

# Analysis of Data Mining Techniques in Talent Management

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## Abstract

Human Resource (HR) applications can be considered as a means for providing consistent decisions and thus it can become an effective method to improve the process of decision making. Also, the main focus of experts in HR department is to identify the talents of individuals in an organization and to manage it by making sure that the right person is assigned the right job as and when required. This paper analyzes the different types of data mining classification techniques that can be used to make the prediction and identifying the talents of the human resources.

**Keyword:** Human Resource, Data mining, Decision Tree, Talent management, Artificial Neural Networks.

## 1. Introduction

The process of data mining helps to find hidden information that can be useful from the huge data available in the database. It involves steps such as exploration, pattern identification and deployment [1]. The combination of Artificial Intelligence (AI) techniques with HR applications can be helpful for decision makers to make unbiased decisions. HR professionals being humans may be biased toward a particular candidate in the recruitment process. So, AI algorithms can be designed that can help the employers to identify the required talent for the job and remove this biasness in making decisions. There are many AI techniques that can be used in this process. One such technique is use of Knowledge Discovery in Databases (KDD) and data mining. The KDD technique helps in extracting information by processing the data from the large databases. The data mining algorithms are used to extract this information. Data mining is the main part of KDD process that helps to investigate the database, extract useful information from the data by analyzing the complete database and then make useful predictions without any inaccuracy and inconsistency.

Human resources refer to the people that work for a particular organization. These can be beneficial for the organization to achieve its goals and objectives, if these human resources are well managed. Human Resource Management (HRM) is a technique to manage these human resources. It refers to the process of making efficient use of the available human resources in an organization. It includes various managerial activities that help to maintain a competent workforce-human resource. These activities includes planning of HR, managing the performance, promoting growth and development of an individual, enhancing the productivity of resources etc. All these activities are done to increase the performance level of an employee so that they can compete effectively and prove beneficial for the organization in achieving its goals. All this depends on having right people for the job with required skills so that they can be deployed in appropriate locations at the right time. This involves making a

lot of managerial decisions and thus HRM is required to make the best decisions. While making the decision of selecting the human resources many factors such as experience of an individual, his previous knowledge, preferences etc. are considered. These factors can result in inconsistency, discrepancy, unfairness and biasness while promoting an individual. So, this situation can make people feel that partiality is being done and which can affect the output obtained from any project in the future. One of the top challenges of HR management is to assign the right person for the right job by identifying the talents of different individuals by seeing their previous records [2]. The data mining techniques can help in completing this challenge. The automated discovery tools are used that help the decision making team in making accurate decisions. These tools analyze the database completely and extract high level information from the database to give this information to the analyst [3]. Data mining can help the HRM team to identify the suitable person for the job. The study done in this paper focuses on helping the HRM team to predict the talent of individual based on the performance using different data mining techniques.

## 2. Related Work

Data Mining is finding useful and hidden patterns of information from large datasets available and in the HR department of any organization the datasets involve data of the employees working for the organization. So, the main focus of decision making team is to use the talent of the employees in a way such that it proves beneficial for the organization and talent management process is carried out. A lot of work has already been done in this field. Some of the reviews have been mentioned below:

The decision tree data mining technique for talent management uses divide and conquer approach. C4.5 classifier has been used for predicting the performance of individuals which provided accurate results [4].

In any organization, recruitment can be considered as one of the most important issue. So, a fuzzy based data mining tool has been proposed so that it could help the HRM team to take decisions efficiently [5].

Parneet Kaur [6] discussed about the use of data mining techniques in the education field. It is shown how WEKA, an open source tool can be used to identify slow learners among students with the help of classification algorithms.

The hidden information of the students can be found using Baye's classification. It can help the institution to know about the students who are consistently performing better and those who need special attention [7].

Saranya Vani. M [8] did a comprehensive study on use of data mining techniques like rule based classification, K -nearest neighbour classifier etc. for classification of data from the large databases.

Mr. Sudhir M. Gorade [9] studied various data mining techniques for classification such as neural network, support vector machines, k-nearest neighbor, and Bayesian classification.

Rajkumar. S [10] explained about criminal analysis and prediction of crime using data mining techniques.

