EMPIRICAL MODEL FOR LEADERSHIP ASSESSMENT UTILIZING CLUSTERING EMBEDDED IN SOFT-COMPUTING APPROACH

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ABSTRACT

Leadership is an important facet of any well-developed organization. The success of any organization depends largely on the ability of the leader to coordinate and reorganize the input of each employee in order to obtain the desired result. In order for these to be done successfully, certain qualities (criteria) are essential which an individual must possess. These qualities includes; trustworthiness, assertiveness, dedication etc. This paper focuses on utilizing Clustering Embedded in Soft-Computing Approach for the recognition of these criteria due to their vagueness (impreciseness). These qualities are subdivided into clusters or classes, based on the presence of such qualities an individual identified.

Keywords: Fuzzy logic, Leader, Leadership, Soft-computing

INTRODUCTION

Leadership is a quality which cannot be acquired by any person from the other but it can be acquired by self-determination of a person (Purnima, 2011; Oppaper, 2012). Leadership can best be called the personality of the very highest ability-whether in ruling, thinking, imagining, innovation, warring, or religious influencing. Leadership is a quality hidden in the personality of a human being. Human personality is very complex and it is very difficult to grade individuals according to one's personality. Leadership, on the other hand, depends on the organic structure of the personality which includes experience, skill, responsibility, intelligence, power of organizing people and social interaction. Leadership can be viewed as one's ability to get others to willingly follow or it is the ability of the Leader to induce subordinates to work with confidence and zeal. In other words "Leadership is the process by which a leader imaginatively directs guides and influences the work of others in choosing and attaining specified goals by mediating between the individuals and the organization in such a manner, that both will obtain maximum satisfaction (Oppaper, 2012).

Fuzzy sets were introduced by (Zadeh, 1965) to represent/manipulate data and information possessing non statistical uncertainties. Fuzzy sets provide a means of representing and manipulating data that are not precise, but rather fuzzy. Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial truth - truth values between "completely true" and "completely false"(Kasabov, 1998; Robert, 2000; Christos and Dimitros, 2008). The theory of fuzzy logic provides a mathematical strength to capture the uncertainties associated with human cognitive processes, such as thinking and reasoning. A fuzzy set A is called trapezoidal fuzzy number (Figure 1) with tolerance interval [a, b], left width α and right width β if its membership function has the following form

$$A(t) = \begin{cases} 1-(a-t)/\alpha & \text{if } a-\alpha \le t \le a \\ 1 & \text{if } a \le t \le b \\ 1-(t-b)/\beta & \text{if } a \le t \le b+\beta \\ 0 & \text{otherwise} \end{cases}$$

and we use the notation A = (a, b, α, β). It can easily be shown that

$[A]^{\gamma} = [a - (1 - \gamma)\,\alpha,\ b + (1 - \gamma)\,\beta],\ \forall \gamma \varepsilon [0, 1]$.

The support of A is $(a - \alpha, b + \beta)$.

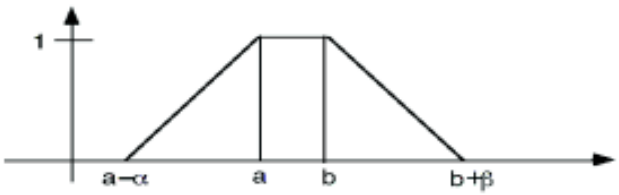


Figure 1: *Trapezoidal fuzzy number*

Fuzzy systems often learn their rules from experts. When no expert gives the rules, adaptive fuzzy systems learns by observing how people regulate real systems (Leondes, 2010) The difference between classical and fuzzy logic is something called "the law of excluded middle" (Bart and Satoru, 1993; Ahmad, 2011). In standard set theory, an object does or does not belong to a set. There is no middle ground. In such bivalent systems, an object cannot belong to both its set and its compliment set or to neither of them. This principle preserves the structure of the logic and avoids the contradiction of object that both is and is not a thing at the same time (Zadeh, 1965). However, fuzzy logic is highly abstract and employs heuristic (experiment) requiring human experts to discover rules about data relationship (Angel and Rocio, 2011).

