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# Applications of Fuzzy Decision Support Systems in Human Resource Management by using TOPSIS approach

**S. N. Murty Kodukulla[1]*, K. Harikrishna Prasad[2], Dr. B. S. N. Raju[3]**
[1,2]Assistant Professor, School of Management Studies-M.R.P.G. College, Fort Campus, Vizianagaram
[3]Professor, School of Management Studies-M.R.P.G. College, Fort Campus, Vizianagaram

**ABSTRACT**
**Objectives**: To address the relevance of human resource management as well as the impact that the administration of this component of a company on the operation of that firm. In addition, to describe how to facilitate this process by making use of decision support systems, which are tools that can be applied to improve the results section.
**Method:** The theory that underpins the decision support systems is referred to as the TOPSIS (Technique for order of preference by similarity to ideal solution) approach, and it is a well-known method. In his paper, we discussed how the fuzzy and TOPSIS techniques will be used to provide interesting results.
**Findings**: Applicability of fuzzy TOPSIS approach in effective HR Decision making process in the areas of planning and administrative management.
**Novelty:** The numerous beneficial properties of the fuzzy technique can be utilized in the field of human resource management. The use of the fuzzy- TOPSIS approach increases the selection performance of employers and makes managerial decision-making easier.

**KEYWORDS:** Fuzzy Decision Support Systems, Human Resource Management, TOPSIS method, Fuzzy logic.

## 1. INTRODUCTION

Human Resources are viewed as the organization's principal source and property, as well as its primary source of interpretation, according to contemporary organizational theory. Human resources are essential to an organization's success or failure. Human resource administrators are fundamentally concerned with the recruitment of personnel. If the company's personnel selection decisions are defective, the consequences will be severe. In the past, organizations hired candidates based on tests such as personality tests, aptitude tests, and skill tests. However, the most difficult aspect of this examination was the recruiting vision.

A number of selection and employment characteristics are qualitative and cannot be measured, as you are aware. Thus, the application of fuzzy logic in human resource management has discovered a niche. In contemporary times, organizations rely heavily on information technology to make crucial decisions, which serve as the indisputable guiding principles in a highly competitive business landscape. This approach empowers managers to make informed and purposeful decisions.

Decision support systems, a type of computer-based information system, refer to the utilization of computers for the purpose of storing and organizing data. An interactive system that offers assistance to decision makers in interpreting information obtained from fundamental facts, documentation, personal expertise, and business models is referred to as an effective decision support system.

Subsequently, the matter is resolved and managed through the implementation of suitable resolutions [1].

Decision support systems can aid in making a diverse array of decisions. The aforementioned systems conduct a comprehensive analysis of the issue that encompasses both semi-structured and structured approaches. The predominant types of decision support systems were model-driven and focused on a specific subset of the available data. Presently, these systems have the capability to infiltrate the realm of data analysis companies that handle large volumes of data and perform diverse analyses [2,3]. The expansion of the definition of information processing and database technology systems can be attributed to the advancements made in this field.

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## 2. REVIEW OF LITERATURE.

A decision support system (DSS) is a computer program application used to improve a company's decision-making capabilities. It analyzes large amounts of data and presents an organization with the best possible options available. The main phases of a Decision Support System are Intelligence, Design, Choice, Implementation and Monitoring. Jhsan Erozan [4] presents a method for identifying critical components and a decision support tool for managing maintenance activities of critical components in manufacturing system.

Jose M. Gonzalez-Cava[5] presents a new methodology to solve a Closed-Loop Supply Chain (CLSC) management problem through a decision-making system based on fuzzy logic built on machine learning. Xindong Peng and Haihui Huang[6] described the feasibility of algorithm is stated by a financial risk evaluation example with corresponding sensitivity analysis.

### 2.1 Types of Decision Support Systems

Whilst the classification of Decision Support Systems is notably extensive, we endeavor to provide a comprehensive categorization of these systems in this context. The principal system categories can be delineated as follows:

**Model - Driven**: The majority of their efforts are concentrated on statistical, financial, optimization, and simulation models. According to the values specified by the user, an endeavor is made to aid in decision-making. These decision-support systems do not require a large amount of data to operate effectively. These systems include Decodes, an open source.

