SUMMARY: SMART DECISION MAKING USING FUZZY LOGIC FOR KNOWLEDGE MANAGEMENT SYSTEM

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ABSTRACT

Decision making is a vital part of the business world. A person working as a low level supervisor or a CEO of the company all have to take decisions. Employees, customer and stockholders notice how a manager make and take decisions. Decisions can’t be undone without spending huge cost in terms of money and time. This critical activity needs to be handled carefully. It requires research and consideration of various alternatives available at the time. A bad decision not only stands to losea huge amount of potential revenue but can even collapse and dissolve. If right information is available to right person at the right time the outcome is awesome, taking enterprise to the new highest. Researchers from computer science fields are continuously trying to improve the process. The evolution of Knowledge Management System (KMS) was also a part to support the decision making process for the top level managers as the different types of information system is helpless at the strategic level of planning. The use of Fuzzy Logic approach is to handle the uncertain situations more effectively. The ant colony optimization technique is recommended for optimal search.

We are here giving a short summary of our research work containing a complete theoretical outline to develop an effective decision making tool for knowledge management system using fuzzy logic.

Keywords: Knowledge Management System, Fuzzy Logic, Fuzzy Sets, Fuzzy Decision Making, Strategic Decision Making.

1. INTRODUCTION

Our research revolves around three things majorly – 1) Decision Making Process, 2) Fuzzy Logic and 3) Knowledge Management System. Let’s briefly discuss each one by one.
1.1 Decision Making Process

Decision making process is a daily course of action for all of us. Good decision leads us towards success and bad decisions towards failure and loses. Quality of decision is majorly depends on information available at that moment. Our study is related to the strategic decision making process. Managers are expected to make smart choices among the alternatives which are often uncertain. Her/his choices should be smart enough so as to please organization’s stakeholders and the organization too. Strategic decision making is a most critical task in any organization. It is something more than making judgments and choice. We have many theories regarding risk, options, game theory and choice but it is less useful in understanding in how people in organization make decision. The some of the characteristics of strategic decisions are they are elusive problems that are difficult today, they rarely have one best solution but often a lesser or possible solution, high level of ambiguity and uncertainty are associated with the solution.

1.2 Fuzzy Logic

Logic was initiated in 1965 by Lotfi A. Zadeh, professor for computer science at the University of California in Berkeley. Basically, Fuzzy Logic (FL)[1] is a multivalued logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. Notions like rather tall or very fast can be formulated mathematically and processed by computers, in order to apply a more human-like way of thinking in the Programming of computers. Fuzzy systems are an alternative to traditional notions of set membership and logic that has its origins in ancient Greek philosophy. According to the traditional view, science should strive for certainty in all its manifestations (precision, specificity, sharpness, consistency etc.) hence, uncertainty is regarded as unscientific. According to the alternative or modern view, uncertainty is considered essential to science; it is not only an unavoidable plague, but it has, in fact, a great utility. In our study we are applying fuzzy logic because of its capability to handle the decision making process very close to human thinking. As our study is related to strategic decision making process which contains uncertainty and ambiguity application of fuzzy logic is more suitable rather than conventional logic. Various applications using fuzzy logic are developed and researchers are still emphasizing more on development in this field. Some of the applications are An Application of Fuzzy Logic for Expert Selection [2], Integration of Fuzzy Logic and Tsunami Warning System for Information Security [3], Handling Ambiguous Data during Requirements Verification using Fuzzy logic [4].

1.3 Knowledge Management System

The layman’s definition of Knowledge Management is the system and managerial approach of collecting, processing and organizing enterprise specific knowledge assets for business functions and decisions.

There exist a continuum of data, information and knowledge within any enterprise. In 1980’s the concept data and the system to manage the data became popular. In 1990’s information system become the hot item for business. Now this is the era of knowledge. Data are mostly structured, factual and mostly numeric. Information is factual but unstructured and majorly textual. On the other hand knowledge is inferential, abstract and is needed to support business decisions. According to the researchers data consist of facts, images or sound. When data are combined with interpretation and meaning, information emerges. Information is formatted, filtered and summarized data that when combined with action and application becomes knowledge. Knowledge exists in the forms of instincts, ideas, rules and procedures that guide actions and decisions. Good knowledge management is all about getting the right knowledge at the right place to the right person at the right time. The right knowledge is the knowledge that you need in order to be able to do your job to the best of your ability. Knowledge in organizations is classified into two types- explicit which are available in the
written forms and documents or databases like manuals, written procedures, best practices, learning and findings. The other type is tacit knowledge which is the knowledge that people carry in their heads. This knowledge which is most critical for the success of any organization is an “unspoken understanding” about something. Tacit knowledge is very difficult to write down in a document or a database. In our research paper knowledge management in education sector the detail study regarding how knowledge management can be done for any education institute is given. [5].

