A Review of Performance Assessment in Virtual Organization using Domain-Driven Data Mining and Sentiment Analysis

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ABSTRACT: Due to the transformation from industrial age to knowledge era, performance evaluation in virtual organizations has been considered as one of the most important issues. Virtual Organization being geographically diffused, evaluating the performance of the employees working in it is a major challenge. Assessment as a dynamic process produces data, which acts as performance indicator for an individual and subsequently impacts on the decision making of the stakeholders as well as individual. The rapid development in the business scenario has not left any sphere of the human work life untouched. The idea proposed in this system is to perform an analysis considering number of performance measures for the derivation of performance prediction indicators needed for employee performance assessment, monitoring and evaluation. The aim is to predict the quality, productivity output and potentiality of the employees across various disciplines which will enable higher level authorities to take decisions and understand certain patterns of employee motivation, satisfaction, growth and decline in virtual organization. An interpretive, phenomenological Domain Driven Data Mining (D3M) method using 360 Degree data mining for objective measurement and sentiment analysis for subjective measurement enabled a hermeneutic analysis process which includes human practices, culture, work of art and text. This new generation data mining methodology used for extracting useful patterns from the organizational employee database and is able to extract certain unidentified trends in employee performance when assessed across several parameters. Sentiment analysis is done to know the perception of an individual employee towards various tasks and work structure. Further the system is integrated with fuzzy group decision support system which works as multi-factorial evaluation.

KEYWORDS: Virtual Organization, Domain Driven Data Mining (D3M), Sentiment Analysis, Fuzzy Group Decision Support System (FGDSS)

I. INTRODUCTION

Virtual Organization is a network of independent firms that join together, often temporarily, to produce a service or product. It is often associated with terms such as virtual office, virtual teams, and virtual leadership. The ultimate goal of the virtual organization is to provide innovative, high-quality products or services instantaneously in response to customer demands. It stands for a task, project or permanent organization which is decentralized and independent of any spatial connection [1]. This new form of organization emerged in 1990 and is also known as digital organization, network organization or modular organization. Alternatively speaking, the virtual organization is a social network in which all the horizontal and vertical boundaries are removed. In virtual organizations, the employees work on different tasks in different environments rather they communicate with each other and convey messages through different communicating media to accomplish a common goal without time barriers. A virtual organization and its small variant, the virtual team, is an organizational network that is structured and managed to function as an identifiable and complete organization. These teams face many crucial problems during different functionalities such as collecting the information, distributing information, decision making and implementation. It is becoming a challenge to the business analysts to build a perfect evaluation system for evaluating the performance of the individual employee as well as the performance of the organization. Performance evaluation as described in [4] is a systematic way of reviewing and

assessing the performance of an employee during a given period of time and planning for his future. It is a powerful tool to calibrate, refine and reward the performance of the employee. It helps to analyze his achievements and evaluate his contribution towards the achievements of the overall organizational goals. According to Flippo (1984), a prominent personality in the field of Human resources, "performance evaluation is the systematic, periodic and an impartial rating of an employee's excellence in the matters pertaining to his present job and his potential for a better job."

A. *CHARACTERISTICS OF VIRTUAL ORGANIZATION:*

The characteristics of a virtual organization are [11]:

- Dispersion-It means that the organization is geographically distributed or diversified based on their location, multiple local cultures and languages.
- Empowerment-It refers to the division of responsibility and work across the network. Every member of the virtual organization has their own strategic goal.
- Restlessness-Restlessness denotes that the changes in organizational practices and customs are accepted across the network.
- Interdependence-The most important characteristic of a virtual organization is its interdependence. It refers that the individual members (persons or organizations) of a network must cooperate with each other in order to gain synergy benefits.

B. *PERFORMANCE MONITORING IN VIRTUAL ORGANIZATION*

The virtual organizations are growing more and more in size and in functions; therefore they are becoming complex to handle. They come across various problems and challenges of Performance Appraisal in order to make a performance evaluation system effective and successful. The focus of the performance evaluation is measuring and improving the actual performance of the employee and also the future potential of the employee. Its aim is to measure what an employee does. The relative worth of an employee is analyzed by the obtained information of an employee.