Fuzzy classification assumes the boundary between two neighboring classes as a continuous, overlapping area within which an object has partial membership in each class (Kuang *et al.,* 2011**)**. It not only reflects the reality of many applications in which categories have fuzzy boundaries, but also provides a simple representation of the potentially complex partition of the feature space. (Sun and Jang**,** 1993; Ahmad, 2011) propose an adaptive-network-based fuzzy classifier to solve fuzzy classification problems. Conventional approaches of pattern classification involve clustering training samples and associating clusters to given categories. The complexity and limitations of previous mechanisms are largely due to the lacking of an effective way of defining the boundaries among clusters. This problem becomes more intractable when the number of features used for classification increases (Robert, 2000; Kasabov, 1998; Rudolf, 2008; Christos and Dimitros, 2008).

The main focus of this research, explore fuzzy logic which is a branch of soft computing for designing a model pertaining to the assessment of a leader within an organization irrespective of his status, background and cultural divides.

Proposed Leadership theorem

According to Kendra (2012),

a. **"Great Man" Theories:**
Great man theories assume that the capacity for leadership is inherent – that great leaders are born not made or destined to lead (Bolden *et al.,* 2003). These theories often portray great leaders as heroic, mythic and destined to rise to leadership when needed. The term "Great Man" was used because, at the time, leadership was thought of primarily as a male quality, especially in terms of military leadership. The Great man theory came to be known as the great person theory of leadership (Ira and Rebecca, 2009).Nevertheless, practitioners in several fields sometimes ask themselves to what extent leaders can be developed or to what extent leadership is an inborn ability or related to more stable dispositional factors (Ira and Rebecca, 2009).

b. **Trait Theories:**
Similar in some ways to "Great Man" theories, trait theories assume that people inherit certain qualities and traits that make them better suited to leadership. Trait theories often identify particular personality or behavioral characteristics shared by leaders. They draw on virtually all the adjectives in the dictionary which describe some positive or virtuous human attribute, from ambition to zest for life (Bolden *et al.,* 2003).

c. **Contingency Theories:**
Contingency theories of leadership focus on particular variables related to the environment that might determine which particular style of leadership is best suited for the situation. According to this theory, no leadership style is best in all situations. It is a refinement of the situational viewpoint and focuses on identifying the situational variables which best predict the most appropriate or effective leadership style to fit

the particular circumstances (Bolden *et al.,* 2003).

d. **Situational Theories**:
Situational theories propose that leaders choose the best course of action based upon situational variables. Different styles of leadership may be more appropriate for certain types of decision-making. This approach sees leadership as specific to the situation in which it is being exercised. For example, whilst some situations may require an autocratic style, others may need a more participative approach. It also proposes that there may be differences in required leadership styles at different levels in the same organization (Bolden *et al.,* 2003).

e. **Behavioral Theories:**
Behavioral theories of leadership are based upon the belief that great leaders are made, not born. Rooted in behaviorism, this leadership theory focuses on the actions of leaders not on mental qualities or internal states. According to this theory, people can learn to become leaders through teaching and observation. These concentrate on what leaders actually do rather than on their qualities. Different patterns of behavior are observed and categorized as 'styles of leadership'. This area has probably attracted most attention from practicing managers (Bolden *et al.,* 2003).

f. **Participative Theories:**
Participative leadership theories suggest that the ideal leadership style is one that takes the input of others into account. These leaders encourage participation and contributions from group members and help group members feel more relevant and committed to the decision-making process. In participative theories, however, the leader retains the right to allow the input of others.

g. **Management Theories:**
Management theories, also known as transactional theories, focus on the role of supervision, organization and group performance. These theories base leadership on a system of rewards and punishments. Managerial theories are often used in business; when employees are successful, they are rewarded; when they fail, they are reprimanded or punished. Learn more about theories of transactional leadership (Bolden *et al.,* 2003).

h**. Relationship Theories:**
Relationship theories, also known as transformational theories, focus upon the connections formed between leaders and followers. Transformational leaders motivate and inspire people by helping group members see the importance and higher good of the task. These leaders are focused on the performance of group members, but also want each person to fulfill his or her potential. Leaders with this style often have high ethical and moral standards (Bolden *et al.,* 2003).