II. OBJECTIVE OF THE RESEARCH

1. The study will enhance the process of decision making.
2. The study will provide more optimum solution for Experts/Knowledge user.

III. SIGNIFICANCE OF THE STUDY

1. As the world is moving from industry based economy to knowledge based economy such type of research is essential.
2. This study will contribute into the effort of intelligent decision making.
3. The significant development of fuzzy logic paradigm enables contemplation of such management decision making problem in more intelligent and adaptive way.
4. Fuzzy logic and fuzzy sets are quite effective in handling imprecision, uncertainty and ambiguity which is mostly included in strategic decision making process.

IV. PRESENT SYSTEM PROBLEM

1. Strategic decision making process is surrounded by several uncertain and ambiguous conditions. The present software programs based on conventional logic are less effective. My research paper regarding failure of IT projects gives the details regarding this situation.
2. Conventional logic is less effective in dealing uncertain and ambiguous conditions. It only deals with precision, certainty, and rigor.
3. Less effective knowledge mining techniques are deployed as researchers are still developing a concrete solution to support this organization’s most critical activity.

V. DETAIL RESEARCH DESIGN

5.1. The Overall approach

The study will start from analyzing the requirements of the user. If it can proceed using our proposed study then continue for the next step otherwise go back and tell the user that fuzzy approach is not required. If it satisfies the conditions then start developing new knowledge warehouse having everything to help strategic decision process. The system will give the possible alternatives matching to the situation. Managers have to select the option by using his knowledge and experience. [6]

5.2. An Outline of Knowledge Mining Multi-Tier Architecture for Decision Making

Nobody in this technological era will deny that we are living in Multi facet smart working environment. To cope up with such type of environment we need to perform task smartly, in an improved manner. Smart system can be generated only by using smart framework. That is the reason why knowledge Management is gaining popularity among the experts. All of us will agree that the process of decision making is toughest job and success of every organization majorly depends upon the decisions taken by managers from time to time to achieve the desired goal. The result is the
outcome of the decision taken, which everybody expects to be positive. In order to support this most critical process we are proposing a theoretical architecture of our Knowledge Mining tool. For every manager and organization knowledge management become part and parcel. It is a boon to this world and is going to reap the benefits in long run. Our proposed architecture for knowledge mining is applicable to all the organizations who want a separate and effective system for decision making as the impact of effective decision is directly related to profitability and existence of the organization. Knowledge mining is critical and costly matter and it can be implemented more effectively in the process of new product development, research and design, software development, setting up educational policies, new land acquisition, goal setting, forecasting etc. the purpose of our paper writing is to provide a framework of our proposed study for the organizations interested to deploy and manage knowledge generated in the organization and effective use of the same in the process of decision making. The process of decision making still needs human intervention, our proposed architecture will give you the best suitable options available and matching to user’s need.

5.3. The General Outline of the Proposed Architecture

There are two types or users one is normal data users we will call them knowledge operators or data operators and the other one is knowledge workers. Knowledge operators can access normal database as a conventional users through user friendly Graphical User Interface (GUI), to a certain extend they can READ the data from knowledge base but cannot have WRITE or EXECUTE permission.

Knowledge workers are the experts who not only access both databases but his main contribution are maintaining the Knowledge base and updating it at regular interval.

