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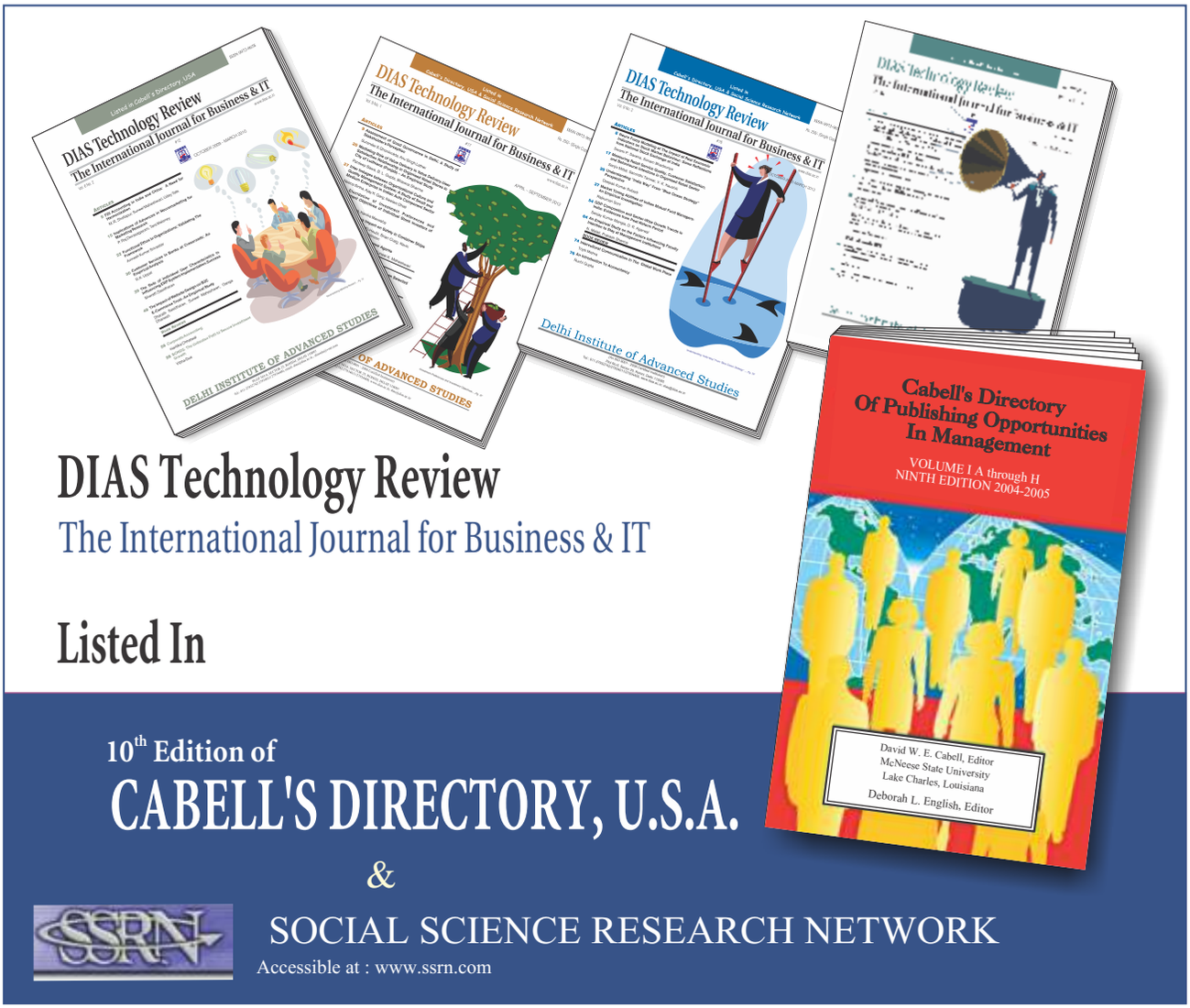

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15 Relationship between Indian and US Stock Returns Before, During and After Financial Crisis

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19 Comparative Analysis of Bankruptcy Prediction Models: An Indian Perspective

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29 SERVQUAL: A Multi-Dimensional Scale for Perceptual Measure of Service Quality in the Mobile Telecommunication Industry

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The customer's service quality perception toward different mobile service companies has been studied by the author through SERVQUAL model with two additional dimensions namely Competitive Advantage and Network Quality

40 Telemedicine : Integrating ICT and Health Care System

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The author in this research paper has examined various initiatives taken by the Indian Government along with other organizations to utilize expertise of India in ICT in the healthcare sector.

48 Empirical Evaluation of values of servant leaders in ITES Sector

Dr. Puja Khatri, Ms. Sumedha Dutta

An analytical research on servant leader's traits & servant leader's value system has been made by the author to examine a unique perspective to servant leadership.

DOCTORAL ABSTRACT

57 A Study of Relationship between Corporate Social Responsibility Initiatives and its Disclosure(S) and Corporate Financial Performance of Select Companies in Automotive Sector in India

Dr. Shilki Bhatia

This research studies the relationship between Corporate Social Responsibility and Corporate Financial Performance to give an insight to the companies for taking a judicious decision regarding investment in CSR initiatives.

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From The Editor's Desk

It is our profound pleasure to present to our readers the 28th issue of DIAS Technology Review.

The upheaval of sweeping winds of change in business world is germinating numerous operational problems in the organizations. To address functional needs, internal quality metrics and efficiency issues of modern organizations many models, aspect-oriented designs and soft wares are being developed by the technocrats on a continuous basis.

In the article **Measure of Distance and Similarity for Single Valued Neutrosophic Sets with Application in Multi-Attribute Decision Making the author** has studied single valued neutrosophic sets (SvNSs) which can handle various scientific and engineering application problems related to distance, similarity, entropy and cross entropy measures of SvNSs in the real world. An algorithm has been given in the article to determine the ranking of available courses of actions on the basis of values, measures of similarity amongst optimal points and the available courses of actions.

The study **Relationship between Indian and US Stock Returns Before, During and After Financial Crisis** explores response asymmetry in return and volatility from US to Indian markets. Authors in this article have analyzed the spillover and contagion effect. They have suggested a wide range of applications to fund managers and private equity firms regarding hedge funds, mutual funds, retirement funds and sovereign wealth to insulate their portfolios during market bubbles.

To prepare financial models researchers are using Neural network, Multiple discriminant analysis and Logistic regression approaches these days. In the article **Comparative Analysis of Bankruptcy Prediction Models: An Indian Perspective** the author has attempted to develop, compare and test the performance of *bankruptcy prediction models* for 72 listed companies in India over the period 1991-2016. The results indicate that as compared to multiple discriminant analysis and logistic regression, neural network has the highest accuracy for all the three years prior to bankruptcy.

The research paper **SERVQUAL: A Multi-Dimensional Scale for Perceptual Measure of Service Quality in the Mobile Telecommunication Industry** envisages the customer's service quality perception toward different mobile service companies through SERVQUAL model with two additional dimensions: Competitive Advantage and Network Quality. The author has indicated a significant MANOVA effect confirming difference in perception and level of understanding about service quality dimensions among the subscribers.

Telemedicine is one of the most revolutionary innovation in healthcare management as it has augmented the quality of healthcare services delivery. The article **Telemedicine: Integrating ICT and Health Care System** highlights various initiatives taken by Indian Government to utilize its expertise, different challenges and future prospects of ICT in healthcare sector network in India.

The research article **Empirical Evaluation of Values of Servant Leader in ITES Sector** introduces a promising leadership style, *'Servant leadership'* focusing on peoples' growth for taking organization's performance and community's performance to the next level. The authors in this article have explored servant leader's traits along with servant leader's value system as they offer a unique perspective to servant leadership. The empirical work has resulted in identifying three pertinent values comprising a servant leader's value system, namely, Team Orientation, Altruistic Orientation and Ethical Orientation.

Corporate Social Responsibility (CSR) is not a mere business buzzword, but being used by businesses to side-track from the essential economic role. The Doctoral abstract **A Study of Relationship between Corporate Social Responsibility Initiatives and its Disclosure(S) and Corporate Financial Performance of Select Companies in Automotive Sector in India** highlights the ethical misconduct incidents, Corporate Social Responsibility (CSR) Initiatives and its disclosure and Corporate Financial Performance (CFP) in the Automotive Sector.

In our endeavour of knowledge propagation, we are hopeful that this new edition of DIAS Technology Review will also prove to be more enlightening and enthralling to our valued readers.

Regards,

Dr. Anju Batra

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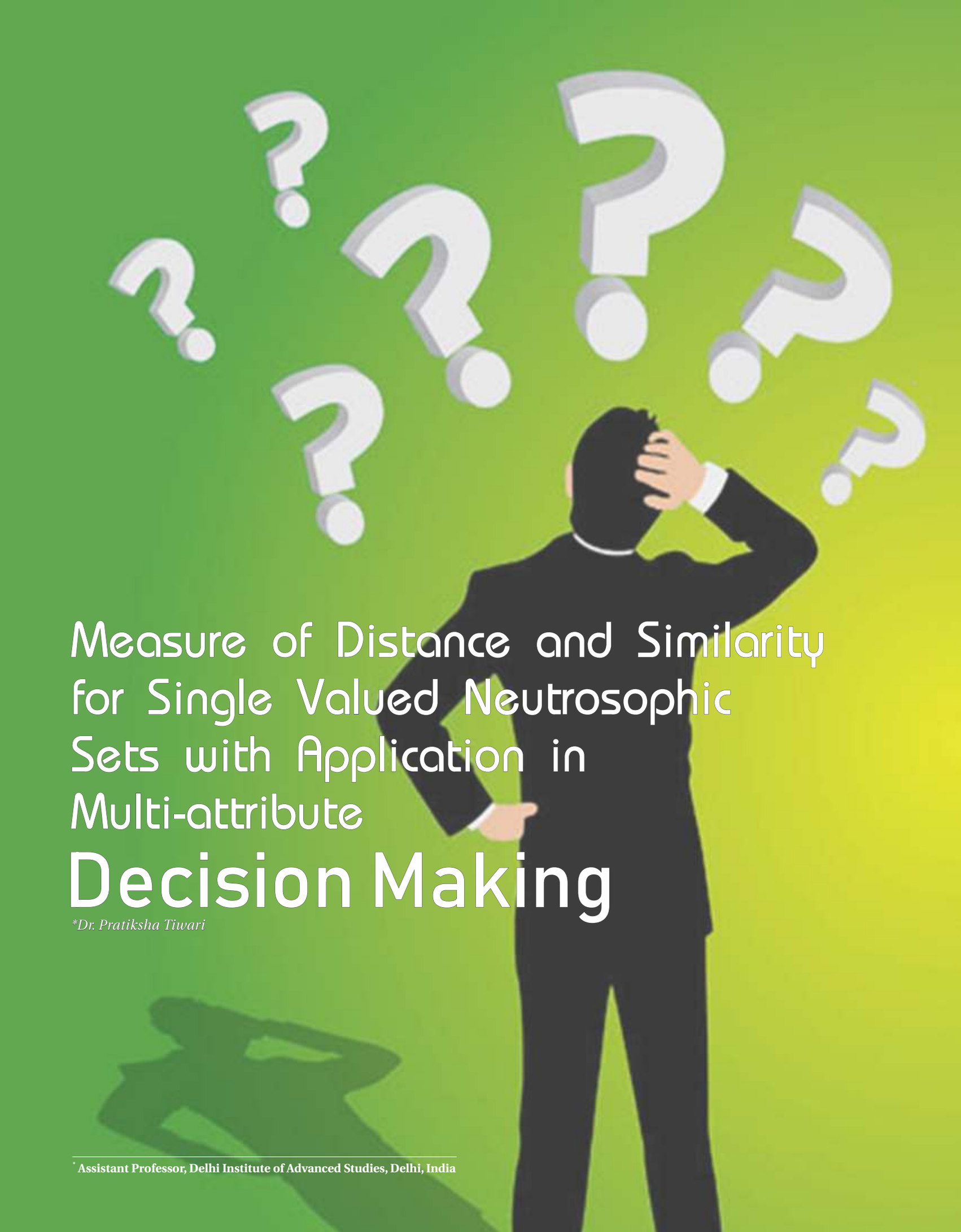

