j} - W_{1j})(P_{2j} - P_{1j})$

$\lambda_{2ij} = W_{1j}(P_{2ij} - P_{1ij}) + P_{1ij}(W_{2j} - W_{1j})$

$\lambda_{3ij} = W_{1j} P_{1ij}$

$\Delta_{1ij} = (W_{3j} - W_{2j})(P_{3ij} - P_{2ij})$

$\Delta_{2ij} = W_{3j}(P_{3ij} - P_{2ij}) + P_{3ij}(W_{3j} - W_{2j})$

$\Delta_{3ij} = W_{3ij} P_{3ij}$ and $d_{ij} = W_{2j} P_{2ij}$

Step 5.2: Define each sub-goal/requirement as a fuzzy number Ai, i = 1, 2,…, m by means of extended addition and scalar multiplication through the following criteria:

$A_i = 1\backslash m \odot (d_{i1} \oplus d_{i2} \oplus, \ldots, \oplus d_{ic})$

With parabolic membership function in the form of:

$(\lambda_{1i}, \lambda_{2i}, \lambda_{3i} / EA_i / \Delta_{1i}, \Delta_{2i}, \Delta_{3i})$ where

$\lambda_{1i} = \frac{1}{m}\sum_{j=1}^{m} \lambda_{1ij}$, I = 1,2,3….n;

$\Delta_{1i} = \frac{1}{m}\sum_{j=1}^{m} \Delta_{1ij}$, I=1,2,3,….n;

and $EA_i = \frac{1}{m}\sum_{j=1}^{m} d_{ij}$

Step 5.3 Define Extended Average (EA) by means of extended addition and scalar multiplication through all alternatives (sub-goals/ requirements).

$EA = \frac{1}{n} \odot (g1 \oplus g_2 \oplus, \ldots, \oplus g_h)$ with parabolic membership function in the form of:($\lambda_1, \lambda_2, \lambda_3$/ Sum_EA/ $\Delta_1, \Delta_2, \Delta_3$)

Where

$\lambda_{i,} = \frac{1}{n}\sum_{ij=1}^{n} \lambda_{1i}$, I = 1,2,3….n;

$\Delta_{i,} = \frac{1}{n}\sum_{i=1}^{n} \Delta_{1i}$, I=1,2,3,….n;

$Sum\_EA = \frac{1}{n}\sum_{i=1}^{n} EA_i$

Step 5.4 Define the extended difference, $EA_i \emptyset$ Sum_EA, for each Ai ε R, with parabolic membership function in the form of: $((\lambda_{1i} - \Delta_1), (\lambda_{2i} - \Delta_2), (\lambda_{3i} - \Delta_3)$ / EA_i – Sum_EA / $(\Delta_{1i} - \lambda_1)(-\Delta_{2i} - \lambda_2)(\Delta_{3i} - \lambda_3))$

Step 5.5: Calculate ranking value (rv) of each requirements

In this step, we calculate the ranking values (rv_i) for each requirements Ai by means of F-preference relation R: if $(\lambda_{3i} - \Delta_3) < 0$, $(\Delta_{3i} - \lambda_3) \geq 0$, $EA_i \geq$ Sum_EA; then

$rv_i = \mu R(A_i \ominus EA, 0) = \Pi^+ / (\Pi^+ + \Pi^-)$;

else if $(\lambda_{3i} - \Delta_3) < 0$, $(\Delta_{3i} - \lambda_3) \geq 0$, $EA_i \geq$ Sum_EA; then

$rv_i = \mu R(A_i \ominus EA, 0) = \psi^+ / (\psi^+ + \psi^-)$;

else if $(\lambda_{3i} - \Delta_3) < 0$, $(\Delta_{3i} - \lambda_3) \geq 0$, $EA_i \geq$ Sum_EA then

$rv_i = \mu R(A_i \ominus EA, 0) = 0.5$;

else if $(\lambda_{3i} - \Delta_3) < 0$, $(\Delta_{3i} - \lambda_3) \geq 0$, $EA_i \geq$ Sum_EA then

$rv_i = \mu R(A_i \ominus EA, 0) = 1$;

else if $(\lambda_{3i} - \Delta_3) < 0$, $(\Delta_{3i} - \lambda_3) \geq 0$, $EA_i \geq$ Sum_EA then

$rv_i = \mu R(A_i \ominus EA, 0) = 0$;

$\Pi^+ = -[\,¼\,(\Delta_{1i} - \lambda_1) - 1/3\,(\Delta_{2i} - \lambda_2) + 1/2\,(\Delta_{3i} - \lambda_3)] + [1/4(\lambda_{1i} - \Delta_1)(1 - Z^4) + 1/3(\lambda_{2i} - \Delta_2)(1 - Z^3) + ½\,(\lambda_{3i} - \Delta_3)(1 - Z^2)$