The following are Qualities of Proficient leadership as used in this paper (Greenstein, 2011; Eve, 2009)

Trustworthiness (Integrity)

A leader has an exemplary character. It is of utmost importance that a leader is trustworthy to lead others. A leader needs to be trusted and be known to live their life with honestly and integrity. A good leader "walks the talk" and in doing so earns the right to have responsibility for others. True authority is born from respect for the good character and trustworthiness of the person who leads. Integrity is the integration of outward actions and inner values. A person of integrity is the same on the outside and on the inside. Such an individual can be trusted because he or she never veers from inner values, even when it might be expeditious to do so. A leader must have the trust of followers and therefore must display integrity. Honest dealings, predictable reactions, well-controlled emotions, and an absence of tantrums and harsh outbursts are all signs of integrity. A leader who is centered in integrity will be more approachable by followers.

Enthusiastic (Passionate)

A leader is enthusiastic about their work or cause and also about their role as leader. People will respond more openly to a person of passion and dedication. Leaders need to be able to be a source of inspiration, and be a motivator towards the required action or cause.

Although the responsibilities and roles of a leader may be different, the leader needs to be seen to be part of the team working towards the goal. This kind of leader will not be afraid to roll up their sleeves and get dirty.

Confident

A leader is confident. In order to lead and set direction a leader needs to appear confident as a person and in the leadership role. Such a person inspires confidence in others and draws out the trust and best efforts of the team to complete the task well. A leader who conveys confidence towards the proposed objective inspires the best effort from team members.

Tolerant of Ambiguity

Good leaders are tolerant of ambiguity and remain calm, composed and steadfast to the main purpose. Storms, emotions, and crises come and go and a good leader takes these as part of the journey and keeps a cool head. Be tolerant also mean functioning in an orderly and purposeful manner in situations of uncertainty. People look to the leader during times of uncertainty and unfamiliarity and find reassurance and security when the leader portrays confidence and a positive demeanor.

Goal Oriented

A good leader as well as keeping the main goal in focus is able to think analytically. Not only does a good leader view a situation as a whole, but is able to break it down into sub parts for closer inspection. Not only is the goal in view but a good leader can break it down into manageable steps and make progress towards it. The good leader not only maintains high standards, but also is proactive in raising the bar in order to achieve excellence in all areas.

Magnanimity (Complement)

Magnanimity means giving credit where it is due. A magnanimous leader ensures that credit for successes is spread as widely as possible throughout the company. Conversely, a good leader takes personal responsibility for failures. This sort of reverse magnanimity helps other people feel good about them and draws the team closer together. To spread the fame and take the blame is a hallmark of effective leadership.

Humility and Humor

Leaders with humility recognize that they are no better or worse than other members of the team. A humble leader is not self-effacing but rather tries to elevate everyone. Leaders with humility also understand that their status does not make them a god. Mahatma Gandhi is a role model for Indian leaders, and he pursued a "follower-centric" leadership role (Eve, 2009). A sense of humor is vital to relieve tension and boredom, as well as to defuse hostility. Effective leaders know how to use humor to energize followers. Humor is a form of power that provides some control over the work environment. And simply put, humor fosters good camaraderie and works closely with humility.

Openness

Openness means being able to listen to new ideas, even if they do not conform to the usual way of thinking. Good leaders are able to suspend judgment while listening to others' ideas, as well as accept new ways of doing things that someone else thought of. Openness builds mutual respect and trust between leaders and followers, and it also keeps the team well supplied with new ideas that can further its vision.

Fairness

Fairness means dealing with others consistently and justly. A leader must check all the facts and hear everyone out before passing judgment. He or she must avoid leaping to conclusions based on incomplete evidence. When people feel they that are being treated fairly, they reward a leader with loyalty and dedication.

Assertiveness

Assertiveness is not the same as aggressiveness. Rather, it is the ability to clearly state what one expects so that there will be no misunderstandings. A leader must be assertive to get the desired results. Along with assertiveness comes the responsibility to clearly understand what followers expect from their leader. Many leaders have difficulty striking the right amount of assertiveness. It seems that being

under assertive or overassertive may be the most common weakness among aspiring leaders.

Creativity

Creativity is the ability to think differently, to get outside of the box that constrains solutions. Creativity gives leaders the ability to see things that others have not seen and thus lead followers in new directions.

Dedication

Dedication means spending whatever time or energy is necessary to accomplish the task at hand. A leader inspires dedication by example, doing whatever it takes to complete the next step toward the vision. By setting an excellent example, leaders can show followers that there are no nine-to-five jobs on the team, only opportunities to achieve something great.

