International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-2 Issue-5, April 2013

Data Mining: A Tool for Knowledge Management in Human Resource

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Abstract*—Competitiveness is a company's ability to maintain gain and reputation in its respective market or industry. Human Resource Management (HRM) plays a lead role in determining this competitiveness and effectiveness for better survival. The HRM generally refers to the policies, practices and systems influencing employee behavior, attitude and performance. Companies consider HRM as "people practices". So it becomes the responsibility of the HRM to mine the best talents at the right time, train them, observe their performance, reward them and ultimately keep them happy in a company. It is simply because of the reason that every strategy of an organization is directly or indirectly related to the talents of the same. To gain and sustain a competitive advantage, knowledge management (developing, sharing and applying knowledge) within the organization becomes essential. But then how is HRM connected to Knowledge Management (KM) becomes a very relevant question. When employees are evaluated from their performance, different methods can be used for mining the best knowledge out of them. This paper is an attempt to study and understand the potential of Data Mining (DM) techniques for automated intelligent decisions from rich employee data base for predictions of employee performance implementing the finest KM strategies, thus achieving stable HR system and brilliant business.

***Index Terms*— Data Mining, Knowledge Management, Human Resource Management, Talent Management, Classification, Prediction**

I. INTRODUCTION

Technology advancement in business organizations has always grown with steady Human Resource (HR) professionals. They are now able to contribute more time to strategic business decisions as the development of technology has allowed for the automation of many transactional HR processes [1]. HR professionals need not handle data manually anymore. These data is considered best for decision-making easy in any organization. At the same time it is challenging to find out the best and useful data from vast troves. This is where Data Mining comes to play greater roles. When information, data and knowledge can be used interchangeably, DM is considered the best tool for Knowledge Management (KM) in Human Resource Information System (HRIS) as well by HR professionals. Data Mining (DM) appeared around the 90's when the database communities used them for clustering, classifying and predicting data for better decision making in business. Presently DM and Knowledge discovery are used interchangeably. In organizations, DM goes beyond the exact purpose when it reaches knowledge discovery. Employee retentions and compensations are done based on these patterns developed. KM is about developing, sharing and applying knowledge within organization to gain and sustain a competitive advantage [2]. In this paper Section- I is an introduction, Section-II gives definitions and concepts of Data Mining and Knowledge Management with Human Resource Management, Section-III describes KM in an ICT approach, Section-IV describes KM with HRM strategies, Section-V explains data mining in Talent Management (TM) with challenges in TM and DM methods used in them, finally Section-VI are the concluding discussions on KM as the future of HR.

II. DEFINITIONS AND CONCEPTS

A. Data Mining

DM really gained a lot of prominence in the society as it helped make prediction methodologies easier in various fields. Data mining may be viewed as the extraction of patterns and models from observed data [3]. Data mining tools aid the discovery of patterns in data. [4], [5], and [6]. Gartner, the global leader in technology research and IT services define mining as the process of discovering meaningful correlations, patterns and trends by sifting through large amount of data stored in depositories [7]. Any data base or data ware house that is rich and colorful with information has to be mined for intelligent decision making. Over the years, various techniques have evolved in DM namely machine learning, statistics, classification, clustering, rule induction, pattern recognition, neural networks. Out of these classification and predictions gained much importance as they really promoted intelligent decisions. They have also been introduced in machine learning, statistics and pattern recognition. Although DM techniques have attracted all fields like medical, telecommunication, manufacturing, health care and customer relationship, the technique was not of much attraction to the HR fields [8, 9]. But things have changed recently in HR also or the so called Talent Management(TM) which is considered sometimes within and beyond HRM.

