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# Risk Management; Utilizing Genetic-Fuzzy Approach

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**ABSTRACT**
*Project Risk management is an integral part for business survival. This research paper focuses on determining project risk factors using genetic algorithm and fuzzy logic base on the demerits of conventional approaches. Genetic algorithm help optimise the parameters data items while fuzzy logic handle imprecisions. Unified Modelling Language was utilized for modelling the software system, depicting clearly the interaction between various components and the dynamic aspect of the system. This paper demonstrates the practical application of metric based soft computing techniques in the health sector in determining patient's satisfaction.*

***Keywords:*** *CRM, Genetic Algorithm, Fuzzy Logic*

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## I. INTRODUCTION

Managing risks on project is a process that includes risk assessment and a mitigation strategy for the risks (David, 2003). Risk assessment includes both the identification of potential risk and the evaluation of the potential impact of the risk. A risk mitigation plan is designed to eliminate or minimise the impact of the risk event-occurrences that have negative impact on the project. Identifying risk is both a creative and a disciplined process. The creative process includes brainstorming sessions where the team is asked to create a list of everything that could go wrong (David and Alison, 2003). A more disciplined process involves using checklist of potential risks and evaluating the likelihood that those events might happen on the project. Checklist may be utilized by several companies based on prior projects. These checklists usually enable project manager and project team member in identifying both specific risks on the checklist and expanding the thinking of the team. The past experience of the project team, project experiences within the company and expert in the industry can be valuable resource for identifying risk on a project (David, 2003).Identifying the sources of risk by category is another method for exploring potential risk on a project. These sources risk includes; technical, cost, schedule, client, contractual, weather, financial, political, environmental and people. The people categories can be subdivided into risk associated with people, which includes risk of not finding needed skills to execute the project or the sudden unavailability of key people on the project. The same framework of work breakdown structure (WBS) was utilizing for developing a risk breakdown structure (RBS). A risk breakdown structure organizes the risk that has been identified into categories using a table with increasing level of detail to the right (David and Alison, 2003).

***The focal point of this paper is centred on selecting and optimising criteria for determining risk management***

## II. REVIEW OF LITERATURE

The theory of fuzzy logic provides a mathematical strength to capture the uncertainties associated with human cognitive processes, such as thinking and reasoning. In standard set theory, an object does or does not belong to a set. There is no middle ground. In such bivalent systems, an object cannot belong to both its set and its compliment set or to neither of them. This principle preserves the structure of the logic and avoids the contradiction of object that both is and is not a thing at the same time (Zadeh, 1965). However, fuzzy logic is highly abstract and employs heuristic (experiment) requiring human experts to discover rules about data relationship (Angel and Rocio, 2011).

Fuzzy classification assumes the boundary between two neighboring classes as a continuous, overlapping area within which an object has partial membership in each class (Kuang; Ting-Hua and Ting-Cheng, 2011). Fuzzy logic highlights the significant of most applications in which categories have fuzzy boundaries, but also provides a simple representation of the potentially complex partition of the feature space. (Sun and Jang**,** 1993 and Ahmad, 2011) Conventional approaches of pattern classification involve clustering training samples and associating clusters to given categories. The complexity and limitations of previous mechanisms are largely due to the lack of an effective way of defining the boundaries among clusters. This problem becomes more intractable when the number of features used for classification increases (Christos and Dimitros, 2008).

The Genetic Algorithm (GA) is a search and optimization technique based on the principles of genetics and natural selection. They represent processes in nature that are remarkably successful at optimizing natural phenomena. They are capable of solving other types of problems, using genetic operators abstracted from nature; they form a mechanism suitable for a variety of search problems. These algorithms encode a potential solution to a specific problem on a simple chromosome-like data structure and apply recombination operators to these structures so as to preserve critical information. Genetic algorithms are often viewed as function optimizer. The main idea is survival of the fittest (natural selection). Genetic algorithm is composed of three main genetic operators namely; **Selection:** is a way for the genetic algorithm to move toward promising regions in the search space. **Mutation:** is a genetic operator that changes one or more gene values in a chromosome. The mutation process helps to overcome trapping at local maxima. **Crossover:** Exchanging Chromosomes portions of genetic materials.