C. *NEED FOR ANALYZING THE PERFORMANCE OF EMPLOYEES*

- To notice the growth factor of the virtual organization over a given period of time.
- To judge the gap between the actual and the desired performance of both the employees and organization.
- To help the management in exercising organizational control, strengthen the relationship and communication between superior - subordinates and management – employees.
- To diagnose the strengths and weaknesses of the individuals so as to identify the training and development needs of them in future.
- To provide feedback to the employees regarding their past performance and to guide them how they can perform better.
- To provide information to assist in the other personal decisions in the organization, clarity of the expectations and responsibilities of the functions to be performed by the employees.

D. *PROBLEM DEFINITION OF THE PROPOSED SYSTEM*

Traditional approaches have not adequately considered the complex personal, interpersonal, and organizational factors that affect the efficacy of performance evaluation in the virtual organization setting. So, the idea is to develop an hybrid automated system which enhances the results of traditional performance evaluation system by an integrated Domain Driven Data Mining approach for evaluating data intelligence, domain intelligence, human intelligence, network intelligence, social intelligence, and meta synthesis of ubiquitous intelligence for performance appraisal using 360 degree Assessment tool and Fuzzy Group Decision Support System (FGDSS).

E. *OBJECTIVES AND SCOPE OF THE PROPOSED SYSTEM*

This work aims at analyzing the performance of the employees in virtual organization and introducing a ubiquitous approach to rate the employees in the organization by using phenomenological domain Driven Data Mining (D3M) technique which utilizes 360 Degree data mining for objective measurement and sentiment analysis for subjective measurement. The 360-degree data mining allows employees to assess strengths and weakness in their workplace, interpersonal communications and management style with the focus on individual and organizational development. The system will investigate the main factors that affect the performance of employees in any virtual industry and to point out the high rollers and low rollers in that firm. The system is limiting itself to take offline data from interview process in the company which is taken at the time of interview along with the online data in the form of interpersonal questionnaires, various feedback forms and aptitude test results.

The developed system will be used in:
1. IT industry and business firms.
2. Work from home companies for part time and full time employees.

II. LITERATURE SURVEY

According to Mowshowitz (1994) in [2]**,** the term virtual organization was first introduced to the language in the early 1980's, though it did not receive much academic attention until the early 1990s. Since this time, the concept of the virtual organization has become firmly entrenched in the literature and in the minds of researchers and business professionals. From the example given by Travica (1997) in [3], a narrow definition can be deduced: "VO's (virtual organizations) refers to a new organizational form characterized by a temporary or permanent collection of geographically dispersed individuals, groups or organization departments not belonging to the same organization or entire organizations, that are dependent on electronic communication for carrying out their production process".
According to Moon, C. et al (2007) in [16], performance appraisal of candidates in relation to a particular position, is a key task towards managing the human resources of an organization. Supervisors are concerned with performance appraisal judgments and evaluations that they have to make on their subordinates. On the other hand, subordinates are increasingly realizing the importance of performance appraisal since it would very much affect their rewards and future career path. As the world began to shift towards knowledge based capitalism, it reminds all organizations on the importance of maintaining their talented knowledge workers.

Siyamak Noori, Seyed Hossein Hosseini, Arash Bakhsha (2009) in [5], investigated the main factors that affect the virtual organization performance and proposed an expert opinion model to show how these factors can be used in virtual organization evaluation. According to the authors, this conceptual framework gives a valuable insight into the performance in virtual organization and ca give a useful help to practitioners to evaluate the performance of these organizations.

G.Meenakshi, Prof.Nalla, Malla Reddy (2009) in [6], proposed a comprehensive method called 360 degree feedback appraisal system where the feedback about the employees comes from all the sources that come into contact with the employee on his/her job. They used 360 degree assessment tool for carrying out data and domain intelligence and fuzzy group decision support system (FGDSS). Based on the findings of their work, the application of fuzzy set theory in FGDSS is said to be able to assist decision maker to make better decisions under different circumstances and alternatives a good example of the application of the fuzzy-set theory to decision-making process is multi-factorial evaluation model.
Qasem A. Al-Radaideh, Eman Al Nagi, et.al (2012) in [7], developed a classification model in order to predict the performance of employees by using data mining algorithm such as Decision Tree, Naïve Bayes classifier. Human Resource departments mainly used this model for predicting the newly appointed employees.