**Communication-Driven**: This type of decision support system is responsible for determining the possible group actions of a mission, such as those taken by the Microsoft Corporation group [7,8].

**Data-Driven**: Along with domestic and occasionally international businesses, a significant amount of time series data is utilized in this form of analysis.

**Document-Driven**: It is to one's advantage to be able to handle, retrieve, and edit unstructured data before being able to place it in the appropriate electronic structure [9].

**Knowledge-driven**: The process of problem-solving is carried out in an informed manner inside these many categories of decision support systems by making use of rules, procedures, or other equivalent structures.

On the other hand, in the modern day, we are able to observe the ever-increasing significance of decision support systems, and this is something that is visible in both the public and commercial sectors[10].

**Management Science in Fuzzy Environment:**

The traditional methods utilized in management science are drawn from mathematics as well as two-valued and multi-valued logic, both of which place a greater emphasis on accurate data. Because these techniques don't allow for the expression of ambiguity or human feelings (which are linguistic variables), the resulting mathematical models aren't as flexible or accurate as they could be.

In today's world, fuzzy management knowledge that makes use of fuzzy theory can be an innovative technique to resolving challenges and uncertainties resulting from the application of management system strategies. The theory of fuzzy systems can incorporate parameters such as knowledge, experience, judgments, and decisions into models by utilizing fuzzy logic theory and fuzzy measure theory. This creates flexibility in the model and produces a gray image of the world . The way in which the human brain analyzes information in its whole serves as the foundation for the theory of ambiguous systems. The following operations make up the various components that make up the information processing mechanism in the brain:(The process of retrieving information, recognizing it, thinking about it, assessing it, and making a decision).

Classical management science approaches can be adapted to fuzzy environments and applied to a variety of system management activities through the utilization of fuzzy systems theory. These activities include decision-making, the development of policies, planning, and modeling.

The Science of Fuzzy Management is a response to stances in the dynamic economic and social responsibility, and it was developed in response to these viewpoints. Fuzzy management science can also be used to develop models that, similar to humans, are capable of intelligently processing high-quality data. The following is a list of general features of managerial knowledge that lacks precision:

- Both the actual conditions and the coefficients are analyzed in order to establish the intuitive boundaries.
- Needed It is possible to acquire the knowledge and skills necessary to manage systems by communicating with experts in natural language mode. Furthermore, fuzzy inference makes it simple to construct computer models and algorithms.
- We can provide a more realistic solution by presenting the available answers to a question rather than limiting the number of possible responses to a specific value, and by also including the insights and perspectives of relevant experts and managers.

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## 3. DECISION-MAKING IN FUZZY ENVIRONMENT

The process of decision-making can be challenging in practical settings due to various factors, including incomplete or imprecise information, cognitive biases, and linguistic limitations, which can significantly impact the outcome. The aforementioned factors serve as evidence that the process of making decisions in contemporary society takes place within an environment that is characterized by uncertainty [11].

The table presented below delineates the fuzzy management science techniques in accordance with various management systems.

## 4. TOPSIS APPROACH

| Operations | | Method |
|---|---|---|
| Data gathering and experience | | Fuzzy databases, fuzzy knowledge base |
| Planning | Create model | Fuzzy structural models<br>Fuzzy regression models<br>Group Method Handling in Fuzzy |
| | Analysis and Evaluation | Theory to describe the object features in Fuzzy integral<br>Fuzzy AHP |
| | Optimization and Decision Making | Fuzzy mathematical programming<br>Fuzzy multi-objective planning<br>Fuzzy Multiple criteria decision<br>Fuzzy statistical decision |
| Administrative Management | Administrative Management | Application of Fuzzy Theory in the Behavioral Sciences<br>Application of Fuzzy Theory in Investment<br>Fuzzy Production Management<br>Fuzzy Decision Support System (FDSS)<br>Fuzzy Expert Systems<br>Fuzzy Quality Control (QC) |

In 1980, Huang and Yun created the TOPSIS (Technique for order of preference by similarity to ideal solution) Technique for Order Preferences by Similarity to Ideal Solution. Method space computing is multidimensional, and its optimal solution is a virtual point. We must have numerical information about the weight criteria in order to solve the decision matrix and provide suggested answers when using the TOPSIS method.