**Figure 1:** Overall Approach of the Study

**Figure 2:** General outline of proposed architecture
5.4. Basic Requirement of Mining Architecture

Fully automated knowledge discovery system is difficult to obtain and in last year’s many researcher focused on the way of manually applying traditional machine learning and discovery methods to data stored in databases. The Knowledge Discovery in Database (KDD) Model proposed by Piatetsky-Shapiro, Matheus and Chan represents a starting point for our solution. Their system contains the following components:

- Database Interface, to manage database queries.
- Controller, to control the invocation and parameterization of other components.
- Knowledge base, to contain domain specific information.
- Focus to determine portions of data to analyze.
- Pattern Extraction, to collect pattern – extraction algorithms.
- Evaluation, to evaluate the interestingness and utility of extracted patterns.

Their model represents an abstraction of what usually occurs in KDD systems. In this paper we will start from the solution that Knowledge repository i.e. Knowledge Base is ready to use. Their model represents an abstraction of what usually occurs in KDD systems. We will consider that Knowledge repository i.e. Knowledge Base is ready to use. Next step is to start extracting knowledge.

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Figure 3: Knowledge Mining Architecture

5.5. Proposed Three Tire Knowledge Mining Architecture

The knowledge mining process works as follows in this architecture –

User defines the parameters for knowledge mining using graphical user interface. The knowledge mining services on the client perform some pre-processing prior to calling the knowledge mining services on the middle tier. The first task on the middle-tier is authentication and authorization of the users. Then the data mining services queue and execute the tasks of several
clients and send back the results. These are used in the post-processing of the client, which computes the final outcome and presents it to the user. A client may start several knowledge mining tasks in one session. Each of them includes a number of calls to the middle tier. Knowledge mining services use the knowledge access services on the middle tier in order to read from different types of data sources.

This three-tier approach has several advantages compared to the two-tier architecture. First, the knowledge mining services can fully control bandwidth and CPU cycles for each user because there is a centralized service that manages users’ tasks and resources. This enables the system to guarantee a maximum usage of system resources for knowledge mining purposes. Second, the system can service users according to their priority and to their membership in user groups. This includes restricted access to knowledge mining tables as well as user specific response behavior. Third, a wide range of optimization strategies can be realized. The tasks of the knowledge mining services can be distributed over the client and the middle tier. The middle tier can exploit parallelism by parallel processing on the middle tier hardware and parallel connections to the database layer. Additionally, the knowledge mining services can reuse the outcome of knowledge mining sessions and pre-compute common intermediate results. [6]

![Figure 4: Clubbed Architecture (Knowledge Mining Architecture clubbed with present Conventional Data warehouse)](image)

VI. IMPLEMENTING AN ANT COLONY OPTIMIZATION TECHNIQUE

While working at the strategic level managers tend to take which has direct impact on the organizations. Still we need human intervention to deal with such type of decision making. Before coming to any conclusion the various parameters are find out which has a direct impact on the process. The knowledge related to the process is available through knowledge management system. We are proposing the use of Ant Colony Optimization [ACO] technique for the next exploration. What will be the next best strategy or in which manner a particular problem should be deal can be addressed more efficiently using ACO.

A graph G consists of a non-empty set of elements called vertices of graph G is called the vertices set of G, represented by \( V(G) \) and the list of edges is called the edge list of G denoted by \( E(G) \). In ACO artificial ants construct a solution by building a path on a construction graph. Each ant is initially positioned on a randomly chosen node of G and builds a solution by applying probability rule called as state transition rule. This probabilistic rule is biased by pheromone value so that higher the pheromone on connection, the higher the profanity that it will be selected.
Consider that an enterprise want to launch its new product in global market. It has working in 8 different countries. Now it has to choose whether they global launching or country wise. Assume that enterprise want to go step wise i.e. country wise launching of their product; the next job is to find out the optimum route so as to gain the maximum profit and demographic advantage. Under such situation construct a graph containing countries as their nodes and level of profitability, resource availability, political environment etc.is the characteristics of the edges connecting the different countries.

![Graph](image)

**Figure 5: Enterprise strategic dependency network**

Figure 5 illustrates the strategic dependency network. Let us assume that at the time point F ant K is positioned to find out the best profitable and maximum profitable sequence. (We are applying the fuzzy logic [1] approach for detering the characteristics of variables so as to get more humanistic approach)

Table 1 illustrates the fuzzy preference assigned to various parameters for edges. The linguistic terms used are very high, fairly high, high, medium, slightly medium, moderately poor, fairly poor and poor.