Measure of Distance and Similarity for Single Valued Neutrosophic Sets with Application in Multi-attribute Decision Making

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ABSTRACT

A single valued neutrosophic sets (SvNSs) is a particular case of neutrosophic set, which can handle scientific and engineering applications in real world. Distance, similarity, entropy and cross entropy measures of SvNSs are major tool is to solve various real world problems In the paper, an average distance measure based on Hamming and Hausdorff distance is defined for SvNSs. Similarity measure is proposed on the basis of defined averaged distance using the relationship between distance and similarity measures. Further, one more similarity measure is defined and its validity is proved. Then a multi-attribute decision making is also established under single valued neutrosophic environment, in which attribute values are assigned to each course of action by the decision makers/experts and attribute weights are known, whereas the optimal point is defined using the decision matrix using the proposed method. Also, an algorithm is presented to determine the ranking of available course of actions on the basis of values of measure of similarity amongst optimal point and the available course of actions. Lastly, an example is used to demonstrate the application of proposed similarity measures in multi-attribute decision making.

INTRODUCTION

Neutrosophic set developed by Smarand ache (1999) is a new evolving instrument for uncertain data processing. It has the potential of being a framework for analysis of uncertain data sets which include big data sets. Neutrosophic sets are generalization of interval valued intuitionistic fuzzy sets. Because of the fuzziness and uncertainty of many practical problems in the real world, it is applicable to a wide range of practical problems. Zadeh (1965) developed fuzzy set theory which is a huge success in various areas involving uncertainty. In fuzzy set theory, non-membership value of an element is defined normally as complement of its membership value from one, but practically it is not so. This situation is dealt by higher order fuzzy sets proposed by Atanassov (1986) and is termed as intuitionistic fuzzy sets (IFSs). It is found to be highly useful in dealing vagueness and hesitancy originated from inadequate information. It characterizes three characteristic functions for membership and non-membership and hesitancy respectively for an element of the universe of discourse where sum of all the three functions is 1. Therefore, IFSs are much more flexible and practical than fuzzy sets in dealing with vagueness and uncertainty problems. However, fuzzy sets, IFSs, cannot handle indeterminate information and inconsistent information that exist in the real world and we need further structures such as neutrosophic sets which is a powerful generalization of classic sets, fuzzy sets, interval-valued fuzzy sets, intuitionistic fuzzy sets, interval valued intuitionistic fuzzy sets, paraconsistent sets, dialetheist set, paradoxist sets, and tautological sets. Like intuitionistic fuzzy sets,neutrosophic sets are also characterized by three functions: truth-membership, indeterminacy-membership, and falsity-membership, but they are represented independently. The neutrosophic sets generalize the above-mentioned sets from a philosophical point of view and its functions are real standard or non-standard subsets of]–0, 1+[, and there is no restriction on the sum of three. Thus, it will be difficult to apply these in real scientific and engineering areas. Thus, Wang et al. (2010) derived single-valued neutrosophic set (SvNS), which is a particular case of neutrosophic set. It can describe and handle indeterminate information and inconsistent information. For example, when we ask a customer for his/ her opinion about a statement, he/she may say that the possibility of agreeing to a statement is 0.6 and disagreeing is 0.4 and not sure is 0.2. For a SvNS notation it can be represented as (0.6, 0.4, 0.2) whereas it cannot be dealt by intuitionistic fuzzy sets as sum of membership, non-membership and hesitation value is not 1. Therefore, the notion of a neutrosophic set is more general and overcomes the aforementioned issues.

Various researcher studied different measures such as entropy, cross entropy, distance and similarity for fuzzy and intuitionistic fuzzy sets that will help in decision making. The concept of similarity is primarily significant in practically every field. Many methods have been proposed for measuring the degree of similarity between fuzzy and intuitionistic fuzzy sets. But these methods are not suitable for dealing with the similarity measures of neutrosophic set. Few researchers have dealt with the similarity measures for neutrosophic set. This paper deals with the similarity measures for single valued neutrosophic sets and demonstrates its use in multi-attribute decision making, using an illustrative example.

ASIC CONCEPTS AND RELATED WORK

Neutrosophic sets emerged as a tool to deal uncertain data. It has the potential to become a general framework for uncertainty analysis in data. The neutrosophic set is a part of neutrosophy and generalizes FS, IvFS, IFS, and IvIFS from a philosophical point of view. Smarandache (1999) derived neutrosophic set which is defined as follows:

Definition 1: Let X be a universe of discourse, a neutrosophic set A in X is characterized by a quadruple $\langle x, T_A(x), I_A(x), F_A(x) \rangle$ i.e. (x, truth-membership function, indeterminacy-membership function, falsity-membership function), where x X. The functions $T_A(x): X]–0, 1 + [, I_A(x),: X]–0, 1 +[$, and $F_A(x): X]–0, 1 +[$. Thus there is no restriction on the sum so $–0 \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3+$.

Wang et al. (2011) proposed a subclass of neutrosophic sets termed as single valued neutrosophic sets which are easier to apply to real scientific and engineering problems and is defined as

Definition 1.1: Let X universe of discourse, a single valued neutrosophic set (SvNS) A in X is characterized by quadruple $\langle x, T_A(x), I_A(x), F_A(x) \rangle$ i.e. (x, truth-membership function, indeterminacy-membership function, falsity-membership function), where $x \in X$, $T_A(x), I_A(x), F_A(x) \in [0, 1]$ and $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

Definition 2 (Set operations on single valued neutrosophic sets): Let A and B be two SvNSs defined by quadruple $x, T_A(x), I_A(x), F_A(x)$ and $x, TB(x), IB(x), F_B(x)$ respectively, where $x \in X$ then set operations are defined as follows:

1) $A \cup B = \{\langle x, T_A(x) \vee T_B(x), I_A(x) \vee I_B(x), F_A(x) \wedge F_B(x) \rangle / x \in X\}$

2) $A \cap B = \{+x, T_A(x) \wedge T_B(x), I_A(x) \wedge I_B(x), F_A(x) \vee F_B(x) \rangle / x \in X\}$

3) $\bar{A} - \{(x, F_A(x), 1 - I_A(x), T_A(x)) / x \in X\}$

4) $A \subseteq B$ iff $T_A(x) \leq T_B(x), I_A(x) \geq I_B(x)$ and $F_A(x) \geq F_B(x) \forall x \in X$;

5) $A = B$ iff $T_A(x) = T_B(x), I_A(x) = I_B(x)$ and $F_A(x) = F_B(x) \forall x \in X$.

Definition 3 (Distance between two single valued neutrosophic sets): For any two SvNSs A and B, a real valued function D: SvNSs (X) × SvNSs () [0, 1] is termed as a distance measure of SvNSs on X, if it satisfies the below mentioned axioms:

1) Distance between any two SvNSs A and B is zero if A = B.

2) Distance measure is symmetrical w.r.t to any two SvNSs *A* and *B*.

3) For any three SvNSs A, B and C such that *A* *B* *C*, we have *D*(*A*, *C*) *D*(*A*, *B*) and *D*(*A*, *C*) *D*(*B*, *C*).

Distance between FSs was presented by (Kacprzyk, 1997). Its extension was proposed by Atanassov in 1999 as two dimensional distances whereas third parameter hesitancy degree in distance was introduced by Szmidt and Kacprzyk (2000) for intuitionistic fuzzy sets. Yang & Chiclana (2012) proved three dimensional distance consistency over two dimensional distances. Grzegorzewski (2004) and Park et al. (2007) gave distance measure for IvFSs and IvIFSs respectively. Broumi and Smarandache (2013) presented weighted Hausdorff distance measure based on Hausdorff distance.

$$D_1(A,B) = \frac{1}{n}\sum_{i=1}^{n} w_i \left\| |T_A(x_i) - T_B(x_i)| \vee |I_A(x_i) - I_B(x_i)| \vee |F_A(x_i) - F_B(x_i)| \right\|_p \quad \ldots(1)$$

Ye (2014) presented weighted distance measures for SvNSs based on Hamming and Euclidean Distances given below:

Weighted Hamming Distance

$$D_1(A,B) = \frac{1}{3}\sum_{i=1}^{n} w_i \left[|T_A(x_i) - T_B(x_i)| + |I_A(x_i) - I_B(x_i)| + |F_A(x_i) - F_B(x_i)| \right] \quad \ldots(2)$$

where w_i is weight corresponding to x_i such that $\sum_{i=1}^{n} w_i = 1$. And weighted Euclidean Distance $D_2(A, B)$

$$= \left\{ \frac{1}{3}\sum_{i=1}^{n} w_i \left[\left(T_A(x_i) - T_B(x_i)\right)^2 + \left(I_A(x_i) - I_B(x_i)\right)^2 + \left(F_A(x_i) - F_B(x_i)\right)^2 \right] \right\}^{1/2} \quad \ldots(3)$$

where w_i is weight corresponding to x_i such that $\sum_{i=1}^{n} w_i = 1$.

Definition 4 (Similarity between SvNSs) : Let *A* and *B* be any two SvNSs, a real valued function *S*: IvISs () × IvIFSs () [0, 1] is defined as a measure of similarity for IvIFSs on *X*, if it satisfies following axioms:

1) Measure of similarity between any two IvIFSs is 1 iff A = B.

2) Measure of similarity is symmetric w.r.t. any two IvIFSs.

3) For any three IvIFSs A, B and C such that *A* *B* *C*. We have *S*(*A*, *C*) *S*(*A*, *B*) and *S*(*A*, *C*) *S*(*B*, *C*).