According to David, 2003 and David and Alison, 2003 project management risk factors includes*; **adequate manpower, planned time frame, needed raw materials, technical support, stringent government policy, environmental factor and contractual .***

## III. METHODOLOGY, DESIGN AND RESULT

The Dataset present in Table 1 was obtained through a research survey, utilizing questionnaires as the research tool. The quantitative and qualitative questionnaires comprises of two segments. The first phase contains demographic information's while the second phase comprises of project management risk factor questions with the aim of eliciting relevant customer satisfaction questions. A total of fifty questionnaires were constructed and distributed to various project manager and team member and spread across several company within Nigeria. All questionnaires administrated were retrieved without mutilation.

***Table 1:*** *Data Set showing the Degree of membership for Project Risk factors*

| Parameters or Fuzzy sets For Project Risk Factors | Codes | Membership Function for project Risk Factor | | |
|---|---|---|---|---|
| | | Cluster 1 ($C_1$) | Cluster 2 ($C_2$) | Cluster 3 ($C_3$) |
| Adequate Manpower | R01 | 0.50 | 0.15 | 0.35 |
| Planned Time Frame | R02 | 0.20 | 0.20 | 0.60 |
| Needed Raw Materials | R03 | 0.10 | 0.80 | 0.10 |
| Technical Support | R04 | 0.20 | 0.10 | 0.70 |
| Stringent Government Policy, | R05 | 0.30 | 0.60 | 0.10 |
| Environmental Factor | R06 | 0.05 | 0.05 | 0.90 |
| Contractual Agreement | R07 | 0.00 | 0.50 | 0.50 |

***Table 2:*** *Genetic Algorithm Optimization*

| S/N | Selection | Chromosomes (Binary; 0 or 1) | | | Fitness function |
|---|---|---|---|---|---|
| | | Parent (1st Gen) | Crossover | Parent (2nd Gen) | |
| 1 | 50 | 110010 | 1 & 6 | **110**101 | **53** |
| 2 | 46 | 101110 | 2 & 4 | **101**100 | **44** |
| 3 | 46 | 101110 | Mutation | 1011**0**0 | **44** |
| 4 | 44 | 101100 | 2 & 4 | **101**110 | **46** |
| 5 | 38 | 100110 | 5 & 7 | **100**010 | **34** |
| 6 | 37 | 100101 | 1 & 6 | **100**010 | **34** |
| 7 | 18 | 010010 | 5 & 7 | **010**110 | **22** |
| **Fuzzy membership Function Boundary** | | | | | **0.53** |

The generated results in table 3 were achieved utilizing 0.53 for determining high degree membership function and low degree membership function after a conclusive optimization from Table 2. The fuzzy partition for each input feature consists of the parameters for assessing project risk. The fuzzy rules that can be generated from the initial fuzzy partitions for the classification of project risk factor are thus:

a. Low Project Risk (Class: $C_1$)
b. Moderate Project Risk (Class: $C_2$)
c. High Project Risk (Class: $C_3$)

If the Project (P) experiences less than or equal to two ($P \leq 2$) of the parameters for assessing project risk *THEN* ($C_1$), If the Project (P) experiences three ($P = 3$) of the parameters for project risk *THEN* ($C_2$) If the Project (P) experiences four ($P \geq 4$) or more of the parameters for assessing project risk *THEN* ($C_3$).

***Table 3:*** *Data Set showing the Degree of membership Project Risk Factors*

| Parameters or Fuzzy sets For Project Risk | Codes | Membership Function for Project Risk | | |
|---|---|---|---|---|
| | | Cluster 1 ($C_1$) | Cluster 2 ($C_2$) | Cluster 3 ($C_3$) |
| Timeliness | R01 | 0.50 | 0.15 | 0.35 |
| Proper Signage | R02 | 0.20 | 0.20 | 0.60 |
| Optima Human Touch | R03 | 0.10 | 0.80 | 0.10 |
| Accuracy Healthcare delivery | R04 | 0.20 | 0.10 | 0.70 |
| Responsiveness | R05 | 0.30 | 0.60 | 0.10 |
| Adequate infrastructures | R06 | 0.05 | 0.05 | 0.90 |
| Balance Healthcare cost | R07 | 0.00 | 0.50 | 0.50 |
| **Result** | | **Low Project Risk** | **Moderate Project Risk** | **High Project Risk** |