V. Suriyakumari, A. Vijaya Kathiravan (2013) in [1], proposed a ubiquitous Domain Driven Data mining approach for performance monitoring in virtual organizations using 360 degree data mining & opinion mining for human, network

and social intelligence. He prepared online model for evaluating the rating given to the employees based on the performance.

According to Santhamma, Nagaveni B. Biradar, et.al (2014) in [8], the performance of employees in IT industries can be evaluated by the combined analysis using domain driven data mining (D3M) technique and 360 degree feedback method for objective measurement and opinion mining (OM) technique for subjective measurement. The opinions are classified using support vector machine (SVM) classifier.

According to Nirmala G, P.B. Mallikarjuna, et.al (2014) in [9], the caliber, work rate and the prospective of an employee will enable higher level authorities to take decisions and understand certain patterns of employee compensation, incitement, growth and decline which can be predicted using Apriori Association Rule and clustered using K-means Clustering across many disciplines. By considering the different performance measures, the employees can be divided into groups by using K means clustering. These performance measures can be used to determine the future potential of an employee based on the parameter such as decision making, performance comparisons, conduction workshops and conferences. By using Apriori Association rule, the administration department can be able to consider the employees who can meet with minimum value of a particular activity.

Rohit Kotalwar, Raj Chavan, Sunny Gandhi, Vinayak Parmar, et.al (2014) in [10], proposed a scheme as to predict an employee's performance using Decision Tree algorithm. This algorithm is used to predict the employee's performance with high accuracy and to improve their performance.

According to N.Magesh, DR.P.Thangaraj, S.Sivagobika,S.Praba, R.Mohana Priya, et.al (2014) in [12], heuristic information of an employee can be used for calculating the yearly increment of an employee. They have used three techniques such as Classification, Clustering, Decision Tree. The historical data can be considered by using decision tree algorithm. By using decision tree classifier the performance of an employee can be tested by considering the various attributes of an employee. The main motive of this approach is to collect the required data of an employee and finally generates a decision tree based on the historical data.

Francis F. Balahadia, Ma. Corazon G. Fernando, Irish C. Juanatas (2016) in [13], proposed a teacher evaluation method based on opinion mining, which filters the student comment on teachers to form a teacher evaluation repository automatically. The sentiment analysis engine classifies these comments to positive or negative category and points out which is good or not good about teachers work. It will undergo to text classification using Naïve Bayes, it will compare the individual words of the sentence with the database of words, while comparing, the words will find the probability of the labels and then these words will be compared to the probability of positive and negative label.

III. PROPOSED METHODOLOGY

In previous studies, less satisfaction was indicated for the virtual organization with the traditional performance evaluation technique which was completely based on the offline data of an employee. In order to overcome the limitations of traditional studies, this hybrid system is proposed. The proposed approach is to evaluate the performance of the employees in the virtual organization by a new generation data mining methodology called domain driven data mining approach which aims to target the development paradigm shift from data centred hidden pattern mining to actionable knowledge discovery [14][15].

The employee will be judged on the basis of various performance measures like communication skills, inter-personal skills, problem solving, team work attitude, adaptability/flexibility, initiative, decision making, leadership, maturity and organizational citizenship behaviour (OCB). Opinion mining using sentiment analysis is to be done for Human, Network and Social Intelligence. Further, 360-degree assessment method is applied which provide the employee with feedback about their performance. Supervisors, peers, and, where appropriate, customers answer questions about an individual's skills and attributes.

Further, the proposed methodology is utilizing fuzzy set theory for multi-criteria assessment in the group decision-making of promotion screening. This is because, in many situations, assessor tends to use ambiguously defined qualitative criteria in evaluating the performance of their subordinates. Therefore it creates difficulty for assessor to precisely quantifying the score of each candidate and thus it is fruitful to apply fuzzy set theory on computer-based fuzzy group decision support system (FGDSS).