From axiomatic definition of distance and similarity measures it is clear that *S*(*A*, *B*) = 1 – *D*(*A*, *B*) where A and B are SvNSs, *D* and *S* are distance and similarity measure for SvNSs respectively.

Broumi and Smarandache (2013) presented several similarity measures for SvNSs. Ye (2014) presented similarity measures based on equation (2) and (3) as

$$S_1(A,B) = 1 - \left\{ \frac{1}{3}\sum_{i=1}^{n} w_i \begin{bmatrix} |T_A(x_i) - T_B(x_i)| \\ +|I_A(x_i) - I_B(x_i)| \\ +|F_A(x_i) - F_B(x_i)| \end{bmatrix} \right\}$$

and

$$S_2(A,B) = 1 - \left\{ \frac{1}{3}\sum_{i=1}^{n} w_i \begin{bmatrix} \left(T_A(x_i) - T_B(x_i)\right)^p \\ +\left(I_A(x_i) - I_B(x_i)\right)^p \\ +\left(F_A(x_i) - F_B(x_i)\right)^p \end{bmatrix} \right\}^{1/p}.$$

Ye also presented one more similarity measure as

$$S_3(A,B) = \frac{1 - \left\{ \frac{1}{3}\sum_{i=1}^{n} w_i \left| \left(T_A(x_i) - T_B(x_i)\right)^p + \left(I_A(x_i) - I_B(x_i)\right)^p - \left(F_A(x_i) - F_B(x_i)\right)^p \right| \right\}^{1/p}}{1 + \left\{ \frac{1}{3}\sum_{i=1}^{n} w_i \left| \left(T_A(x_i) - T_B(x_i)\right)^p + \left(I_A(x_i) - I_B(x_i)\right)^p - \left(F_A(x_i) - F_B(x_i)\right)^p \right| \right\}^{1/p}}$$

Ye (2015) proposed improved measures of cosine similarity measures for simplified neutrosophic sets including single valued cosine similarity and interval valued neutrosophic cosine similarity. He also introduced corresponding weighted similarity measures and applied it to medical diagnoses. Aydoğdu (2015) introduced two measures of similarity for SvNSs and developed single entropy measure for the same and applied it to neutrosophic multi-criteria decision making. Ye &Smarandache (2016) introduced refined single-valued neutrosophic sets, developed similarity measure of the same and applied it to multi criteria decision making.

Szmidt and Kacprzyk (2009) constructed Hausdorff distance between Intuitionistic Fuzzy Sets based on the Hamming metric and particularly give importance to the consistency of the metric used and the essence of the Hausdorff distances. Next section deals with new weighted distance and similarity measures based on averaged distance measure based on Hamming and Hausdorff distance defined as

$$D_4(A,B) = \frac{1}{2n}\sum_{i=1}^{n} \left\{ \frac{\frac{|T_A(x_i) - T_B(x_i)| + |I_A(x_i) - I_B(x_i)| + |F_A(x_i) - F_B(x_i)|}{3}}{|T_A(x_i) - T_B(x_i)| \vee |I_A(x_i) - I_B(x_i)| \vee |F_A(x_i) - F_B(x_i)|} \right\} \quad \ldots(4)$$

Distance, similarity measures and optimal point is proposed in the following sections under single valued neutrosophic environment.

Distance and Similarity Measures for SvNSs:

This section defines weighted distance and similarity measures based on equation (4) as follows:

Definition 5 Distance Measure: Consider two SvNSs A and B, represented by quadruple $\langle x, T_A(x), I_A(x), F_A(x)\rangle$ and $\langle x, T_B(x), I_B(x), F_B(x)\rangle$ respectively in a universe of discourse $X = \{x_1, x_2, \ldots, x_n\}$. Weighted distance measure $D_W(A, B)$ based on averaged distance measure is defined as follows:

$$D_W(A,B) = \frac{1}{2n}\sum_{i=1}^{n} w_i \left\{ \frac{\frac{|T_A(x_i) - T_B(x_i)| + |I_A(x_i) - I_B(x_i)| + |F_A(x_i) - F_B(x_i)|}{3}}{+|T_A(x_i) - T_B(x_i)| \vee |I_A(x_i) - I_B(x_i)| \vee |F_A(x_i) - F_B(x_i)|} \right\}, \quad \ldots(5)$$

where wi is weight corresponding to xi such that $\sum_{i=1}^{n} w_i = 1$.

Theorem 1: Dw(A, B) is a valid measure of distance between two SvNSs A and B.

Proof: Consider two SvNSs A and B represented by quadruple $\langle x_i, T_A(x_i), I_A(x_i), F_A(x_i)\rangle$ and $\langle x_i, T_B(x_i), I_B(x_i), F_B(x_i)\rangle$ respectively in a universe of discourse = $\{x_1, x_2, \ldots, x_n\}$. It is easy to see that D_W(A,B) [0, 1] satisfies axioms (1) and (2) defined in Definition 3. In order to prove axiom (3), consider three SvNSs *A*, *B* and *C* such that $A \subseteq B \subseteq C$.

Then

$$T_A(x_i) \le T_B(x_i) \le T_C(x_i),\ I_A(x_i) \ge I_B(x_i) \ge I_C(x_i) \text{and} F_A(x_i) \ge F_B(x_i)) \ge F_C(x_i).\ \text{Thus}$$
$$|T_A(x_i) - T_B(x_i)| \le |T_A(x_i) - T_C(x_i)| \text{ and } |T_B(x_i) - T_C(x_i)| \le |T_A(x_i) - T_C(x_i)|,$$
$$|I_A(x_i) - I_B(x_i)| \le |I_A(x_i) - I_C(x_i)| \text{ and } |I_B(x_i) - I_C(x_i)| \le |I_A(x_i) - I_C(x_i)|,$$
$$|F_A(x_i) - F_B(x_i)| \le |F_A(x_i) - F_C(x_i)| \text{ and } |F_B(x_i) - F_C(x_i)| \le |F_A(x_i) - F_C(x_i)|.$$

$$\Rightarrow \frac{\begin{bmatrix}|T_A(x_i)-T_B(x_i)|\\+|I_A(x_i)-I_B(x_i)|\\+|F_A(x_i)-F_B(x_i)|\end{bmatrix}}{3} \le \frac{\begin{bmatrix}|T_A(x_i)-T_C(x_i)|\\+|I_A(x_i)-I_C(x_i)|\\+|F_A(x_i)-F_C(x_i)|\end{bmatrix}}{3}$$

And

$$\frac{\begin{bmatrix}|T_B(x_i)-T_C(x_i)|\\+|I_B(x_i)-I_C(x_i)|\\+|F_B(x_i)-F_C(x_i)|\end{bmatrix}}{3} \le \frac{\begin{bmatrix}|T_A(x_i)-T_C(x_i)|\\+|I_A(x_i)-I_C(x_i)|\\+|F_A(x_i)-F_C(x_i)|\end{bmatrix}}{3}$$

Also, $\begin{bmatrix}|T_A(x_i)-T_B(x_i)|\\ \vee |I_A(x_i)-I_B(x_i)|\\ \vee |F_A(x_i)-F_B(x_i)|\end{bmatrix} \le \begin{bmatrix}|T_A(x_i)-T_C(x_i)|\\ \vee |I_A(x_i)-I_C(x_i)|\\ \vee |F_A(x_i)-F_C(x_i)|\end{bmatrix}$

$$\begin{bmatrix}|T_B(x_i)-T_C(x_i)|\\ \vee |I_B(x_i)-I_C(x_i)|\\ \vee |F_B(x_i)-F_C(x_i)|\end{bmatrix} \le \begin{bmatrix}|T_A(x_i)-T_C(x_i)|\\ \vee |I_A(x_i)-I_C(x_i)|\\ \vee |F_A(x_i)-F_C(x_i)|\end{bmatrix}$$

Thus $D_w(A, B)$ and $D_w(B, C)$ $D_w(A, C)$. Hence $D_w(A, B)$ is a valid measure of distance.

According to the relationship between the distance and similarity measures, similarity measure corresponding to $D_w(A, B)$ is derived as follows

$$S_w(A,B) = 1 - \frac{1}{\gamma n}\sum_{i=1}^{n} w_i \left\{ \frac{|T_A(x_i)-T_B(x_i)|+|I_A(x_i)-I_B(x_i)|+|F_A(x_i)-F_B(x_i)|}{3} + |T_A(x_i)-T_B(x_i)| \vee |I_A(x_i)-I_B(x_i)| \vee |F_A(x_i)-F_B(x_i)| \right\}, \quad \ldots(6)$$

where w_i is weight corresponding to x_i such that $\sum_{i=1}^{n} w_i = 1$.

Obviously, we can easily prove that $S_w(A, B)$ satisfies the axioms mentioned in Definition 4. Furthermore, we can also propose another measure of similarity for SvNSs.

$$S(A,B) = \frac{1}{n}\sum_{i=1}^{n} \frac{T_{A\cap B}(x_i)+I_{A\cap B}(x_i)+F_{A\cap B}(x_i)}{T_{A\cup B}(x_i)+I_{A\cup B}(x_i)+F_{A\cup B}(x_i)} \quad \ldots(7)$$

Theorem 2: $S(A, B)$ is a valid measure of similarity between two SvNSs A and B.

Proof: Consider two SvNSs A and B represented by quadruple $\langle x_i, T_A(x_i), I_A(x_i), F_A(x_i)\rangle$ and $\langle x_i, T_B(x_i), I_B(x_i), F_B(x_i)\rangle$ respectively in a universe of discourse = $\{x_1, x_2, \ldots, x_n\}$. It is easy to see that $S(A, B) \in [0, 1]$ satisfies axioms (1) and (2) defined in Definition 4. In order to prove axiom (3), assume that A, B and C are three SvNSs such that $A \subseteq B \subseteq C$. Then $T_A(x_i) \le T_B(x_i) \le T_C(x_i)$, $I_A(x_i) > I_B(x_i) \ge I_C(x_i)$ and $F_A(x_i) \ge F_B(x_i)) \ge F_C(x_i)$. Thus

$$T_{A\cap B}(x_i) = T_A(x_i) \wedge T_B(x_i) = T_A(x_i) = T_A(x_i) \wedge T_C(x_i) = T_{A\cap C}(x_i) \quad \ldots(8)$$

$$I_{A\cap B}(x_i) = T_A(x_i) \wedge I_B(x_i) = I_B(x_i) \ge I_C(x_i) = I_A(x_i) \wedge I_C(x_i) = I_{A\cap C}(x_i) \quad \ldots(9)$$

And

$$F_{A\cap B}(x_i) = F_A(x_i) \vee F_B(x_i) = F_A(x_i) = F_A(x_i) \vee F_C(x_i) = F_{A\cap C}(x_i) \quad \ldots(10)$$

Adding equations (8), (9) and (10)

$$T_{A\cap B}(x_i) + I_{A\cap B}(x_i) + F_{A\cap B}(x_i) \ge T_{A\cap C}(x_i) + I_{A\cap C}(x_i) + F_{A\cap C}(x_i) \quad \ldots(11)$$