### 3. Talent Management Using Data Mining

The process of Knowledge Discovery in Database (KDD) is believed to be the most significant part in data mining as data mining is an emerging analysis tool in determining the talent of an individual [11]. This is due to the need of extracting some useful information and knowledge from the large amount of data available. The most widely used techniques for performing data mining are prediction and classification.

#### 3.1 Elements of Talent Management

Talent is the ability of an individual that can create a huge difference between the present situation and the future of an organization [12]. Talent Management (TM) plays an important role in identifying the real talent that is required for a particular task. Every employee of the organization claims that he has the talent. But is it true or not? Talent management helps to find out the employees with the best skills and who can contribute more in achieving the goals of organization. TM helps to increase the performance of an individual and motivates them to perform better. The three important elements of Talent Management (Talent Acquisition, Talent Development and Motivation and Talent Retention) are shown in Fig. 1.



Fig.1 Elements of Talent Management

**Talent acquisition** refers to the identification of best talents and then those selected individuals suited for the job are recruited. **Talent Development** means developing the talent of an individual by giving them training on time and motivating them to perform better. **Talent retention** means making an individual stick to an organization for a longer time. But achieving all this requires planning so as to extract the best information and this can be done using different techniques of data mining.

#### 3.2 Classification and Prediction in Data Mining

A large amount of information is hidden in the database which can be useful and that can help in making intelligent decisions [4]. These decisions are accurate and unbiased. Prediction and classification are the important data mining techniques that can help to produce intelligent decisions. The decisions taken are auto generated.

The Fig. 2 shows that in an organization, it is important to make correct decisions regarding selection of employees for a particular job. It can be done by identifying the talent areas of individuals who are already working with the organization. Some activities are also

performed which helps an individual to grow. These activities include training programs, job shadowing and rotations, stretch assignments etc. The employees take part in these activities and based on their contribution in activities they are selected. After selection, data mining techniques are applied. Various techniques of data mining include decision tree, neural network, fuzzy logic which further includes clustering and genetic algorithm. Then classification rules are applied. The utilization of different techniques for prediction and classification can help in determining the exact rate of the performance of employees, their behavior and attitude, their progress in performing any task given to them etc.

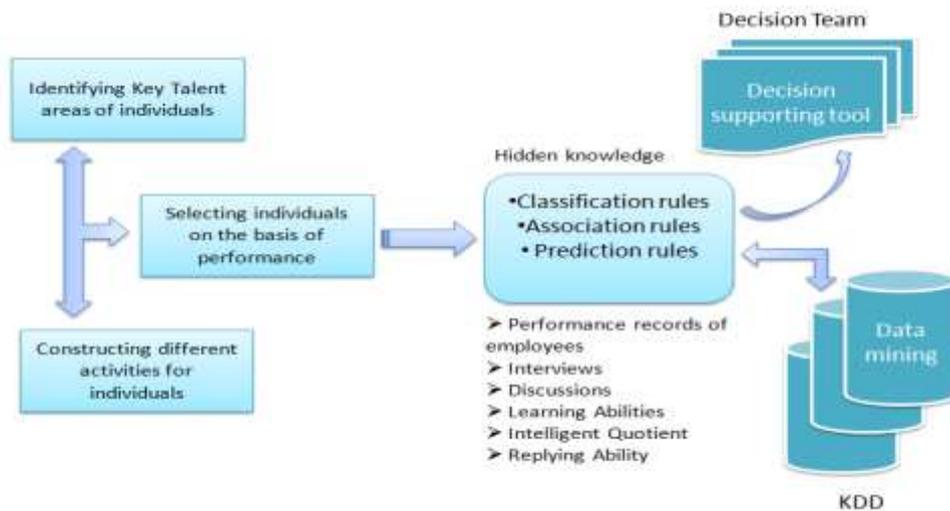


Fig. 2. Human Talent Prediction using Data Mining Technique

This study focuses on identifying the best talented individual for the job by using data mining techniques. These techniques help in producing rules of prediction for identifying the right talent for a particular job. In order to produce relevant good results the different data mining techniques can be used.