Figure 1 shows the whole procedure of the proposed system.
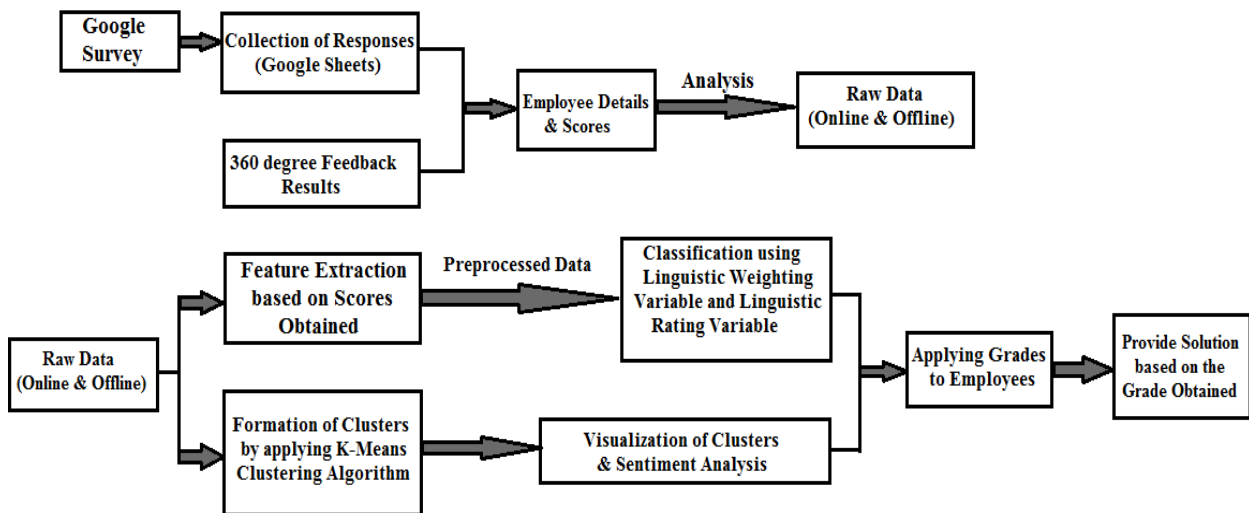
Fig. 1 Flow of Proposed System

The proposed system is divided into 4 phases

1) Phase-1: Phase-1 is the initial phase. In this phase, the data is collected. Data collection is done using Google survey. In Google survey, 5 Google forms were designed. Basically, these forms are the 5 different questionnaires, each form with 10 questions.

The links for these forms are as follows:

Aptitude Test: https://goo.gl/forms/euiwuFne95ZC1pgT2

Logical Reasoning: https://goo.gl/forms/KQl15B9WcTE6wkp93

Verbal Ability Test: https://goo.gl/forms/m6SgLwMcuKL9E3SV2

Organizational Behavior Questionnaire: https://goo.gl/forms/NK3GviYdUiEnqkY43

Technical Questionnaire: https://goo.gl/forms/99fnztEKNkbD6z9Z2.

Figure 2 shows the survey steps and analysis of survey data.
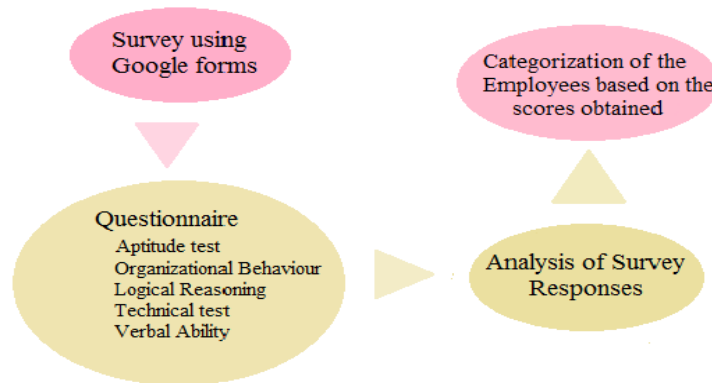

Fig. 2 Survey Steps and Analysis of survey Data

2) Phase-2: Phase 2 is the phase of analysis. The analysis is to be made on the collected responses of the employees. The responses are collected by means of their email-id. The response sheet for every test is maintained in the form of spreadsheets associated with every form. Features are extracted from the collected data. Imported data to MS access for analysis and applying query for the classification of employees using linguistic weighting variables and linguistic rating variables.