MATERIALS

Soft computing is geared toward system (model) solution. It mimic Artificial Intelligence (AI) which is concerned with systems that exhibit the characteristics usually associated with intelligence in human behavior, such as learning, reasoning, problem solving, understanding language, and so on. The main goal of AI is to simulate human behavior on the computer. The knowledge and the use of knowledge are the key characteristics. The art of bringing relevant principles and tools of AI together for solving difficult application problems is therefore sometimes referred to knowledge engineering (Türkay and Adil, 2005).

Soft computing focuses on four main areas which are Neural Network, Fuzzy logic, genetic Algorithm and Probabilistic reasoning. The utilization of fuzzy logic for the development of an empirical leadership assessment model is the focal point of this research.

Basically, Fuzzy Logic (Zadeh, 1965, 1968, 1984) is a multivalued logic, which allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. Fuzzy logic provides an inference morphology that helps appropriate human reasoning capabilities to be applied to knowledge-based systems. The theory of fuzzy logic provides a mathematical strength to capture the uncertainties associated with human cognitive processes, such as thinking and reasoning. A fuzzy set A is called trapezoidal fuzzy number (Figure 1) with tolerance interval [a, b], left width α and right width β if its membership function has the following form

and we use the notation A = (a, b, α, β). It can easily be shown that

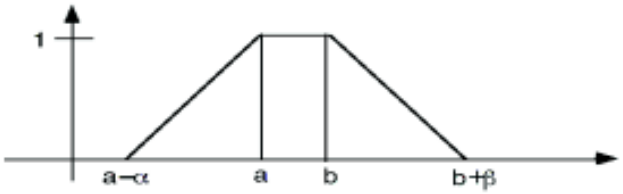
$[A]^{\gamma} = [a - (1 - \gamma)\,\alpha,\ b + (1 - \gamma)\,\beta],\ \forall \gamma \varepsilon [0, 1].$

The support of A is (a −α, b + β).

Figure 1: *Trapezoidal fuzzy number*

Fuzzy Logic is built largely on linguistic variables; linguistic variables represent crisp information in a form and precision appropriate for the problem (Walter, 2005). For example, to answer the question "What is it like outside?" one might observe "It is warm outside."

$$A(t) = \begin{cases} 1 - (a - t)/\alpha & \text{if } a - \alpha \le t \le a \\ 1 & \text{if } a \le t \le b \\ 1 - (t - b)/\beta & \text{if } a \le t \le b + \beta \\ 0 & \text{otherwise} \end{cases}$$



Experience has shown that if it is “warm” and the time is mid-day, a jacket is unnecessary, but if it is warm and early evening, it would be wise to take a jacket along (the day will change from warm to cool). The linguistic variables like “warm”, so common in everyday speech, convey information about our environment or an object under observation (Walter, 2005).

An important facet for the implementation of linguistic variable is Clustering. Clustering is an unsupervised learning task that aims at decomposing a given set of objects into subgroups or clusters based on similarity (Rudolf *et al.,* 2007). The goal is to divide the data-set in such a way that objects (or example cases) belonging to the same cluster are as similar as possible, whereas objects belonging to different clusters are as dissimilar as possible. The motivation for finding and building classes in this way can be manifold (Bock, 1974). Clus-

ter analysis is primarily a tool for discovering previously hidden structure in a set of unordered objects. In this case one assumes that a 'true' or natural grouping exists in the data. However, the assignment of objects to the classes and the description of these classes are unknown. By arranging similar objects into clusters one tries to reconstruct the unknown structure in the hope that every cluster found represents an actual type or category of objects (Rudolf *et al.,* 2007).

A common concept of all described clustering approaches is that they are prototype-based. Each prototype Ci is an n-tuple of parameters that consists of a cluster center ci (location parameter) and maybe some additional parameters about the size and the shape of the cluster. The cluster center ci is an instantiation of the attributes used to describe the domain, just as the data points in the data-set to divide. The size and shape parameters of a prototype determine the extension of the cluster in different directions of the underlying domain. The prototypes are constructed by the clustering algorithms and serve as prototypical representations of the data points in each cluster.