Also,

$$T_{A\cup B}(x_i) = T_A(x_i) \vee T_B(x_i) = T_B(x_i) \le T_C(x_i) = T_A(x_i) \vee T_C(x_i) = T_{A\cup C}(x_i) \quad \ldots(12)$$

$$I_{A\cup B}(x_i) = I_A(x_i) \vee I_B(x_i) = I_A(x_i) = I_A(x_i) \vee I_C(x_i) = I_{A\cup C}(x_i) \quad \ldots(13)$$

And

$$F_{A\cup B}(x_i) = F_A(x_i) \wedge F_B(x_i) = F_B(x_i) \ge F_C(x_i) = F_A(x_i) \wedge F_C(x_i) = F_{A\cup C}(x_i) \quad \ldots(14)$$

Adding equations (12), (13) and (14)

$$T_{A\cup B}(x_i) + I_{A\cup B}(x_i) + F_{A\cup B}(x_i) \le T_{A\cup C}(x_i) + I_{A\cup C}(x_i) + F_{A\cup C}(x_i) \quad \ldots(15)$$

$$\Rightarrow \frac{1}{T_{A\cup B}(x_i)+I_{A\cup B}(x_i)+F_{A\cup B}(x_i)} \ge \frac{1}{T_{A\cup C}(x_i)+I_{A\cup C}(x_i)+F_{A\cup C}(x_i)} \quad \ldots(16)$$

From inequalities (11) and (16), we get

$$\frac{T_{A\cap B}(x_i) + I_{A\cap B}(x_i) - F_{A\cap B}(x_i)}{T_{A\cup B}(x_i) + I_{A\cup B}(x_i) - F_{A\cup B}(x_i)} \ge \frac{T_{A\cap C}(x_i) + I_{A\cap C}(x_i) - F_{A\cap C}(x_i)}{T_{A\cup C}(x_i) + I_{A\cup C}(x_i) - F_{A\cup C}(x_i)}$$

$$\Rightarrow \frac{1}{n}\sum_{i=1}^{n} \frac{T_{A\cap B}(x_i)+I_{A\cap B}(x_i)+F_{A\cap B}(x_i)}{T_{A\cup B}(x_i)+I_{A\cup B}(x_i)+F_{A\cup B}(x_i)} \ge \frac{1}{n}\sum_{i=1}^{n} \frac{T_{A\cap C}(x_i)+I_{A\cap C}(x_i)+F_{A\cap C}(x_i)}{T_{A\cup C}(x_i)+I_{A\cup C}(x_i)+F_{A\cup C}(x_i)}$$
$$\Rightarrow S(A,C) \le S(A,B)$$

Similarly, $S(A, C) \le S(B, C)$. Thus $S(A, B)$ is a valid measure of similarity between two SvNSs.

Corollary: Weighted similarity measure corresponding to equation (7) can be defined as

$$S^w(A,B) = \frac{1}{n}\sum_{i=1}^{n} \frac{T_{A\cap B}(x_i)+I_{A\cap B}(x_i)+F_{A\cap B}(x_i)}{T_{A\cup B}(x_i)+I_{A\cup B}(x_i)+F_{A\cup B}(x_i)} \quad \ldots(17)$$

Next, section defines an optimal point and presents an algorithm that helps to solve multi-attribute decision making problems.

Application of SVNSs Similarity Measures to Multi-attribute Decision Making

This section proposes definition of optimal point and uses proposed similarity measures to draw inferences in multi attribute decision making under single valued neutrosophic environments.

Multi-attribute decision making in an organization involves various attributes along with various decision takers. Recently, it has become more complex. To take any decision, a manager needs to have relevant information and decent analytical skills. In some practical situations the course of action involves incomplete and indeterminate information, which is stated in terms of SvNSs. Similarity measures can be used as a tool to identify best course of action by determining the similarity between each course of action and ideal decision criteria/ideal point. Ideal point does not exist in reality. In order to identify

the substitute of ideal point we have defined optimal point as follows:

$$A_* = \{\langle x_i, \max[T(x_i)], \max[I(x_i)], \min[F(x_i)]\rangle, \forall I\} \quad \ldots(18$$

The best course of action can be identified on the basis of similarity values between optimal point and available course of actions. Larger the value of similarity more closer it is to the optimal point.

Let us consider a multi-attribute decision making problem involving a set of options P = {P_1, P_2, ..., P_m} to be considered on the basis of attributes C = {C_1, C_2, ..., C_n}. Assume that the weight of an attribute C_j (j = 1, 2, . . . , n), entered by the decision-maker, is $w_j \in [0, 1]$, j = 1, ... , n and $\sum_{i=1}^{n} w_i = 1$. Corresponding to each option P_i, I = 1, ... , m and attribute C_j, j = 1,2, ... , n, the values of three function TA(xi), $I_A(x_i)$, and $F_A(x_i)$ denoted by single valued neutrosophic value $d_{ij}(x_{ij})$, which is derived from evaluation of each course of action based on each attribute. To identify best course of action, similarity between each course of action and identified optimal course of action is calculated. Higher the value of similarity measure closer it is with the optimal value. Course of action with highest value is identified as best course of action.

Multi-attribute decision process can be summarized as follows:

Step 1: Identify weight corresponding to each attribute.

Step 2: Formulate decision matrix corresponding to each attribute provided by the decision maker.

Step 3: Identify optimal point using equation (18) using decision matrix obtained in step 2.

Step 4: Calculate the similarity value $S_w(P_j, A_*)$ or $S(P_j, A_*)$ or $S^w(P_j, A_*)$ by using equation (6) or (7) or (17).

Step 5: Rank and identify the best alternatives on the basis weighted similarity measure value.

Next subsection explains the procedure of application of similarity measure in multi-attribute decision making using a numerical example.

LLUSTRATIVE EXAMPLE

Here multi-attribute decision making problem is adopted from Ye (2014) to demonstrate the procedure of multi-attribute decision making. "Consider four suppliers P = {P_1, P_2, P_3, P_4} which are concerned with a manufacturing company, that wants to select the best global supplier according to the core competencies of suppliers. The core competencies of suppliers are evaluated on the basis of four attributes: (i) C_1 is the level of technology innovation; (ii) C_2 is the control ability of the flow; (iii) C_3 is the ability of management; (iv) C_4 is the level of service. Then, the weight vector for the four criteria is $w = (0.3, 0.25, 0.25, 0.2)^T$. The decision matrix of the suppliers is made according to the four evaluating criteria. Therefore, the single valued neutrosophic decision matrix of the suppliers is as follows:

$$D = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \end{matrix} \begin{bmatrix} \langle 0.5,0.1,0.3\rangle & \langle 0.5,0.1,0.4\rangle & \langle 0.7,0.1,0.2\rangle & \langle 0.3,0.2,0.1\rangle \\ \langle 0.4,0.2,0.3\rangle & \langle 0.3,0.2,0.4\rangle & \langle 0.9,0.0,0.1\rangle & \langle 0.5,0.3,0.2\rangle \\ \langle 0.4,0.3,0.1\rangle & \langle 0.5,0.1,0.3\rangle & \langle 0.5,0.0,0.4\rangle & \langle 0.6,0.2,0.2\rangle \\ \langle 0.6,0.1,0.2\rangle & \langle 0.2,0.2,0.5\rangle & \langle 0.4,0.3,0.2\rangle & \langle 0.7,0.2,0.1\rangle \end{bmatrix}$$

To identify the most desirable supplier, we calculate the similarity of each supplier with optimal identified values.

Optimal solution is identified using equation (18) as follows

$$A_* = \{\langle 0.6, 0.3, 0.1\rangle, \langle 0.5, 0.2, 0.3\rangle, \langle 0.9, 0.3, 0.1\rangle, \langle 0.7, 0.3, 0.1\rangle\}$$

$S^w(A_*, A_1) = 0.821399$, $S^w(A_*, A_2) = 0.869126$, $S^w(A_*, A_3) = 0.819895$, $S^w(A_*, A_4) = 0.849895$, optimal solution is identified as the alternative with maximum value of similarity measure. So, the manufacturing company should order from supplier A_2 with preference order A_4, A_1, A_3. According to distance similarity measure, $S_w(A_*, A_1) = 0.955417$, $S_w(A_*, A_2) = 0.956875$, $S_w(A_*, A_3) = 0.957917$, $S_w(A_*, A_4) = 0.948958$, optimal solution is identified as the alternative with maximum value of similarity measure. So, the manufacturing company should order from supplier A_3 with preference order A_2, A_1, A_4.

It can be easily observed that the cross entropy measures proposed by Ye (2014) and Ye (2016) provide ranking A_1, A_3, A_2, A_4 and A_3, A_1, A_2, A_4 respectively to the suppliers. But Ye (2014) and Ye (2016) had taken optimal solution as ⟨1,0,0⟩ which is quite unrealistic. So, the ranking provided by the proposed similarity measure is more reasonable as the optimal solution considered in this paper is more realistic.

- $S_{HS}(A,B) = 1 - D(A,B)$, where $D(A,B)$ is Hausdorff distance between A and B as proposed by Broumi & Smarandache (2013).
- $S_{HS1}(A,B) = \frac{\sum_{i=1}^{n} (T_A(x_i)T_B(x_i) + I_A(x_i)I_B(x_i) + F_A(x_i)F_B(x_i))}{\max(\sum_{i=1}^{n}(T_A(x_i))^2 + (I_A(x_i))^2 + (F_A(x_i))^2, \sum_{i=1}^{n}(T_B(x_i))^2 + (I_B(x_i))^2 + (F_B(x_i))^2)}$ presented by Broumi & Smarandache (2013).
- $S_J(A,B) = \frac{1}{n}\sum_{i=1}^{n} \frac{T_A(x_i)T_B(x_i) + I_A(x_i)I_B(x_i) + F_A(x_i)F_B(x_i)}{\left(\begin{array}{c}(T_A(x_i))^2 + (I_A(x_i))^2 + (F_A(x_i))^2) \\ +(T_B(x_i))^2 + (I_B(x_i))^2 - (F_B(x_i))^2 \\ -(T_A(x_i)T_B(x_i) + I_A(x_i)I_B(x_i) - F_A(x_i)F_B(x_i))\end{array}\right)}$, $S_D(A,B) = \frac{1}{n}\sum_{i=1}^{n} \frac{T_A(x_i)T_B(x_i) + I_A(x_i)I_B(x_i) + F_A(x_i)F_B(x_i)}{\left(\begin{array}{c}(T_A(x_i))^2 + (I_A(x_i))^2 + (F_A(x_i))^2) \\ +(T_B(x_i))^2 + (I_B(x_i))^2 + (F_B(x_i))^2\end{array}\right)}$ and $S_C(A,B) = \frac{1}{n}\sum_{i=1}^{n} \frac{T_A(x_i)T_B(x_i) - I_A(x_i)I_B(x_i) + F_A(x_i)F_B(x_i)}{\sqrt{((T_A(x_i))^2 + (I_A(x_i))^2 + (F_A(x_i))^2)}\sqrt{((T_B(x_i))^2 + (I_B(x_i))^2 + (F_B(x_i))^2)}}$ are defined by Ye (2014).
- $S_{Ca1}(A,B) = \frac{1}{n}\sum_{i=1}^{n} \cot\left[\frac{\pi}{4} + \frac{\pi}{4}\max\left(\begin{array}{c}|T_A(x_i) - T_B(x_i)|, \\ |I_A(x_i) - I_B(x_i)|, \\ |F_A(x_i) - F_B(x_i)|\end{array}\right)\right]$ and $S_{Ca2}(A,B) = \frac{1}{n}\sum_{i=1}^{n} \cot\left[\frac{\pi}{4} + \frac{\pi}{12}\max\left(\begin{array}{c}|T_A(x_i) - T_B(x_i)| \\ +|I_A(x_i) - I_B(x_i)| \\ +|F_A(x_i) - F_B(x_i)|\end{array}\right)\right]$ are defined by Ye (2015).