Table 3 represents the degree of membership function for project risk, for instance, R05 in cluster 1, we notice it has 0.30. In percentage, it can be represented as 30%, in cluster 2, 60%, in cluster 3, 10%. This means that the degree of membership function for project risk of P05 matches **30% of Low Project Risk, 60% of Moderate Project Risk** and **10% of High Project Risk.** The Fuzzy clustering graphical distribution shown Figure 2 depicts one criterion with high degree of membership function for **Low project Risk,** three criteria's with high degree of membership function of **Moderate Project Risk**, four criteria's with high degree of membership function of **High Project Risk.**

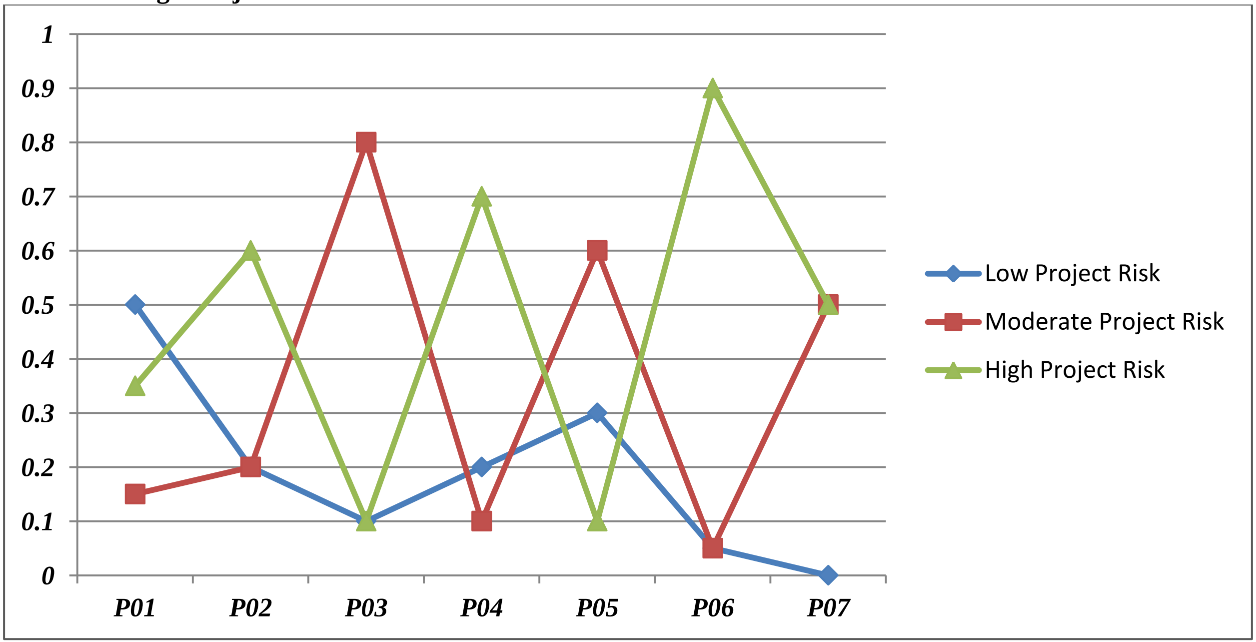


***Fig. 2:*** *Graphical Representation highlighting the Degree of Membership Function for Project Risk*

### *3.3 Design*

Unified modelling language (UML) is a standard modelling language used for modelling software systems. It provides a number of graphical tools that can be used to visualize a system from different viewpoints. The multiple views (user, structural, behaviour, implementation and environment) of the system that is represented by using diagrams together depict the model of the system (Philippe, 2000 and Chris, 2000). The views typically used are The *User view;* represents the goal and objectives of the system form user's viewpoint. The *structured view;* represent the static or idle state of the system. The *behavioural view;* represents the dynamic or changing aspect of the system. The *implementation view;* represents the distribution of the logical elements, such as source code structure, runtime implementation structure of the system. The *environment view;* represents the distribution of the physical elements of the system.