Manuscript published on 30 April 2013.
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B. Knowledge Management

It was soon after the establishment of DM in the 90's KM also got importance. The rise and growth of KM is one of the managerial responses of the imperial trends associated with the globalization and post industrialism [10]. KM has always contributed to beef up the organizational knowledge for business benefits. The aim of KM itself is the interaction between people, technology and processes in an organization. Basically the knowledge industry divides knowledge as floating and static knowledge. Floating knowledge refers to the knowledge works of people with experience and static knowledge refers to the documented information. Therefore it becomes very important to collect and maintain this floating knowledge to data repositories as static knowledge. If KM is well practiced the ability of an organization to grow increases as well. It is all about transforming available data to reusable repository for long future service or reference when it comes to strategic planning. They basically involve simple methods like acquiring, creating and sharing knowledge wide across the organization. When it comes to HR, personal skills are always considered right from effective reading, ability to work and cope up with situation to synthesizing and communicating information in an organization. As we said floating knowledge is difficult to capture as they are in human minds but static knowledge can be transferred to computers. For example, ask a person how to ride a bicycle, it may not be easy for him to explain, at the same time he can ride and show you his know how.

C. HRM

A very deep understanding of HR and associated resources is very crucial for an organizational decision making. It is very important to know your organization and capable people there before you start structuring the strategies. It becomes the ultimate responsibility of the HRM to manage their resources right from keeping them happy with basic facilities to lifting them to comfort zones. These include assessing, selecting, training and rewarding the right employee at the right time. Mostly HRM makes this mistake of not realizing the best talents but do that when the employee decides to leave the organization. But then can HRM be held responsible for an employee leaving? According to me "YES" as HRM is the specialist that stands between the senior management and the staff. So if HRM could project and motivate the right talents at the right time, a strong HRM can hold back best talents leaving the organization. But the question is entirely different when the so called senior management thinks only on monetary benefits of the organization. Management should not behave like "Gods" instead should understand the ability of the talents within; encourage them for the goodwill organization and of course the society. This will enable HRM systems do a committed work. Whilst there remain many arguments as to equating TM with HRM, when both TM and HRM recognize the importance of appropriate role allocation of people, handle same key functional areas of people management and integrate them with business strategy [11], both the terms HRM and TM has been used interchangeably in this paper.

III. KM WITH CREATIVE HRM-AN ICT APPROACH

While talking about data or knowledge, there can be facts or meaningless data. When you have data related to some other data, you may call it information. They could be further refined to get functional forms. In any organization the most fundamental and basic classification of the organizational knowledge is along explicit-tacit dimensions.

Those knowledge classifications that can be specified in words or numbers are called explicit knowledge. At the same time a knowledge that is related to the knower's experience which is situational or subjective is called tacit knowledge. Therefore explicit knowledge is easy to transfer via established rules or procedures whereas tacit knowledge is difficult to formulize, communicate or document. To summarize, to understand completely a written document (explicit knowledge) often requires a great deal of experience (tacit knowledge). For example, A sophisticated recipe is meaningless to someone who has never stood in the kitchen [12].

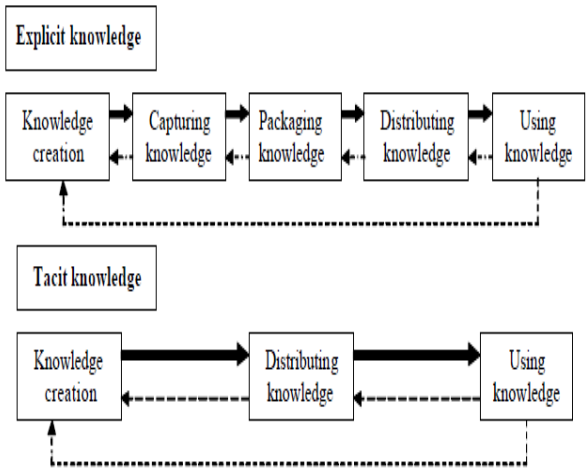

Fig. 1 Explicit and Tacit KM processes [13]

Capturing explicit knowledge can be in four ways [13]. First, the documenting can be done as a passive by-product of the work process done via electronic communication or such which can be collected later on. HRIS could be an effective system to collect explicit information. Secondly; it could be from brainstorming sessions that took place through electronic meetings or video conferencing. Third could be documenting as part of deliberate and structured meetings for future use. And the fourth could be from learning histories and creating data warehouses.

The method of structuring, cleaning, polishing and formatting the required knowledge is packaging knowledge. As shown in the figure tacit knowledge has fewer parts than explicit knowledge. As far as knowledge distribution is considered, it is done using community practices, brainstorming sessions, informal talks and meetings etc. These concepts are all explained in conjunction with ICT systems. When ICT was not so popular, many managers in organizations faced severe problems. They had to seriously depend on old file systems. Table 1 [14] describes close link between KM and HRM to the firm's competitive strategy. Knowledge in itself is not very important, but the way they are applied to the strategic objectives makes them the critical ingredient.