To review the performance of similarity measures let us consider an example. Consider the following four SvNSs

$A_1 = \{\langle x, 0.1,0.2,0.2\rangle\}$, $A_2 = \{\langle x,0.2,0.4,0.4\rangle\}$, $A_3 = \{\langle x,0.1,0.2,0.3\rangle\}$ and $A_4 = \{\langle x,0.0,0.0,0.0\rangle\}$.

Table 1 shows the comparison of proposed measures with some existing measures of similarity between two SvNSs.

TABLE 1 Comparison between similarity measures

	S_{BS}	S_{BS1}	S_J	S_D	S_C	S_{Cot}	S_{Cot1}	S_w	S
A_1A_2	0.866667	0.5	0.66666	0.8	1	0.7265	0.7673	0.833333	1
A_3A_4	0.8	0	0	0	Not Defined	0.6128	0.7265	0.75	1

It is clear from Table1 that S_C and S are unresonable in determining similarity between A_1, A_2, and A_3, A_4. Where as S_{BS1}, S_J and S_D are zero for A_3A_4. Thus S_{BS}, S_{cot}, S_{cot1} and S_w are able to determine similarity in a better way.

ONCLUSION

Distance and similarity measure are significant research area in neutrosophic information theory as they are efficient tools to deal with uncertain and insufficient information. In this paper we have derived averaged distance measure and derived similarity measure using the proposed distance measure and the relation between distance and similarity measure under single valued neutrosophic environment. Further, another similarity measure is proposed for SvNSs. Next, a method is derived to define ideal /optimal point using the existing information as previous literature used $\langle 1,0,0 \rangle$ as optimal point which does not exists in reality. Further, proposed similarity measures along with defined optimal point are used to solve multi-attribute decision making problem, which helps in providing rank to all the available alternatives and helps in identifying the best one. An illustrative example is used to demonstrate its application. Finally the proposed similarity measures are compared with some existing similarity measures. Proposed similarity measure S_w is proved to be better than some existing measures.

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Relationship between Indian and US Stock Returns Before, During and After Financial Crisis

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ABSTRACT

This study suggests substantial diversification benefits depending on the time period under consideration between Indian and the US equity markets. This is particularly true after the financial crisis when correlations between the Indian and the US markets became negative suggesting substantial risk reduction if a portfolio is constructed between the US and Indian stocks. However, the benefits of diversification vanished during financial crisis when every market displayed strong positive correlations.

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INTRODUCTION

Our study examines the nature and extent of linkage between the US and the Indian stock markets before, during and after financial crisis. Despite the growing interdependence of world economy, current literature on the issue found only unilateral impact of the US markets on Indian markets but not vice versa. In other words there is a response asymmetry in return and volatility from the US to Indian markets. However, most of these studies were completed by 2009. Significant changes have taken place in the last few years, and there is literature to support the idea that due to growing interdependence, the diversification benefits are decreasing. Many Indian companies have started to raise money in the US stock exchanges and few US companies have now been acquired by the Indian conglomerates. There is now a significant presence of multinationals in India. All of these factors have motivated us to explore the spillover and contagion effect, in the context of spillover of changes in price (or returns) and volatility, between the US and Indian stock markets. This is especially pertinent during the financial crisis of 2008/09 when global markets declined concurrently. This was not only confined to equity markets, but other markets such as real estate that showed similar steep declines globally. There are wide range of applications of this study from the point-of-view of fund managers, hedge funds, private equity firms, mutual funds, retirement funds, and sovereign wealth funds especially on how they can insulate their portfolios during market bubbles.

ITERATURE REVIEW

Arshanapalli et al, (2001) hypothesized that the Indian stock market was not interrelated to the US markets for the entire sample period from January 1991 to December 1999. As the liberalization measures started to take effect after 1998, the Bombay Stock Exchange (BSE) became more integrated with NASDAQ but did not influence these markets. During the same time, markets of many other countries started to become increasingly interdependent with the US market. Rafiqul et al, (2016) investigated the effect of both return and volatility spillover from the US market to the BRICS markets and among the Brazil, Russia, India, China and South Africa (BRICS) markets. The results suggest that the US stock market has a significant mean return and volatility spillover effect on the BRICS stock markets. Aggarwal and Leal (1996) examined the ten largest emerging stock markets of Asia and Latin America. They observed greater day-to-day linkages between the Asian emerging markets (Korea, Malaysia, the Philippines, Taiwan, and Thailand) and the US markets, but the linkages were not as strong for the Latin American markets (Argentina, Brazil, Chile, and Mexico) with the US.

Similar results were shown in many studies of the Indian stock markets. Kumar and Mukhopadyay (2002) used Granger causality test and univariate GARCH model to study the return and volatility linkage between the Indian and the US markets. They found significant return and volatility spillover from the US to India. Similarly, Nair and Ramanathan (2003) reported unidirectional spillover of returns from the US to Indian market. Lamba (2004) found that the Indian market is influenced by the large developed equity markets, including the US, UK and Japan, and that this influence has strengthened during the more recent time period (January 2000-February 2003).

Choudhry (2004) found a two-way linkage between Indian and Pakistani markets, while one-way influence of the US market on these two markets. Wong et al. (2005) also reported only fractional integration of the Indian stock market with developed markets of the US, the UK and Japan. They showed that the developed markets significantly influenced the Indian market, but not vice versa. Recent study by Taner and Mercan (2016) examined behavior of emerging stock markets during financial crisis that established commonalities during boom and bust periods and found reaction to negative shocks is larger than positive news.

As mentioned earlier, most of the studies found a unilateral impact of the US stock markets on Indian stock markets but not vice versa. However, we believe that the economic, technological, and political situation has changed significantly for India and the US over the last 10 years and the spillover effect between the two countries warrant another look.

ATA AND METHODOLOGY

The data that spans from July 31, 1997 to October 31, 2017 was downloaded from Yahoo Finance. The Indian stock index SENSEX is a market capitalization index of 30 well established companies and was introduced by the Bombay Stock Exchange in 1986. The S&P 500 and NASDAQ are also market capitalization weighted indices introduced in 1957 and 1971 respectively. The following statistical model was used to find correlations between Indian and US stock returns:

$$\rho = \text{Cov}(\text{SENSEX}, \text{SP500}) / \sigma_{\text{SENSEX}} \alpha_{\text{SP500}}$$

Where ρ is the correlation coefficient, Cov is the covariance between SENSEX and SP500, σ_{SENSEX} is the standard deviation of SENSEX's returns and α_{SP500} is the standard deviation of S&P 500 returns.

$$\text{Cov}(\text{SENSEX}, \text{S\&P 500}) = E(\text{SENSEX} - \mu\text{SENSEX})(\text{SP500} - \mu\text{SP500})$$

Where E is the expectations operator and μSENSEX is the mean of SENSEX returns and μSP500 is the mean of SP500 returns. A similar equation would apply for correlation and covariance between SENSEX and NASDAQ.

ESULTS

Yearly returns for the three stock market indices are shown in Table 1. From the results, it is evident that there are periods when SENSEX returns diverged from the returns of both the S&P 500 index and NASDAQ. For instance, in the period prior to the financial crisis, SENSEX returns for 2004 to 2007 were 14.07%, 41.42%, 35.10% and 22.51% respectively,

whereas S&P 500 returns for the corresponding period were 8.61%, 2.96%, 12.77%, 3.47% and NASDAQ returns were 8.24%, 1.36%, 9.09% and 9.36%. Therefore, for this period the Indian stock market was appreciating rapidly as most emerging markets were displaying much higher economic growth than the developed markets. The post financial crisis period from 2010 onwards displays sometimes similar and sometimes divergent returns for SENSEX and the US markets. For instance, in 2012 SENSEX returns were 14.59% whereas S&P 500 and NASDAQ returns were 12.58% and 14.76%, displaying similar numbers. But, in 2014, SENSEX returns were 35.25% whereas S&P 500 and NASDAQ returns were 10.79% and 12.57%, showing a subdued effect on the US market versus a much elevated effect on the Indian market. Also, there was a divergent trend in 2015 when SENSEX returns were -15.99% whereas S&P 500 and NASDAQ returns were -0.73% and -5.57%. These results indicate that the two markets prior to the financial crisis display interdependence. During the financial crisis of 2008/2009, the linkages are much stronger as all markets showed steep declines with elevated levels of volatilities across all three indices. A similar result was obtained by Ang and Bekaert (2002) who found increased correlation for steeply declining international equity markets.

TABLE 1: Yearly Returns in Percentage for the period 7/31/97 to 10/31/17

	SENSEX	S&P 500	NASDAQ
1998	2.79	23.64	33.38
1999	45.10	17.84	61.83
2000	-18.49	-10.69	-49.90
2001	-26.76	-13.98	-23.64
2002	-1.85	-26.61	-37.87
2003	56.09	23.41	40.55
2004	14.07	8.61	8.24
2005	41.42	2.96	1.36
2006	35.10	12.77	9.09
2007	22.51	3.47	9.36
2008	-62.74	-48.59	-51.99
2009	55.14	21.07	36.39
2010	11.37	12.03	15.62
2011	-6.39	-0.01	-1.82
2012	14.59	12.58	14.76
2013	3.06	25.93	32.44
2014	35.25	10.79	12.57
2015	-15.99	-0.73	-5.57
2016	10.62	9.11	8.37
2017	10.62	13.29	8.37

In Table 2, cumulative returns for the three periods, before, during and after the financial crisis are shown. From the data, it is clear that overall returns before the financial crisis were 121.86% for SENSEX and 35.90% and 47.79% for S&P 500 and NASDAQ, which implies that the Indian stock market performed better than the US market for this period. During the financial crisis, there was a much larger decline of -82.49% for the Indian market versus a decline of -58.41% for S&P 500 and -58.91% for NASDAQ. Although, the financial crisis mainly occurred in the US and developed markets, the contagion effect of this crisis was felt more severely by the emerging markets, in particular, the Indian markets with trillions of dollars of market capitalization being evaporated in a very short time period. However, after the financial crisis all three markets rose almost equally with SENSEX's cumulative return of 89.49% versus 60.21% for S&P 500 and 95.63% for NASDAQ.