The behavioural view of our system is modelled utilizing sequence diagram on figure 3

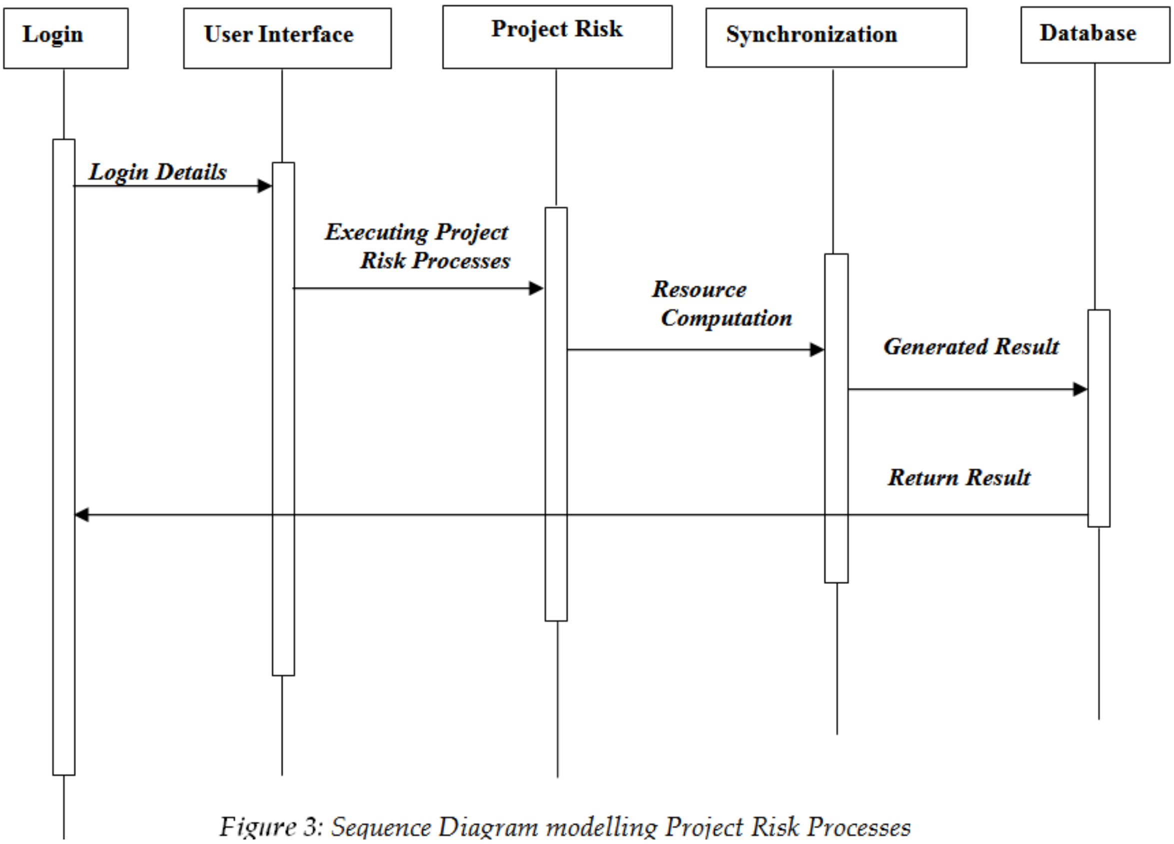


*Figure 3: Sequence Diagram modelling Project Risk Processes*

## IV. DISCUSSION

The Project Risk provides an interactive framework of determining potential project risk objectively as opposed to the subjective questionnaire based approach based on achievable criteria's to pinpoint a central base for determining linguistic variables membership function in achieving our fuzzy middle-ground ("Moderate Project Risk") from "Low Project Risk" and "High Project Risk".

## V. CONCLUSIONS

An intelligent based approach has be harnessed in determining Project Risk, taking into cognizant the appropriate project risk factors.

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