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The codification model [14] calls for managers to encourage and reward employees in different ways to document knowledge in database repositories that could be useful at the time of performance appraisal reviews.

When HRM emphasizes on functions, TM specifically focuses on people [11]. So gradually TM has established not to be different from HR.

Competitive strategies are linked with HRM practices [17]. They made use of a perspective approach of the Porter's

Table 1: Knowledge Management Strategies

	Codification Strategy	Personalization Strategy
General Strategy	Develop ICT system that codifies, stores, disseminates and allows re-use of knowledge	Develop networks for linking people so that tacit knowledge can be shared
Use of ICT	Invest heavily in ICT	Invest moderately in ICT
Human Resources: Recruitment and Selection	Hire new college graduates who are well-suited to the re-use of knowledge and the implementation of solutions	Hire MBAs who like problem-solving and can tolerate ambiguity
Training and Development	Train people in groups and through computer-based distance learning	Train people through on-to-one mentoring
Rewards Systems	Reward people for using and contributing to document databases	Reward people for directly sharing knowledge with others

People document knowledge in different ways. From, the exploitative learning and exploratory learning in [15], the exploitative learning says between employers and employees there can be short-term low risk taking commitments. This is effective HRM. Thus, codification of a knowledge strategy is an attempt to mechanize knowledge. At the same time exploratory learning encourages better behavioral outcomes like risk taking, exchange of ideas and long-term commitments which can be called the 'Creative HRM' [15].

Some of the main HR practices that were found essential for KM in an organization are their HRM strategy like selecting and recruiting, training and development, performance management and creating learning environment. HRM exhibits a fusion of personal and industrial relations, which are based on resource conception of the employee relations and can be viewed as part of business strategic planning policies. Thus finding the right talent, paying them well and explaining them about the management's expectations, justifying management and satisfying employees all requires huge knowledge management. Therefore HRM or TM becomes the most crucial and responsible point of contact inside and outside the organization in maintaining and managing knowledge.

IV. KNOWLEDGE MANAGEMENT FOR HRM STRATEGIES

Strategies have been one of the corner stones of the HRM debate since 1980's [16]. There has always been a tight hunt for the exact model matching the HR and the business strategies [15].This could be probably because of the reason that when you have steady business plans it is indirectly associated with your talents. So talents should be taken care of as part of TM practices. Therefore knowledge management in TM goes through lots of thoughtful processes.

So does both emphasize on integrating business strategies allocating the correct talent, maintaining them, rewarding them etc. Competitive strategies are linked with HRM practices [17]. They made use of a perspective approach of the Porter's competitive strategy to explain this. Three competitive strategies are explained. They are the innovative strategy, quality enhancement strategy and the cost reduction strategy. All the three require skilled people with different knowledge, abilities and technical skills or behavior [17]. In substance we could summarize the three HRM practices as-

HRM's significant implication becomes the innovation strategy. When people work harder (cost-reduction strategy) or smarter (quality strategy) for the same services or products, HRM need not any more emphasize on people management. His naturally help people work differently and enthusiastically which is the main ingredient of HRM.

In reality, organizations tend to combine certain strategies, such as low cost and quality or quality and innovation [17]. These might result in inspiring and pleasing talents, at the same time managing conflicts and tensions. An association between these strategies and HRM practices are shown in Fig: 2.While we link KM with HRM [14], it is not simply the knowledge that is important, but the way it is applied matters. The need for the best HRM practice is also stressed on KM applications.