METHODOLOGY

To design Empirical Model for Leadership Assessment utilizing Clustering Embedded in Soft-Computing Approach we develop a model which consists of a set of parameter needed for proficient leadership (here, we are using twelve basic qualities):

- Trustworthiness (Integrity)
- Enthusiastic (Passionate)
- Confident
- Forbearance of an Ambiguity
- Goal Oriented
- Magnanimity (Complement)
- Humility and Humor
- Openness
- Fairness
- Assertiveness
- Creativity
- Dedication

The Model in Figure 2; comprises of the knowledge base, consists of the database, which consist of twelve basic parameters mentioned earlier. The values of the parameters are often vague (fuzzy) and imprecise hence the adoption of fuzzy logic in the model as means of analyzing these data. These parameters therefore constitute the fuzzy parameter of the knowledge base. The fuzzy set of parameters is represented by 'P', which is defined as P= $\{P_1, P_2\ldots, P_n\}$ where P_i represents the j^{th} parameter and n is the number of parameter (in this case n=12). The set of linguistic values which is modeled as a linker scale denoted by 'L' is given as L= {Proficient, Moderate, might be Moderate and Not proficient}. Crisp set (0 or 1) which are transformed into fuzzy set (values ranging between 0.00 – 1.00) by the fuzzification process. The Fuzzy Inference is fuzzy logic driven. The DSS houses both the cognitive and emotional filters. The Cognitive filter of the decision support engine takes as input the output report of the Defuzzification process and applies the objective rules to rank the individual email on the presence or absence ofspam mail parameters. The Emotional filter takes as input the output report of the cognitive filter and applies the subjective rules in the domain of studies in order to rank individuals email on the extent of the *of* spam mail.

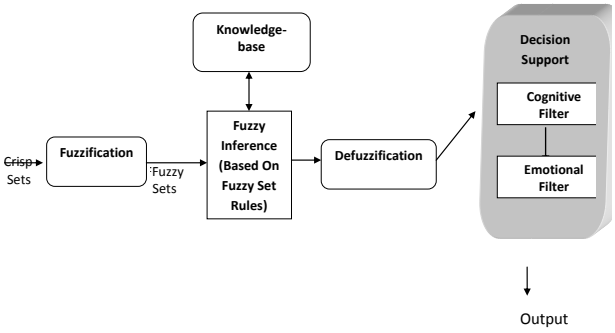


Figure 2: *Fuzzy Model for Leadership Assessment*

RESULT

The fuzzy partition for each input feature consists of the parameters for leadership assessment. However, it can occur that if the fuzzy partition for leadership is not set up correctly, or if the number of linguistic terms for the input features is not large enough, then some

patterns will be misclassified. The rules that can be generated from the initial fuzzy partitions of the classification for leader are thus:

Proficient Leadership (Class: C_1)

Moderate Leadership (Class: C_2)

Might be Moderate leadership (Class: C_3)

Not Proficient Leadership (Class: C4)

If the leader is exhibiting six or more ($L \geq 6$) parameters of leadership *THEN* (C_1), if the leader is exhibiting five ($L = 5$) parameters of leadership *THEN* (C_2), if the leader is exhibiting four ($L = 4$) parameters of leadership *THEN* (C_3) and if the Leader is exhibiting three or less ($L \leq 3$) parameters of leadership THEN (C_1)

The Fuzzy IF-THEN Rules (R_i) for leadership is thus:

R1: IF the leader is exhibiting trustworthiness THENit is in class C_4.

R2: IF the leader is exhibiting trustworthiness and enthusiastic (Passionate) THEN it is in class C_4.

R3: IF the leader is exhibiting is trustworthiness, enthusiastic (passion) and confident THENit is in class C_4.

R4: IF the leader is exhibiting is trustworthiness, enthusiastic (passion), confident and forbearance of ambiguity THENit is in class C_3.

R5: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity and goal oriented THENit is in class C_2.

R6: IF the leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented and magnanimity (complement) THENit is in class C_1.

R7: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented, magnanimity (complement) and Humility and Humor THENit is in class C_1.

R8: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident forbearance of ambiguity, goal oriented, magnanimity (complement) humility and humor and openness THENit is in class C_1.

R9: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented, magnanimity (complement) humility and humor, openness and fairness THENit is in class C_1.

R10: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented, magnanimity (complement) humility and humor, openness, fairness and assertiveness THENit is in class C_1.

R11: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented, magnanimity (complement) humility and humor, openness, fairness, assertiveness and creativity THENit is in class C_1.

R12: IFthe leader is exhibiting is trustworthiness, enthusiastic (passion), confident, forbearance of ambiguity, goal oriented, magnanimity (complement) humility and humor, openness, fairness, assertiveness, creativity and dedication THEN it is in class C_1.