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**Table 1: Fuzzy linguistic term for selection**

In general, an ACO algorithm can be applied to any combinatorial problem as far as it is possible to define-

1. **Appropriate problem representation**: The problem must be able to describe as a graph with as set of nodes and edges between nodes.

2. **Heuristic desirability (η) of edges**: A suitable heuristic measures of the “goodness” of path from one node to every other connected node in the graph.
3. Construction of feasible solution: A mechanism must be processed where by possible solutions are efficiently created.

4. Pheromone updating rule: A suitable method of updating the pheromone levels on edges is required with a corresponding evaporation rule. Typical methods involve selecting the $n$ best ants and updating the paths they choose.

5. Probabilistic transition rule: The rule that determine the probability of an ant traversing from one node in the graph to the next. The features selection task may be reformulated in to an ACO – suitable problem. ACO requires a problem to be represented as a graph where nodes represent features with the edges between them denoting the choice of the next future. The search for the optimal feature subset is then an ant traversal through the graph where a minimum member of nodes are visited that satisfies the traversal stopping criterion. [7]

Figure 6: Illustration of the setup

The ant is currently at node F and has a choice of which to select next so as to add to its next path i.e. dotted lines. It chooses country D next based on the transition rule and in the same manner E, b, E, A, C, H and then G. upon arrival on G the current set is determined to find the optimum sequence for perfect launching of the product. The heuristic desirability of traversal and edge pheromone levels are combined to form the so-called probabilistic transition.

Depending on how optimality is defined for the particular application, the pheromone is updated accordingly. For instance, here the goodness of the pheromone is directly proportional to profitability, economy and inversely proportional to political benefit. There is also the possibility of avoiding any country from the launching process.

The process begins by generating a number of ants $K$, which are then placed randomly on the graph i.e. each ant, starts with on random country. Alternatively, the numbers of ants to place on the graph may be set equal to the number of features within the data; each ant starts path construction at a different country. From these initial positions, they traverse edges probabilistically until a traversal stopping criterion is satisfied. The resulting subsets are gathered and then evaluated. If an optimal subset has been found then the best route subset encountered. If neither condition holds, then the pheromone is updated, a new set of ants are created and the process iterates once more.

VII. RESULT PART

The proposed knowledge mining multitier architecture and implementation of fuzzy logic while accessing the data is really useful for the process of decision making at a strategic level. As we are recommending keeping knowledge database selective and separating than regular database it
performance is increased by leaps and bounds. [8] The method also helps to keep knowledge base secure. The idea of giving incentive for knowledge sharing helps to upgrade the knowledge base. A part of the study i.e. implementation of fuzzy logic in real life situation is discussed in our research paper [2] we gave the detail description of the study by discussing a hypothetical software company’s case study. The screen shots of implementation of the study are as below. After testing the software we found that the study will definitely improve the speed of decision making process. Presently many software companies are trying to implement more efficient knowledge Management System as the acceptance level of the system is going higher and higher. Software development companies are trying to en cash the situation. Our study gave the overall approach right from analysis to development stage which will prove a greater utility for software industries.

Screen 1: Data entry screen for adding new employee details

Screen 2: Screen for finding subject expert

Screen 3: Data entry screen for allocating project

Screen 1 is for making data entry for the new employee who joined the organisation. In the beginning the status of the employee is “Available ” but as soon as he is allotted to new project his status is get updated. The screen 2 is the searching screen which helps to fin the subject expert and his status. Screen 3 is a task allocation screen. When the project is took under development atem is allocated. In this screen as per our fuzzy membership variables set the status get updated from available to slightly busy then moderately busy then busy and at last extremely busy. When his status is extremely busy or busy he is not available for the allotment. The next substitute is searched and manager selects among them.
VIII. CONCLUSIONS

Strategic decision process is surrounded by uncertain, ambiguous and non-precise conditions. Software to help such organizational critical process requires implementation of fuzzy logic as it deals with uncertainty and ambiguity. A complete new approach is required to develop such kind of system. Knowledge management system should save mission critical data only and must be separate from conventional database so as to improve performance and security. The searching speed can be increased by using Ant Colony Optimization technique.

IX. RECOMMENDATIONS

Detail implementation of optimization technique can be considered as a extension of this study.

REFERENCES