From Table 2, it can also be seen that the level of risk or volatility during the financial crisis is much higher for the Indian market as can be seen from the standard deviation of returns which stood at 36.40% for SENSEX against 21.30% for S&P 500 and 26.32% for NASDAQ. Overall, the Indian market is much riskier than the US market. The risks declined significantly after the financial crisis when standard deviation of returns stood at 18.42% for SENSEX against 13.09% for S&P 500 and 14.96% for NASDAQ.

These changes in the stock return distributions can have a number of implications such as portfolio optimization, risk management, valuation and hedging of derivative securities for the portfolio managers and other market participants. This also has policy implications from the point-of-view of governments and monetary authorities globally who had to cooperate with each other to mitigate the fallout on the wild swings and massive decline of the financial markets, failure of the firms, and other negative consequences of financial crisis.

TABLE 2: Descriptive Statistics for the period 7/31/97 to 10/31/17

	SENSEX	S&P 500	NASDAQ
Overall Period			
Cumulative Returns (%)	203.48	106.09	151.55
Mean	0.84	0.44	0.62
Standard. Dev.	23.87	15.14	23.73
Before Financial Crisis			
Cumulative Returns (%)	121.86	35.90	47.79
Mean	0.92	0.27	0.36
Standard. Dev.	26.02	15.07	27.96
During Financial Crisis			
Cumulative Returns (%)	-82.49	-58.41	-58.91
Mean	-1.43	-2.53	-2.16
Standard. Dev.	36.40	21.30	26.32
After Financial Crisis			
Cumulative Returns (%)	89.49	60.21	95.63
Mean	1.17	1.20	1.50
Standard. Dev.	18.42	13.09	14.96

Table 3 displays the correlation during, before and after the financial crisis between Indian and the US markets. From the numbers, it is quite evident there is a very small positive correlation between the SENSEX and S&P 500 index and NASDAQ. The correlation stood at 0.122 and 0.124 between SENSEX versus S&P 500 index and SENSEX and NASDAQ respectively before the financial crisis. However, during the

financial crisis the correlation between SENSEX and NASDAQ at 0.546 became very positive. Despite the fact that the Indian market was largely insulated from the US market, the contagion effect of this magnitude is more related to the fear in the global financial markets rather than any other fundamental factors. This effect was confirmed by Ang and Bekaert (2002) who suggested similar contagions effect during falling global markets when the levels of correlation increased as a result of financial crisis. However, during the post financial crisis period, the correlation between the returns of Indian and the US markets is negative, suggesting substantial portfolio diversification benefits.

TABLE 3: Correlation Between US and Indian Markets for the Period 7/31/97 to 10/31/17

	S&P 500	NASDAQ
Overall Period		
SENSEX	0.129	0.123
Before Financial Crisis		
SENSEX	0.122	0.124
During Financial Crisis		
SENSEX	0.546	0.642
After Financial Crisis		
SENSEX	-0.215	-0.244

CONCLUSIONS

This study suggests substantial diversification benefits depending on the time period under consideration between Indian and the US equity markets. However, the benefits of diversification vanished during the financial crisis when every market displayed strong positive correlations. In fact, emerging markets such as India declined significantly as compared to the developed markets such as the US. This is contrary to what should have occurred given the fact that the emerging markets were relatively insulated from the basic causes of the financial crisis. There are wide range of applications of this study from the point-of-view of fund managers, hedge funds, private equity firms, mutual funds, retirement funds, and sovereign wealth funds especially on how they can insulate their portfolios during market bubbles.

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Comparative Analysis of Bankruptcy Prediction Models: An Indian Perspective

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ABSTRACT

Bankruptcy is a state of insolvency wherein the company or the person is not able to repay the creditors the debt amount. The purpose of this research is to develop and compare the performance of bankruptcy prediction models using multiple discriminant analysis, logistic regression and neural network for listed companies in India. These bankruptcy prediction models were tested, over the three years prior to bankruptcy using financial ratios. The sample consists of 72 bankrupt and 72 non-bankrupt companies over the period 1991-2016. The results indicate that as compared to multiple discriminant analysis and logistic regression, neural network has the highest classification accuracy for all the three years prior to bankruptcy.

Keywords : Bankruptcy prediction, Multiple discriminant analysis, Logistic regression, Neural network

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INTRODUCTION

The Indian Insolvency and Bankruptcy Code 2016 describes Bankruptcy as "a legal status usually imposed by court, on a firm or an individual who is unable to meet its debt obligations. Upon successful completion of the bankruptcy proceedings, the debtor is relieved of the debt obligations incurred prior to filling for bankruptcy."[1]However, the Insolvency is described in the code as "a situation where individuals or organizations are unable to meet their financial obligations."[2]This code has created an institutional mechanism and insolvency resolution process for business operated by companies, individual or any other entities, either by coming up with a viable survival mechanism or by ensuring their prompt liquidation.

Bankruptcy is defined as the inability of the company to continue its current operations due to high debt obligations (Pongsatat et.al., 2004). Typically bankruptcy occurs "when either (i) the firm's operating cash flow is insufficient to meet current obligations which means, the inability to service its debts or (ii) when the firm's net worth is negative that means, the value of the assets is less than the value of its external liabilities" (Knox et. al., 2008).

Bankruptcy is a position where a company is not capable of repaying its liabilities. There can be numerous other reasons for bankruptcy of a company such as assets falling short of liabilities, scarcity of cash, inefficient management or even declining trend in sales. Predicting bankruptcy turns out to be very crucial in taking preventive measures regarding liquidity, solvency and profitability position of the company. Predicting bankruptcy involves collecting relevant financial information of the firm, place it in a credible model to verify and predict the future bankruptcy to take required precautions well in advance.

Bankruptcy prediction is among the most well researched topics in the finance and strategic management literature (Polemis&Gounopoulos, 2012). The early researchers (Ramser& Foster, 1931; Fitzpatrick, 1932; Winakor& smith, 1935) focused on the comparison of the values of financial ratios in bankrupt and non-bankrupt companies and concluded that the ratios of the bankrupt companies were poor (Ugurlu&Aksoy, 2006). Altman (1968) used multivariate discriminant analysis for prediction of corporate bankruptcy. In the 1970s, multiple discriminant analysis was the primary method for prediction of corporate bankruptcy. During the 1980s, use of logistic regression analysis method was emphasized, (Virag&Kristof, 2005). However, Ohlson (1980) applied logistic regression analysis for the first time for prediction of bankruptcy. In recent years, a number of researchers have begun to apply the neural network approach to the prediction of bankruptcy as they have produced promising results in prediction of bankruptcy (Ugurlu&Aksoy, 2006). Odom and Sharda (1990) were first to use Neural networks for bankruptcy prediction.

The objective of this study is to develop a bankruptcy prediction model by taking data of Indian listed companies using multiple discriminant analysis, logistic regression and neural network and compare the performance of the three models.

ITERATURE REVIEW

Vasantha, Dhanraj & Thiayalnayaki (2013) studied selected Indian airline companies. The sample of the study consisted of Kingfisher airlines, Spice Jet airways and Jet airways. Authors also studied financial and operational performance of these companies. The financial soundness of these airline companies was evaluated using Altman's original Z score, Revised Z score model and revised four models. The study also compared the above-mentioned models to suggest strategies for making the right moves.

Muthukumar & Sekar (2014) used Altman Z score and Springate models to study the financial health of automobile sector in India. The study was conducted for the period 2003 to 2012, to check how the global financial crisis affected the automobile sector, which indicates the economic growth of the country. The authors took scores of all companies to calculate an average to create a benchmark for comparison. It has been concluded that none of the companies are in a distressed state.

There have been various methods developed and used across the industries. Some of the most common methods are the Altman Z score and the Merton's distance to default model. Each model has its own limitations and financial institutions are always on the look-out for finding the best method to evaluate credit worthiness.

There have been many related studies in the past which assessed the efficiency of the prediction models. Attempts to find out the best prediction model have been umpteen but none of them have been very successful. Moreover, most of these studies have been on a global scale and concentrate more on firms that are huge multinationals. The purpose of our research is to study the suitability of major bankruptcy prediction models by applying them to companies in the Indian manufacturing sector that have been declared sick and by doing so find out which models are more suitable for firms in this sector.

Most studies that happened in the past lacked validity and were deficient in a number of ways. A review of statistical and theoretic prediction models was presented by Scott (1981), but it was very limited in coverage and can be considered out of date in the current context. Zavgren (1983) describes only the statistical models without any mention of the theoretical models. The first ever study was by Altman (1984), which was done taking ten countries and is an interesting study but limits itself to only one type of statistical model. However, Jones (1987) tried to give a comprehensive view of all the prediction models and focused on research done in the corporate

[1] *https://www.quora.com/What-is-the-difference-between-insolvency-bankruptcy-and-liquidation.*
[2] *http://finmin.nic.in/reports/BLRCReportVol1_04112015.pdf.*

bankruptcy prediction area but it does not discuss theoretical methods or models.

Zhang et. al., (1999), tries to understand the role of neural networks to predict bankruptcy. They also discuss the empirical applications of the networks for predicting bankruptcy but it leaves out all other types of models that are generally used by various firms.

From the review of various studies, the conclusion that can be drawn is the evolution of business failure research can be categorized into following three broad statistical techniques:-

1. Accounting Based Bankruptcy Predicting Model

2. Market Based Bankruptcy Predicting Model

3. Artificial Intelligence Based Bankruptcy Predicting Model

The above three techniques have been frequently applied by numerous studies for predicting bankruptcy. A review of these studies is presented in detail as follows.

Accounting Based Bankruptcy Predicting Model

This takes into consideration firm's previous performance as a base for predicting its future likelihood of survival (Xu and Zhang, 2008). Several studies that include accounting variables for corporate bankruptcy prediction are Beaver (1966), Altman (1968), Ohlson (1980), Dichev (1998), Shumway (2001) etc.

Market Based Bankruptcy Predicting Model

This model uses the information derived from the market, i.e., market prices. Since such information is inherently forward looking, market based approach depicts a firm's future performance considering market variables (Xu and Zhang, 2008). In the literature, this new methodology that uses market based variables for bankruptcy prediction usually follows Black and Sholes (1973) and Merton (1974) option pricing theory that expreses probability of bankruptcy occurring, which in turn depends on the volatility between the market value of the assets and the strike price (value of debt obligations). The critical level where firm will default is that when the worth of firm's assets moves down below a certain level (i.e., debt obligations). However, these theories provide no incremental information when the market is semi-strong form (Hillegeist et. al., 2004). Several recent studies that have used market-based variables for predicting default probability of a firm include Crosbie and Bohn (2002), Brockman and Turtle (2003), Vassalou and Xing (2004), and Reisz and Perlich (2007).