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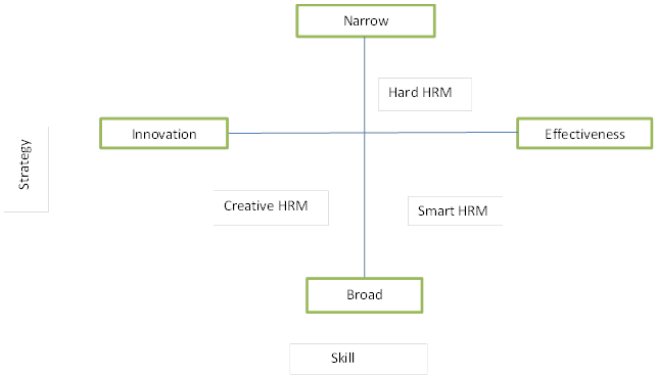

Fig. 2 Strategies and HRM practices [15]

V. DATA MINING TOWARDS TALENT MANAGEMENT AND FORECASTING

Data mining is part of the process in knowledge Discovery in Database (KDD).Data mining is a step to knowledge discovery. In the process of knowledge management, valuable and meaningful data can be actually extracted from vast troves of data using the technique of data mining. Out of the many data mining tasks used classification and prediction techniques are the most widely used ones.

A. Talent Management- challenges

Talent is considered as the ability of any individual to make a substantial difference to the current and future performance of the organization [18]. Talent Management can be defined as a process to ensure leadership continuity in key positions and encourage individual advancement and decision to manage supply, demand and flow of talent through human capital engine [20]. This process of identifying the best talents usually is not very easy. Employees claim to have talents. But do they really have it? HRM has to mine the best out of them.

The three key components of Talent Management are –

1) Talent Acquisition
2) Talent Development
3) Talent Retention

Talent acquisition involves identifying the best talents, selecting and recruiting them. Talent Development deals with development of the recruited staff by giving them on-time training, updating them on industry standards etc. And Talent retention is what exactly HRM does. Retention holds back staff keeping them updated and happy on all aspects. But all these require huge planning in advance to extract the best out of whatever is available. There comes the role of data mining the knowledge that is available within the talents in the form of floating and static knowledge.

B. Classification and Prediction in Data Mining

Intelligent decision making can be made from hidden information in rich database or data warehouse. Intelligent decisions are similar to human decisions but are automated decisions. Classification and prediction in machine learning are among the techniques that can produce intelligent decision [23]. So are researches still in progress.

The classification model goes through two phases Fig. 3. The first phase involves the model construction and the second phase involves the use of model in classification [24]. The model construction phase is known as the learning process where the training data are scrutinized by the classification algorithm. The learned model is then denoted by the classification rules. At phase two the accuracy of the classifier or the classification model is made using the test data. If you get an acceptable accuracy, the rules can be applied to fresh data set. For the purpose three main classification techniques can be used which has its own advantages and disadvantages [19]. First is the decision tree technique which does not require much parameter settings Second technique is the neural network that has high tolerance on noisy data, also with the ability to classify patterns on untrained data with little knowledge on attribute-class relationships. And the third technique that can be used is the k-nearest neighbor technique which is simply instance- based.

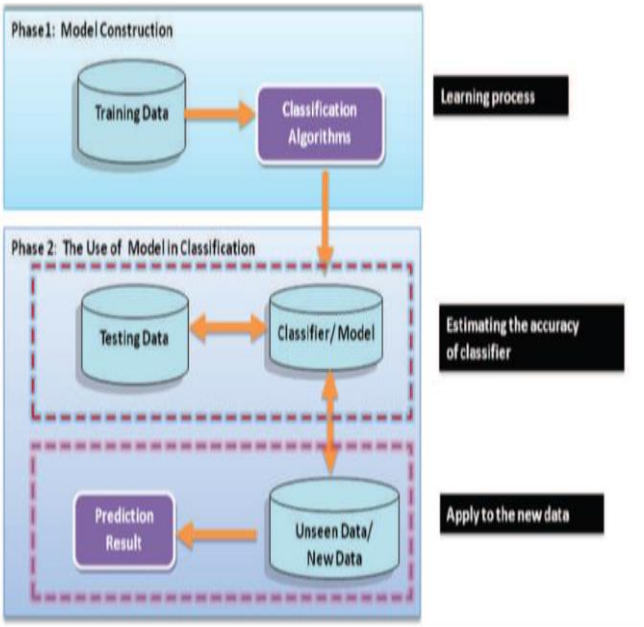

Fig. 3 Classification and Prediction

The process to identify the existing talent in an organization is among the top talent management challenges and the important issue [21]. The talent management process consists of recognizing the key talent areas in the organization, identifying the people in the organization who constitute key talent, and conducting development activities for the talent pool to retain and engage them and also have them ready to move into more significant roles [20] (Fig. 4). These processes involve HR activities that need integration into an effective system [22] (Fig. 4). Studies are still on in the application of data mining in talent management. Jantan et al. focused on identifying this existing talent regarding the key talent in an organization predicting their performance from previous employee performance records in database. This could help the talent management evaluate and identify employees even at the time of performance appraisals.