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These steps are:

- First, make the Decision matrix.
- Next, make the Normalization matrix R ij.
- Then, make the matrix V J.
- Finally, figure out the ideal solution as well as the negative ideal.
- Calculate the Euclidean distance (geometry) between every possibility and both the positive ideal and the positive ideal.
- calculate the closed-Index for each choice
- the better an option is when it has a larger size.

Solving with the TOPSIS method is highly dependent on how the criteria are weighted. Each criterion in the TOPSIS method can linearly increase or decrease the desirability to the decision maker. In the scientific literature of this field, numerous researchers have proposed various fuzzy TOPSIS methods, which are summarized in the following table.

| Source | Type of weighting | Figure of fuzzy number | Rating Method | Normalization Method |
|---|---|---|---|---|
| Chen and Hvlng 1992 | Adadfazy | Traps | Average generalized Li and Lai 1998 | Linear |
| Lylg 1992 | Fuzzy number | Traps | Chen Rankings 1985 | Manhattan |
| Chen 2000 | Fuzzy number | Triangular | Chen 2000 knows the ideal solution (1,1,1) and negative ideal (0,0,0) | Linear |
| Chen 2002 | Fuzzy number | Triangular | with a = 0.5 | Modified Manhattan |
| Zhang and Lu 2003 | Numerical values | Triangular | knows Ideal solution (1,1,1) and negative ideal (0,0,0) | Manhattan |
| chovolin 2003 | Fuzzy numbers | Triangular | Average harvest methods | Linear |

**5. Fuzzy Inference Systems software can be utilized in the development of content-based Fault Detection and Diagnosis Systems (FDSS).**

Fuzzy inference is the term used to describe the procedure of utilizing fuzzy logic to establish a correlation between input data and output. Subsequently, the mapping provides us with a foundation for decision-making, indicating either the available options or the nature of the model. The rudimentary constituents of fuzzy inference are the membership function, fuzzy logic operators, and the if-then principles.

The Fuzzy Logic Toolbox offers assistance for two distinct categories of fuzzy inference systems, namely MAMDANI and SUGENO. There exist discrepancies in the outcomes generated by diverse categories of inference systems.

Fuzzy inference systems have been utilized in diverse domains such as automatic control, data classification, decision analysis, expert systems, and computer vision. The multifaceted character of fuzzy inference systems has led to the emergence of diverse nomenclatures associated with this category of systems.

This suggests that fuzzy rules are used in the establishment of systems, which is similar to the case with fuzzy rule-based systems. Fuzzy modeling, fuzzy logic controllers, GIRIF decision support systems, and simple and ambiguous fuzzy systems are some of the other types of systems [12].

The Mamdani Method for Fuzzy Inference System is widely regarded as the fundamental principles that underlie fuzzy methods by a significant number of individuals. The Mamdani methodology is among the various control system development techniques based on fuzzy set theory that have emerged in recent times. The approach of utilizing linguistic control principles to regulate the steam engine and boiler was conceptualized by Ebrahim Mamdani in 1975.

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This approach was implemented as a collaborative effort and aimed to control the hot-causing elements. The operators were familiar with the linguistic control principles utilized in this approach, as they were based on human experience. This technique was employed for the regulation of the steam engine and boiler. Mamdani's work was motivated by an essay penned by Lotfi Zadeh, which expounded on a fuzzy algorithm for managing intricate systems and facilitating decision-making [12].

## 6. SUMMARY AND CONCLUSION

In this article, we addressed the relevance of human resource management as well as the impact that the administration of this component of a company can have on the operation of that firm. In addition, we can facilitate this process by making use of decision support systems, which are tools that can be applied to improve the results section. The theory that underpins these systems is referred to as the TOPSIS approach, and it is a well-known method. In his paper, we discussed how the fuzzy and TOPSIS techniques might be used to provide interesting results.

The numerous beneficial properties of the fuzzy technique can be utilized in the field of human resource management. The use of the fuzzy- TOPSIS approach increases the selection performance of employers and makes managerial decision-making easier.

**Additional Information and Declaration**

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**Competing Interests**

The authors of this research work declare that they have no competing and conflict of interests.

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