Hillegeistet.al., (2004), compared the market based approach (i.e., Black Sholes and Merton) with some accounting based approaches (i.e., MDA and Logit) and concluded that the market-based approach provides significantly more information about the default probability of a firm vis-a-visaccounting-based approach. Contrary to Hillegeist, a study conducted by Reisz and Perlich (2007) examined default probability of 5784 industrial firms by employing both market and accounting based approaches. This study provides that the accounting-based measures outperform Black-Sholes-Merton measure and recommends them for achieving an optimal default prediction.

Artificial Intelligence Based Bankruptcy Predicting Model

The technological advancement in informatics has evolved artificial intelligence techniques/methods that provided researchers to employ computer databases to estimate failure prediction (Charitou et.al., 2004). Artificial Intelligence (AI) methods include decision tree, fuzzy set theory, genetic algorithm, support vector machine, data envelopment analysis, case-based reasoning, rough sets theory, and various types of neural networks such as PNN (Probabilistic Neural Networks), BPNN (Back Propagation Trained Neural Network), SOM (Self-Organizing Map), Cascor (Cascade Correlation Neural Network), and many others (see, for more on this, Min and Jeong, 2008).

Artificial intelligence technique has been applied in various countries such as Iran, Greece etc. Etemadi et.al., (2008) employed both MDA and Genetic Programming (GP) techniques for forecasting the default probability in Iranian firms. The study notes GP with a high accuracy of default prediction for Iranian firms. Moreover, Zanakisand Zopounidis (1997) employed a case study technique to distinguish between the financial variables of acquired and non-acquired Greek firms. The mixed results were found because of using similar financial ratios profiles between acquired and non-acquired firms. Furthermore, researchers have used different artificial intelligence techniques and propose alternative bankruptcy prediction model. Min and Jeong (2009) suggested a new binary classification technique for forecasting the default probability of firm by validating its prediction power through empirical analysis. Jo and Han (1996) employed both the discriminant technique and two artificial intelligence models (i.e, case-based forecasting and neural network) and suggested integrated approach for attaining high classification accuracy in predicting default characteristics of firms.

All the above three broadly categorized approaches (proposed by different researches) have essential advantages and limitations as well. Therefore, lacking standardized theory has led studies to employ different techniques according to their unique structure of corporate environment and country (Etemadi et.al., 2009).

Numerous researchers have compared the performance of different models of bankruptcy prediction. However, not much research has been conducted using the data of Indian companies.

Charitou, Neophytou and Charalambous (2004) developed bankruptcy prediction models for UK industrial firms using Neural Networks and Logistic Regression models. The results indicated that the neural network model achieved the highest overall classification rates for all three years prior to insolvency. Virang and Kristof (2005) conducted a comparative study of

bankruptcy prediction models on the database of Hungarian companies. They provided that bankruptcy models built using neural networks have higher classification accuracy than models based on MDA and logistic regression.

However, in case of some other studies the results were unsettled. Altman, Marco and Varetto (1994) applied neural network and MDA to large database of 1000 Italian firms for one year prior to their bankruptcy. The comparison yielded no decisive winner. Thus, based on international experience a comparative study is necessary to identify whether international trends prevail and can be applied to Indian firms' bankruptcy prediction as well.

ETHODOLOGY AND DATA

The Sample and Variable Definition

For the present study, the bankrupt company is considered to be a company that is delisted from the stock market. The company that is delisted from Bombay Stock Exchange or National Stock Exchange and whose latest net worth and the net worth prior to the year of delisting is negative. And for the bankrupt companies the year of bankruptcy will be the year in which its net worth became negative. For example: if a company is delisted in the year 2002 and its net worth has become negative in the year 1995 then the year 1995 has been considered as the year of bankruptcy. Financial institutions, delisted companies merged with other companies and companies for which at least three years' full financial statements prior to the year of bankruptcy were not available are excluded from this research.

From 1991 with the start of economic liberalization in India major structural changes took place in the Indian economy. Thus, the period considered for this study spans from 1991 to 2016. Application of the above stated definition of bankruptcy in this duration resulted in a sample of 72 companies as bankrupt. Similar to Altman's (1968) study's procedure, a twin company was chosen that did not bankrupt from the same industry and approximately matched the asset size prior to the year of bankruptcy. This process has also been applied in majority of previous bankruptcy prediction studies. In order to develop bankruptcy models the companies are matched or made pairs so as to isolate key factors which distinguish otherwise similar firms (Morris, 1997). Thus, the total sample consists of 138 companies.

The bankrupt and non-bankrupt companies are randomly split to create distinct analysis and holdout samples. The analysis sample contains 50 bankrupt and 50 non-bankrupt companies and the holdout sample contains 22 bankrupt and 22 non-bankrupt companies.

Predictor Variable Selection

Similar to the previous studies that have used financial accounting ratios in their empirical studies of bankruptcy prediction, this study also employs financial ratios for development of bankruptcy prediction models. Previous studies revealed many significant predictions of bankruptcy that can be used for developing bankruptcy prediction models for Indian companies. So this study employs 35 financial ratios, which proved to be successful in prior studies.

TABLE 1: EMPLOYED FINANCIAL RATIOS

Category	Variable Name	Variable Definition
Operating	CF/TA	Cash Flow from Cash Flow Operations/Total Assets
	CF/CL	Cash Flow from Operations/Current Liability and Provisions
	CF/SF	Cash Flow from Operations/Shareholder's Fund
	CF/SALE	Cash Flow from Operations/Sales
	CF/TL	Cash Flow from Operations/Total Liabilities
Leverage	RE/TA	Retained Earnings/ Total Assets
	SF/TA	Shareholder's Fund/Total Assets
	SF/TD	Shareholder's Fund/ Total Debt
	SF/TL	Shareholder's Fund/ Total Liability
	TL/TA	Total Liabilities/ Total Assets
Profitability	WC/TA	Working Capital/ Total Assets
	EBIT/TA	Earnings before Interest and Tax/ Total Assets
	EBIT/CL	Earnings before Interest and Tax/ Current Liabilities
	EBIT/FA	Earnings before Interest and Tax/ Fixed Assets
	EBIT/SF	Earnings before Interest and Tax/ Shareholder's Fund
	EBIT/TL	Earnings before Interest and Tax/ Total Liabilities
	NI/SALE	Net Income/ Sales
	NI/SF	Net Income/ Shareholder's Fund
Liquidity	CA/TA	Current Assets / Total Assets
	CA/CL	Current Assets / Current Liabilities
	CL/TA	Current Liabilities and Provisions/ Total Assets
	CL/SF	Current Liabilities and Provisions/ Shareholder's Fund
	CL/TL	Current Liabilities and Provisions/ Total Liabilities
	QA/TA	Quick Assets/ Total Assets
	QA/CL	Quick Assets/ Current Liabilities and Provisions
Activity	CA/SALE	Current Assets/ Sales
	INV/SALE	Inventory/ Sales
	SF/SALE	Shareholder's Fund/ Sales
	QA/SALE	Quick Assets/ Sales
	SALE/CA	Sales/ Current Assets
	SALE/TA	Sales/ Total Assets
	SALE/FA	Sales/ Fixed Assets
Market	MV/TD	Market Value of Equity/ Total Debt
	MV/SF	Market Value of Equity/ Shareholder's Fund

The ratios considered in this research are listed in Table 1. This study uses financial data from the Prowess database of Centre for Management Studies, Jamia Millia Islamia University. The data sample consists of financial ratios of company's one year (Year-1), two year (Year-2) and three year (Year-3) prior to the year in which they became bankrupt. In case of non-bankrupt company, data for the same year has been considered as is considered for its matched bankrupt company.

ATA ANALYTICAL TOOLS AND TECHNIQUES

DISCRIMINANT MODEL

Discriminant analysis is used to classify objects/records into two or more groups based on the knowledge of some variables related to them. Discriminant function analysis or Discriminant Analysis is used to classify cases into the values of a categorical dependent, usually a dichotomy. If discriminant function analysis is effective for a set of data, the classification table of correct and incorrect estimates will yield a high percentage correct. Multiple discriminant analysis (MDA) is an extension of discriminant analysis and an extension of multiple analysis of variance (MANOVA), sharing many of the same assumptions and tests. MDA is used to classify a categorical dependent, which has more than two categories, using as predictors a number of interval or dummy independent variables. The Discriminant analysis equation is defined as-

$$Y = a + k_1x_1 + k_2x_2 + ... + k_nx_n \quad \text{..... (Eq. 1)}$$

Where Y is dependent variable; a is a constant; x_1, x_2, ... x_n are independent variables; k_1, k_2, ... k_n are coefficients of the independent variables.

This model is used to classify or make predictions in problems where the dependent variable appears in qualitative form e.g., male or female, bankrupt or non-bankrupt etc. It represents the best way of classifying observations into one of the several defined groupings – frequently known as priori groups. These groups are dependent upon the observation's individual characteristics. In this research, while classifying companies, the financial ratios are put into the discriminant function making up the linear combination. By comparing the discriminant values of separate bankrupt and non-bankrupt companies, one can determine which group a certain company is falling into.

Logistic Regression

It is a specialized form of regression that is formulated to predict and explain a binary (two-group) categorical variable rather than a metric-dependent measurement (Ong et.al., 2011). Logistic regression utilizes the coefficients of the independent variables to predict the probability of occurrence of a dichotomous dependent variable (Dielman, 1996). In the context of bankruptcy prediction, this technique weighs the financial ratios and creates a score for each company in order to be classified as bankrupt or non-bankrupt. The function in logistic regression is called the logistic function and can be written as follows:

$$p_i = 1 / (1 + e\text{-}z_i) \quad \text{..... (Eq. 2)}$$

Where p_i = the probability of the ith case experiences of the event of interest

z_i = the value of the unobserved continuous variable for the ith case.

Neural Network

Neural networks are inspired by neurobiological systems. Robert Hecht-Nielsen, inventor of one of the earliest neurocomputers, defines a neural network as a computing system made up of several simple, highly interconnected processing elements which processes information by their dynamic state responses to external inputs (Caudill, 1989). It is a function of predictors (also called inputs or independent variables) that minimizes the prediction error of target variables (also called outputs). An artificial neural network is layered; each of these layers has several neurons that are connected to other neurons belonging to the preceeding and following layer (Bredart, 2014).

MPIRICAL RESULTS

In order to identify any difference between bankrupt and non-bankrupt companies descriptive statistics are calculated based on financial ratios one year prior to bankruptcy. Table 2 presents a summary of the descriptive statistics.