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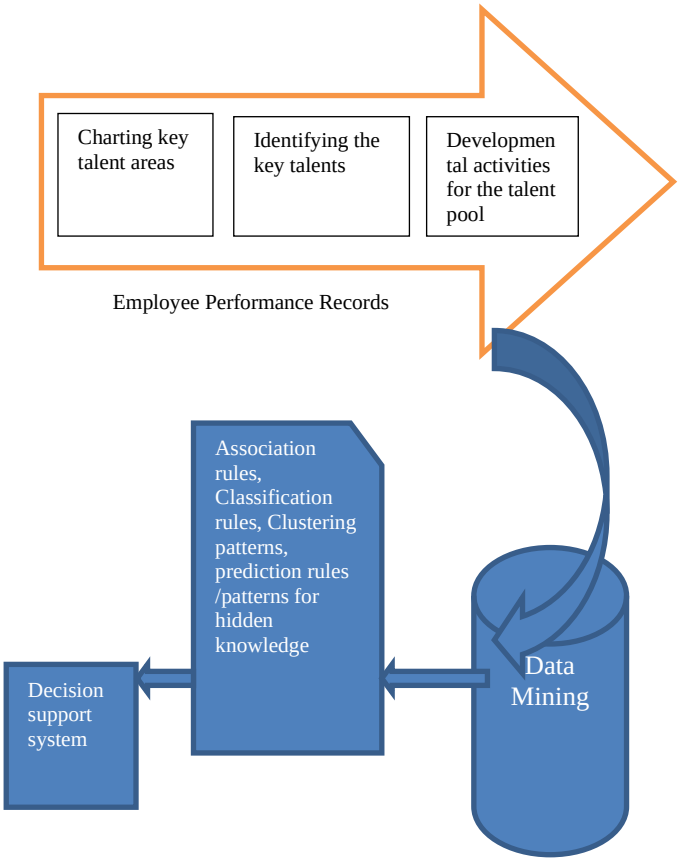

Fig. 4 Data Mining and Talent Management

C. *Talent Forecasting*

Recently, with the new demand and increased visibility, HR seeks a more strategic role by turning to data mining methods [8]. The forecasting is done from the existing employee performance database .Some of the best data mining methods used are clustering which involves listing employees with similar characteristics and group top performers. Association rules are used to associate employee's profiles to the most appropriate program or job and then associate the employee attitude with performance. And the predictions used on classification to find out the percentage of accuracy in employee performance, behavior and attitude, analyzing, forecasting and identifying the best profile for different employees (Fig.5).