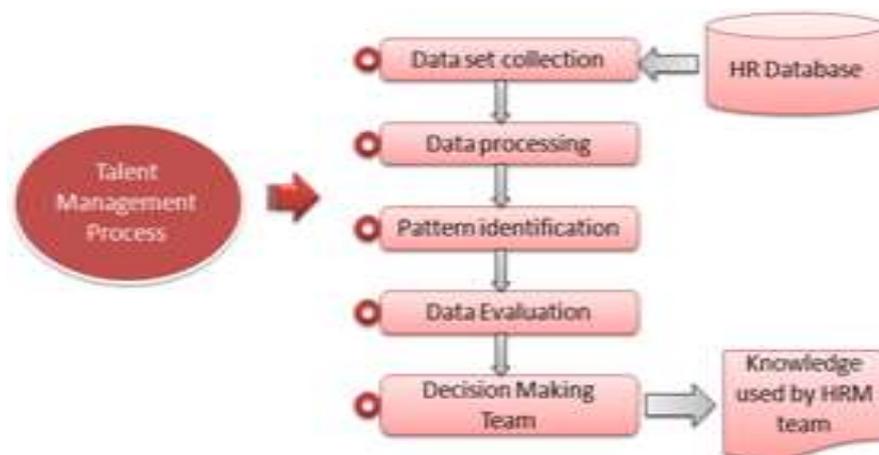


Fig. 3 Process of Talent Management

The Fig. 3 clearly shows that the first step involves collecting data from the human resource database such as previous records of employees including their performance, talents etc. The

collected data is then preprocessed in order to remove discrepancy and inconsistency of data set and to improve the quality of given data set. Then, the patterns are identified by analyzing the data sets so that the relationship among data can be represented with the help of different techniques such as Neural Network, Decision Tree, Fuzzy Logic, Rough Set Theory and so on [13]. This information is sent to the decision making team so that useful and unbiased decisions can be made. The above steps are repeated until meaningful knowledge is extracted.

#### 4. Talent Forecasting using Data Mining Techniques

Data mining techniques such as decision tree, neural network and fuzzy logic are used in making predictions and are used in many fields. A brief analysis of these techniques is as follows:

- a) **Decision Tree:** This technique is used to represent the data in the form of a tree like structure and it belongs to supervised learning. It is a very useful technique as there is no need of any previous knowledge for constructing the decision tree. Also, the classification done using this technique is very accurate [14]. It includes following methods:
  - (i) **ID3 algorithm:** This algorithm follows top-down greedy approach in constructing the decision tree from the given set of attributes. The information gain approach is used and the attribute with the highest information gain is selected [15].
  - (ii) **C4.5 algorithm:** It is an extension of ID3 algorithm. It is called as statistical classifier and works on information gain. This algorithm can handle both continuous and discrete attributes and each attribute with different cost [15]. It is very easy to understand as each derived rule can be interpreted easily [4].
  - (iii) **Random Forest algorithm:** In this multiple subsets are created based on the original data set and predictions are made for all the constructed trees. The final prediction is based on the aggregation of result of all the trees [15].
- b) **Neural Network:** It consists of input layer and output layer. Many learning algorithms and activation functions are applied on the inputs to obtain the exact output. The neural networks are trained to identify, store and retrieve the stored patterns in order to obtain the correct output. They can be used to extract useful information from a huge amount of data [17]. It includes:
  - (i) **Multilayer Perceptron:** It is a multilayer feed forward neural network. In this multiple layers are involved called hidden layers. More number of hidden layers helps to produce more accurate results.
  - (ii) **Back Propagation algorithm:** It allows backtracking. In this error is calculated if the actual and desired output does not match and the calculated error is then back propagated [17].
- c) **Fuzzy Clustering:** It includes fuzzy clustering technique in which clusters or groups are made containing the similar type of data. The clusters formed can be well separated or overlapping according to the data available [18].

Table 1 lists some of the characteristics of data mining techniques.