$\Pi^- = 1/4(\lambda_{1i} - \Delta_1)(Z^4) + 1/3(\lambda_{2i} - \Delta_2)Z^3 + ½\,(\lambda_{3i} - \Delta_3)Z^2$

$Z = [-\lambda_{2i} + \Delta_2) + \text{sqrt}\,\{(\lambda_{2i} + \Delta_2)^2 - 4(\lambda_{1i} - \Delta_1)(\lambda_{3i} - \Delta_3)\}] / [2(\lambda_{1i} - \Delta_1)]$

$\psi^+ = 1/4(\lambda_{1i} - \Delta_1)P^4 + 1/3(\lambda_{2i} - \Delta_2)P^3 + ½\,(\lambda_{3i} - \Delta_3)P^2$

$\psi^- = -[\,¼\,(\Delta_{1i} - \lambda_1) - 1/3\,(\Delta_{2i} - \lambda_2) + 1/2\,(\Delta_{3i} - \lambda_3)] + [1/4(\lambda_{1i} - \Delta_1)(1 - P^4) + 1/3(\lambda_{2i} - \Delta_2)(1 - P^3) + ½\,(\lambda_{3i} - \Delta_3)(1 - P^2)$

$P = [(\lambda_{2i} + \Delta_2) - \text{sqrt}\,\{(\Delta_{2i} + \lambda_2)^2 - 4(\Delta_{1i} - \lambda_1)(\Delta_{3i} - \lambda_3)\}] / [2(\Delta_{1i} - \lambda_1)]$

Table 1. Comparison of various Prioritization Requirement Methods

Method	Concept	No of Comparison	Ease Of Use	Reliability	Size of Project
AHP	Pair-wise	n*(n-1)/2	Easy	High	Medium
Priority Group	Relationship Matrix	n-1	Difficult	Low	Medium
B -Tree	Adjacent requirement	n*(n-1)/2	Very easy	Medium	Medium Large
Bubble Sort	Adjacent requirement	n*(n-1)/2	Very easy	Medium	Small
Ranking	Value Assign	n-1	Easy	High	Medium
BST	Pair-wise	n*(n-1)/2	Very easy	Medium	Medium
Fuzzy Fishbone	Pair-wise	< n*(n-1)/2	Easy	High	Medium

Continuation……. Table 1

Method	Fuzziness	Complexity Analysis	Type	Perspective
AHP	Not Supported	$O(n^2)$	Algorithmic	Product Manager
Priority Group	Not Supported	O (n log n)	Algorithmic	Product Manager
B -Tree	Not Supported	O (t*logt n)	Algorithmic	Product Manager
Bubble Sort	Not Supported	$O(n^2)$	Algorithmic	Product Manager
Ranking	Not Supported	O (n log n)	Manual	Requirement Specialist
BST	Not Supported	$O(n^2)$	Algorithmic	Product Manager
Fuzzy Fishbone	Supported	$O(n^2)$	Algorithmic	Product Manager

The projected approach is simple to execute, reliable, cost effective, less time to execute and error tolerant in nature. The outcome obtained using fuzzy based method are always substantial as compared to other methods and give support to analyst in decision making related to necessity prioritization.

V. CONCLUSION

The success of a software project depends upon how intensively its intended purpose by meeting all stakeholders concerns pertaining to project provisions such as cost, schedule and performance etc. There are different stakeholders concerned in the project and every stakeholder has consolidated concerns over requirements. Each stakeholder has individual concerns facilitate to obtain preference orderings or priority of software requirements and consolidated concerns assist the software developer and analyst to obtain consensual preference priority that would satisfy all stakeholders involved in the project. Decision-making in requirements engineering plays a vital role in building quality software. Significant research is being applied in the requirements engineering field towards finding the reasons for high failure rates in software development. However, the industry still fails to produce quality requirements. Based on our literature review, we identifying that major contributing factor in getting a low rate of success is due unclear and imprecise requirements. In this paper, we proposed a novel fuzzy based fishbone method for decision making in Goal Oriented Requirements Engineering. It facilitates active stakeholder involvement in decision making process by integrating GORE with existing approaches in requirements engineering with respect to decision making. The main objective of this work is to present a formal framework to aid the decision making in a software development process, with ambiguous and vague data. GORE lays focus on the activities before the formulation of software system requirements. Finally, the proposed method improves the quality of decision making system and obtains high-quality products along with finer productivity.

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