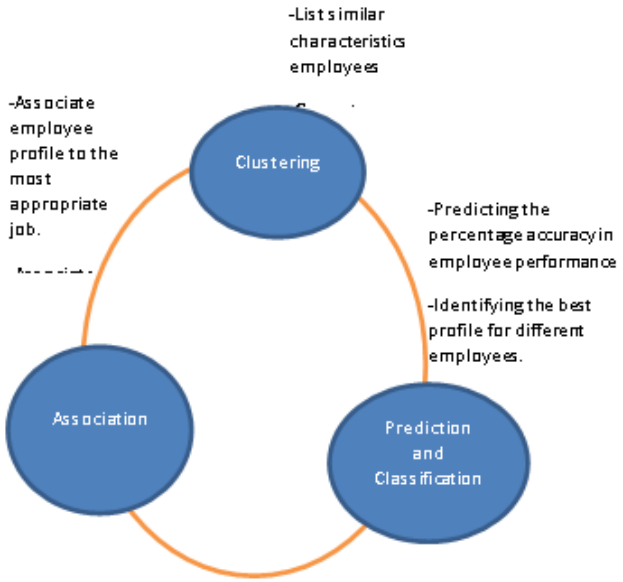

Fig. 5 Data Mining for Talent Management

D. *DM techniques -Human Talent Predictions*

Till now many discussions were up in this paper regarding KM and relationships with TM strategies. To an extent good explanation of explicit and tacit knowledge has also been done in TM. But what should be the data mining technique that has to be used to mine the so called knowledge for predictions and further strategies in TM remains the highlight. For the purpose we can discover an employee performance using classification and prediction techniques in DM. Since the construction of decision trees does not require any expert knowledge or parameter setting, they remain popular and are considered for exploratory knowledge discovery. Still the technique which is otherwise known as the 'divide-and-conquer' rule is undergoing researches.

The accuracy of the classification model helps to identify the important attributes and rules. So the hidden knowledge from the performance evaluation could be implanted to the decision support system for the prediction of employee performance. Thus intelligent decision support systems can be used to predict whether the employee is eligible for promotions or not [23] (Fig.6). These DM predictions on employee performance can lead to good strategic planning.

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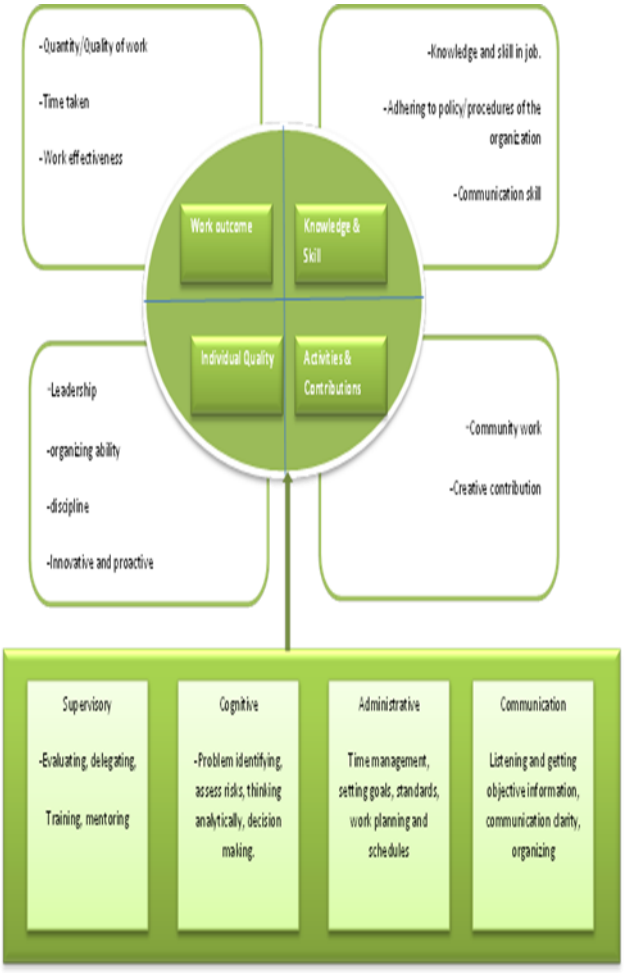

Fig: 6 Human Talent predictions using DM techniques [23]

VI. KM - FUTURE OF HR: CONCLUDING DISCUSSIONS

HR community has been trying its best in developing different methods to share knowledge within organization for better transparency in policies and uplifting the employee community. The two main issues that drive to the need of KM program implementations are the competitive mentality of the organizations and this competitions resulting in internal KM programs with allocated budgets.

The leverage that KM has contributed to the strategic organization plans is tremendous. The KM expansions has allowed HR experts move outside the traditional limits, as they provide solid and measurable benefits to the senior management with exact predictions. Thus exact on-time predictions help management expand the corporate culture, identify and reward the best talents. This also helps the management understand that unlike fixed assets, intellectual assets should be better valued and taken care of. The most creative and innovative talents will be of the highest demand in the market and companies who fail to capture their employees' wisdom suffer every time a talent walks out of the door.

This study has attempted to describe the importance of using data mining for talent management especially classification and prediction. Though C4.5 classifier has shown its potential accuracy [23] many a time in experiments conducted by researchers, there is a severe need for other decision tree classifiers also to be experimented which shall be studied and considered for future research.

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