Table 1: *Data Set showing the Degree of membership of Leadership Assessment*

PARAMETERS OR FUZZY SETS OF LEADERSHIP ASSESSMENT	CODES	DEGREE OF MEMBERSHIP OF LEADERSHIP ASSESSMENT			
		Cluster 1 (C_1)	Cluster 2 (C_2)	Cluster 3 (C_3)	Cluster 4 (C4)
Trustworthiness	R01	0.50	0.00	0.50	0.00
Enthusiastic (Passion)	R02	0.50	0.00	0.50	0.00
confident	R03	0.65	0.10	0.15	0.00
Forbearance of ambiguity	R04	0.70	0.10	0.10	0.10
Goal Oriented	R05	0.50	0.20	0.10	0.20
Magnanimity (complement	R06	0.50	0.00	0.50	0.00
Humility and Humor	R07	0.00	0.50	0.50	0.00
Openness	R08	0.00	0.55	0.00	0.45
Fairness	R09	0.10	0.60	0.20	0.10
Assertiveness	R10	0.00	0.50	0.00	0.50
Creativity	R11	0.30	0.50	0.10	0.10
Dedication	R12	0.00	0.00	0.50	0.50
RESULTS		**PROFICIENT LEADERSHIP**	**MODERATE LEADERSHIP**	**MIGHT BE MODERATE LEADERSHIP**	**NOT PROFICIENT LEADERSHIP**

DISCUSSION

A typical data set that contains the twelve parameters is presented in Table 1. This shows the degree of membership for leadership assessment. As the value tends to 1.0, the more the chances that the user is experiencing spam mail.

Figure 3: *Pie Chart Representation of Table 1, in term of percentage*

The pie chart in **Figure 3** is a representation of Table 1 which clearly show Cluster 1, Cluster 2, Cluster 3 and Cluster 4 In term of occurrence in percentage.

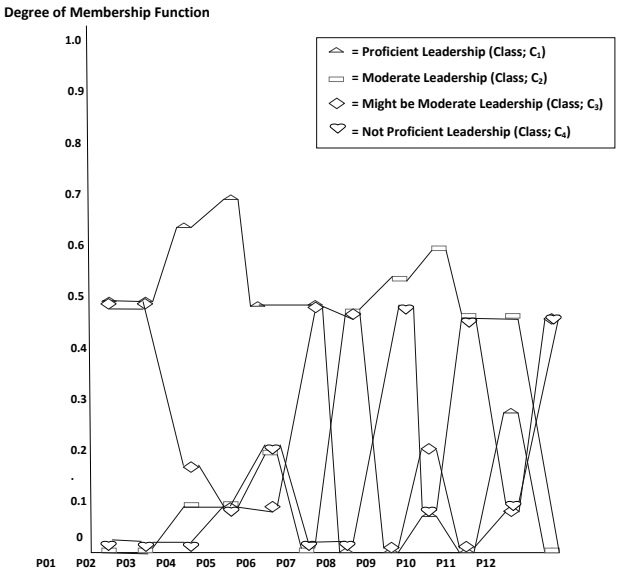


Figure 4: *Graphical representation of Membership Grades for Leadership Assessment*

The graphical representation in Figure 4, is a representation of Table 1 and clearly show six Parameters with high degree of "Proficient Leadership" in Cluster 1, five parameters with high degree of "Moderate leadership" in Cluster 2 and four parameters of with high degree of "Might be Moderate Leadership" in Cluster 3, and two parameters with high degree of "Not Proficient Leadership" in Cluster Four.

CONCLUSION

Leadership is a unique responsible within any organization in order for success to be achieved. Certain criteria's must be possessed by these leaders for success to be achieved. The need of designing a model for leadership assessment is very essential to the developed of any organization. Leadership Assessment utilizing Fuzzy Clustering Embedded in Soft-Computing Approach has been developed and subdivided into four classes, Proficient leadership, Moderate leadership, Might be Moderate leadership and Not Proficient leadership based on the criteria display by an individual. This model which uses a set of fuzzified data set incorporated into soft computing model is more precise than the traditional system for recognizing and assessing leader. The system designed is an interactive system that tells an organization the current nature of and a particular individual. A system of this nature should be introduced in the IT Sector or any well-meaning organization to ease the job of IT professional, employee and leader in general.

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