Figure below shows the insights of all the Google forms.
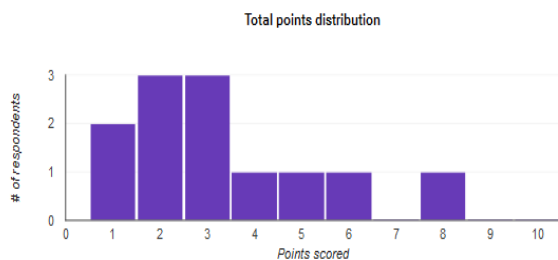
Fig. 3 Analysis of Technical Test
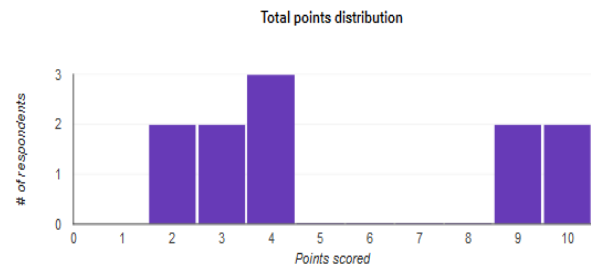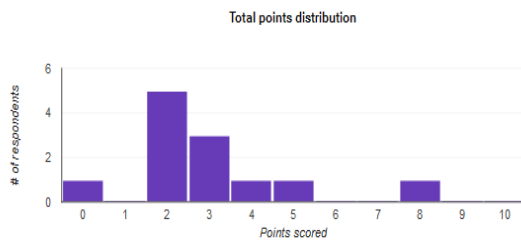

Fig 4. Analysis of Organizational Behavior Test

Fig 5. Analysis of Logical Ability Test
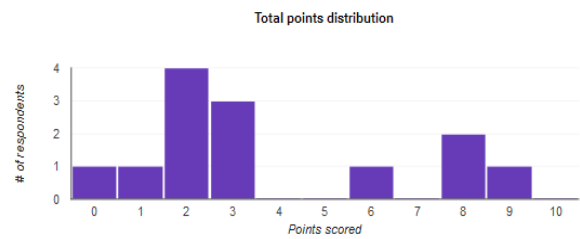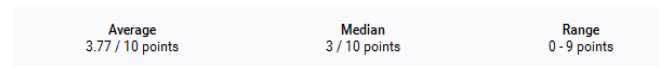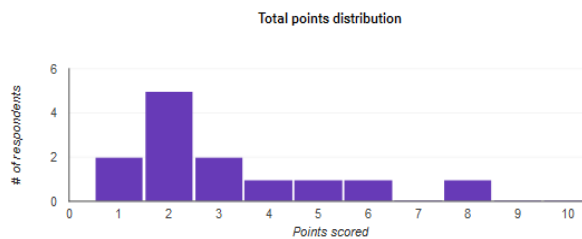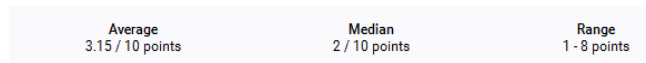

Fig 6. Analysis of Aptitude Test

Fig. 7 Analysis of Verbal Ability Test

3) Phase-3: In Phase-3, the employees will be rated based on their performance in the survey conducted and the results of the feedback data from 360 degree assessment test by their peers, subordinates, admin, HR and customers. This data is clustered into meaningful categories by applying K-Means clustering algorithm.

4) Phase-4: In Phase-4, the categories are visualized and clusters are identified and based on the opinion words that indicate positive, negative and neutral opinions about the performance of the employees.

Based on the categories in which the employees are classified, they will be graded from the range of 1 to 9.

IV. CONCLUSIONS

This paper discusses the importance of evaluating the performance of the employees in virtual organization. It is notices based on the given literature survey that there is a need to develop the proposed system because employee's performance evaluation in virtual organization is tedious work. Therefore, a hybrid approach is defined to increase performance monitoring of employee's using Domain Driven Data Mining(D3M) approach using 360 degree feedback and sentiment analysis .Utilizing the concept of using four multi-factorial evaluation model in the performance appraisal system could alleviate the changes need to be made in this system whenever it is necessary. Further, the rating will be provided based on the survey results. When it comes to making long term and short term goals, virtual organization must carefully calculate who will champion their initiatives. Therefore, it is important to select the appropriate employee for the tasks that will affect the position of the organization in business scenario. Placing the wrong person can result in devastating

problem which are subject to strong public scrutiny. These problems can range from lack of employees morale to financial destruction.

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