**Table 1: Data Mining Techniques**

<b>Data Mining Technique</b>	<b>Characteristics</b>	<b>Algorithms/Techniques</b>
<b>Decision Tree</b>	<ol style="list-style-type: none"> <li>1. It is used for prediction with higher accuracy.</li> <li>2. It is easy to interpret</li> <li>3. It is explainable to the user.</li> <li>4. It is easy to understand</li> </ol>	<ul style="list-style-type: none"> <li>• ID3 Algorithm</li> <li>• C4.5 Algorithm</li> <li>• Random Forest</li> </ul>
<b>Neural Network</b>	<ol style="list-style-type: none"> <li>1. It is useful for prediction of candidates that would be better for a particular job.</li> <li>2. It can identify the number of staff members required at any point of time in an organization.</li> <li>3. It can handle changes in the input.</li> </ol>	<ul style="list-style-type: none"> <li>• Multi layer Perceptron</li> <li>• Back propagation algorithm</li> </ul>
<b>Fuzzy Logic</b>	<ol style="list-style-type: none"> <li>1. It can be used to assign value to an employee on the basis of competency level.</li> <li>2. It is used to form groups of people having similarities.</li> <li>3. It can predict right people for the job with accuracy.</li> </ol>	Fuzzy Clustering

## 5. Data Mining in HR Applications

The various data mining techniques can also be used in Human Resource Management (HRM) as well. A brief overview of these activities in HRM is as follows:

- a) **Decision Tree:** It can be used to find suitable individuals for a job by making a tree out of the available data set according to the qualities present in an individual. This tree is designed according to the skills and attitudes of candidates and thus help the decision making team in doing their placement for the job.
- b) **Fuzzy Logic and ANN:** These can be used to determine individual differences in order to hire individuals suitable for a particular job. Personnel selection involves identification and evaluation of a candidate considering the requirements of the job. Personnel selection using these methods can help an organization to find best applicants for the job [18]. Data mining using these methods also help in assigning project to the employees according to the abilities, skills and knowledge.
- c) **Rough Set Theory:** It is also related to fuzzy logic and is very effective in establishing relationship between imprecise and noisy data [18]. It provides mathematical tools to find the hidden patterns in the data. The information extracted is stored in the form of a table. This information helps the HRM team in doing the selection of an individual for the job effectively and thus helps in the recruitment process.

The Table 2 shows the data mining techniques in various activities of HRM.

**Table 2: Data Mining in HR Applications**

<b>Data Mining Method Used</b>	<b>Activity in HRM</b>
Decision Tree	Placement of individual for a particular job, Job attitudes
ANN and Fuzzy Logic	Development of Employees, Assignment of project to employees
Rough Set Theory	Personnel Selection and Recruitment

## 6. Observations and Results

Talent is the ability of an individual that can create in a huge difference between the present situation and the future of an organization. Talent Management (TM) plays an important role in identifying the real talent that is required for a particular task. Every employee of the organization claims that he has the talent. But is it true or not? Talent management helps to find out the employees with the best skills and who can contribute more in achieving the goals of organization. TM helps to increase the performance of an individual and motivates them to perform better.

In this work, data mining techniques such as decision tree, neural network and fuzzy logic that are used in making predictions about human resources and management of talent have been analyzed by the authors. It has been observed by the authors that decision tree technique is used for prediction with higher accuracy, easy to interpret, explainable to the user and easy to understand. Neural network technique is useful for prediction of candidates that would be better for a particular job, identify the number of staff members required at any point of time in an organization and can handle changes in the input. Fuzzy logic technique can be used to assign value to an employee on the basis of competency level, used to form groups of people having similarities and can predict right people for the job with accuracy. Further, decision tree technique used ID3 algorithm or C4.5 algorithm or random forest algorithms for prediction and management. Neural networks technique use multi layer perceptron or back propagation algorithm for prediction and management. Fuzzy logic uses Fuzzy clustering algorithm for prediction and management of the HR talent. Every technique has its own characteristics, advantages, disadvantages and applications depending upon its applicability on various activities of HRM.

## 7. Conclusion

This paper describes about the significance of data mining techniques in Human Resources applications. Also, it helps in making predictions and classification. It also explains the concept of talent management process used by HRM team to identify the best individuals. With this the organization can help their employees by improving their career growth which in turn will be beneficial for the company. It can also improve the hiring methods of new employees. The use of KDD in the data mining process can prove very useful as it can help in identifying the right person for the job without any inconsistency and biasness.

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