Discriminant Analysis

In order to develop thediscriminant analysis in this study a stepwise selection technique was employed. The stepwise process involves introducing the ratios into the discriminant

TABLE 4 DESCRIPTIVE STATISTICS

	Non-Bankrupt		Bankrupt		Total			
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	F	Sig.
RE/TA	0.150	0.199	-0.100	0.341	0.025	0.305	28.885	0.000**
SF/TA	0.367	0.152	0.212	0.144	0.289	0.167	39.549	0.000**
SF/TD	1.998	3.553	0.485	0.445	1.241	2.635	12.847	0.000**
SF/TL	0.876	1.090	0.343	0.310	0.610	0.842	15.925	0.000**
TL/TA	0.575	0.165	0.730	0.146	0.653	0.174	35.468	0.000**
CF/TA	0.091	0.080	0.042	0.088	0.066	0.087	12.405	0.001**
CF/CL	0.527	0.547	0.167	0.894	0.347	0.760	8.478	0.004**
CF/SF	0.283	0.288	0.343	1.741	0.313	1.244	0.083	0.773
CF/SALE	0.105	0.142	-0.002	0.312	0.052	0.248	6.936	0.009**
CF/TL	0.156	0.201	0.060	0.129	0.108	0.175	11.712	0.001**
AR/CF	3.433	22.810	-1.269	16.730	1.082	20.072	1.990	0.161
CA/TA	0.440	0.163	0.348	0.210	0.394	0.193	8.492	0.004**
CL/CL	2.441	1.365	2.461	3.199	2.451	2.451	0.002	0.961
CL/TA	0.233	0.153	0.196	0.128	0.215	0.142	2.409	0.123
CL/SF	0.846	1.077	2.170	3.481	1.508	2.652	9.512	0.002**

TABLE 4 DESCRIPTIVE STATISTICS

	Non-Bankrupt		Bankrupt		Total			
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	F	Sig.
CL/TL	0.443	0.351	0.270	0.166	0.356	0.286	14,320	0.000**
QA/TA	0.234	0.122	0.204	0.162	0.219	0.143	1.586	0.210
QA/CL	1.254	0.753	1.355	1.609	1.304	1.253	0.234	0.629
WC/TA	0.207	0.154	0.152	0.184	0.180	0.171	3.730	0.055
EBIT/TA	0.106	0.060	-0.012	0.176	0.047	0.144	28.946	0.000**
EBIT/CL	0.611	0.539	-0.032	1.195	0.290	0.978	17.299	0.000**
EBIT/FA	0.356	0.327	-0.006	0.429	0.175	0.421	32.291	0.000**
EBIT/SF	0.334	0.242	-0.270	2.000	0.032	1.451	6.470	0.012*
EBIT/TL	0.199	0.129	-0.007	0.219	0.096	0.207	47.231	0.000**
NI/SALE	0.029	0.138	-0.567	2.494	-0.269	1.785	4.101	0.045*
NI/SF	0.099	0.186	-1.415	2.899	-0.658	2.184	19.557	0.000**
CA/SALE	0.659	1.470	0.667	0.431	0.663	1.079	0.002	0.967
INV/SALE	0.399	1.426	0.281	0.254	0.340	1.022	0.478	0.490
SF/SALE	0.515	0.600	0.629	0.914	0.572	0.773	0.786	0.377
QA/SA;E	0.260	0.194	0.385	0.331	0.323	0.278	7.712	0.006**
SALE/CA	3.047	2.319	1.907	1.266	2.477	1.947	13.399	0.000**
SALE/TA	1.256	0.880	0.607	0.479	0.931	0.777	30.187	0.000**
SALE/FA	4.177	3.886	2.048	2.388	3.113	3.387	15.687	0.000**
MV/TD	1.042	3.122	0.345	0.400	1.194	2.375	20.943	0.000**
MV/SF	1.311	1.979	1.396	1.863	1.354	1.916	0.071	0.791

¨ 1% significant level ˙ 5% significant level

function one at a time based on their discriminating power. The bankruptcy prediction models are presented below:

Year-1:

Z = 4.999xSF/TA + 0.963xEBIT/FA +0.731xSALE/TA – 2.271 ….....(Eq.3)

Year -2:

Z= 5.057xEBIT/TL + 1.053xSALE/TA – 1.743 ……(Eq. 4)

Year -3:

Z = -0.246xCL/SF + 3.862xEBIT/TL + 0.882x SALE/TA – 1.196……(Eq.5)

In the above function the cut-off point is 0. The cut-off point indicates that the company with Z score greater than 0 is predicted as non-bankrupt and the company with Z score less than 0 is predicted as bankrupt. The Model performance is evaluated using the overall accuracy rate. Overall accuracy is based on the total number of correct classifications.

The results obtained by using multi discriminant analysis on the holdout sample are presented in Table 3 above. In one year prior to bankruptcy that is Year-1, observed non-bankrupt cases are 14 banks which were predicted as non-bankrupt but 7 banks were wrongly predicted as bankrupt, turned out to be non-bankrupt. Whereas, the 7 predicted as non-bankrupt were further observed as non bankrupt and 16 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage is 70.45.

However, in Year-2, observed non-bankrupt are 13 banks which were predicted as non-bankrupt banks but 10 which were wrongly predicted as bankrupt but they turned out to be non-bankrupt. Whereas, 8 were predicted as non-bankrupt which further observed as non bankrupt and 13 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out in two years prior to bankruptcy is 61.36.

The situation in three years prior to bankruptcy is that Year-3 shows the observed non-bankrupt cases are 14 banks, which were predicted as non-bankrupt but 7 banks were wrongly predicted as bankrupt, but turned out to be non-bankrupt. Whereas, 11 were predicted as non-bankrupt which further observed as non bankrupt and 12 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out in two years prior to bankruptcy to be 61.36.

It has been observed that the accuracy rate shows a declining

TABLE 3 CLASSIFICATION RESULTS – MULTIPLE DISCRIMINANT ANALYSIS

			Predicted		
			Non-Bankrupt	Bankrupt	Correct Percent
Year 1	Observed	Non-Bankrupt	14	7	68.18
		Bankrupt	7	16	72.73
	Overall Percent Correct				70.45
Year 2	Observed	Non-Bankrupt	13.	10	59.09
		Bankrupt	8	13	63.64
	Overall Percent Correct				61.36
Year 3	Observed	Non-Bankrupt	14	7	68.18
		Bankrupt	11	12	54.55
	Overall Percent Correct				61.36

trend from 70.45 % one year prior to bankruptcy to 61.36 % for 2 years and 3 years prior to bankruptcy.

Logistic Regression

Stepwise logistic regression analysis is used to develop models for predicting corporate bankruptcy. The bankruptcy prediction models have been presented in the form of equations below:

Year-1:

$$Z = -6.578 \times SF/TA - 7.716 \times EBIT/TL - 1.643 \times SALE/TA + 4.081 \quad \text{.....(Eq. 6)}$$

Year-2:

$$Z = -9.039 \times EBIT/TL - 1.065 \times SALE/CA + 3.661 \quad \text{.....(Eq. 7)}$$

Year-3:

$$Z = 25.181 \times EBIT/TA - 19.847 \times EBIT/TL - 1.178 \times SALE/TA + 1.189 \quad \text{.....(Eq. 8)}$$

The Z score obtained from the model can be transformed into a probability using the logistic transformation P = 1/(1+e-z). The cut-off value is 0.5. It means that if the estimated probability calculated as above is greater than 0.5 the company would be predicted as bankrupt.

The results obtained by using logistic regression on the holdout sample are presented in Table 4. (In one year prior to bankruptcy by applying Logistic regression is shown as Year-1, which observed non-bankrupt cases as 16 banks which were predicted as non-bankrupt but 6 banks were wrongly predicted as bankrupt but they turned out to be non-bankrupt. Whereas, the 5 were predicted as non-bankrupt which further observed as non bankrupt and 17 were predicted correctly as bankrupt). Thus, the overall correct prediction percentage is 75.00.

However, in Year-2, observed non-bankrupt are 13 banks which were predicted as non-bankrupt banks but 9 which were wrongly predicted as bankrupt turned out to be non-bankrupt. Whereas, the 9 were predicted as non-bankrupt which further observed as non bankrupt and 13 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out to be 59.09 in two years prior to bankruptcy.

The situation in three year prior to bankruptcy that is Year-3 shows the observed non-bankrupt cases are 14 banks, which were predicted as non-bankrupt but 8 banks were wrongly predicted as bankrupt but they turned out to be non-bankrupt. Whereas, the 9 cases were predicted as non-bankrupt which further observed as non bankrupt and 13 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out to be 61.36 in two years prior to bankruptcy.

The results indicate that the accuracy rate falls from 75.00% one year prior to bankruptcy to 59.09% two years prior to bankruptcy. For the third year prior to bankruptcy the accuracy rate slightly increases to 61.36%.

Neural Network

To develop the neural network bankruptcy prediction model, the sample of 72 bankrupt and 72 non-bankrupt companies is portioned into training, testing and holdout samples. The training sample comprises the data records used to train the neural network. 40 bankrupt and 40 non-bankrupt companies were assigned to the training sample in order to obtain a model. The testing sample is an independent set of data records used to track errors during training in order to prevent overtraining. 10 bankrupted and 10 non-bankrupted companies were assigned to the testing sample. The holdout sample is another independent data set used to access the final neural network. Remaining 22 bankrupted and 22 non-bankrupted companies were assigned to the holdout sample.

The results so obtained by applying neural networks on the holdout sample are presented in table above. In one year prior to bankruptcy by applying neural network shown as Year-1, which observed non-bankrupt cases as 20 banks which were predicted as non-bankrupt but 2 banks were wrongly predicted as bankrupt but they turned out to be non-bankrupt. Whereas, the 8 were predicted as non-bankrupt which further observed as non bankrupt and 14 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage is 77.27.

However, in Year-2, observed non-bankrupt are 13 banks which were predicted as non-bankrupt banks but 9 which were wrongly predicted as bankrupt but they turned up to be non-bankrupt. Whereas, the 9 were predicted as non-bankrupt which further observed as non bankrupt and 13 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out to be 63.64 in two years prior

TABLE 4 CLASSIFICATION RESULTS – LOGISTIC REGRESSION

			Predicted		
			Non-Bankrupt	Bankrupt	Correct Percent
Year 1	Observed	Non-Bankrupt	16	6	72.73
		Bankrupt	7	16	77.27
	Overall Percent Correct				75.00
Year 2	Observed	Non-Bankrupt	13.	9	59.09
		Bankrupt	9	13	59.09
	Overall Percent Correct				59.09
Year 3	Observed	Non-Bankrupt	14	8	63.64
		Bankrupt	9	13	59.09
	Overall Percent Correct				61.36

TABLE 5 CLASSIFICATION RESULTS – NEURAL NETWORK

			Predicted		
			Non-Bankrupt	Bankrupt	Correct Percent
Year 1	Observed	Non-Bankrupt	20	2	90.91
		Bankrupt	8	14	63.64
	Overall Percent Correct				77.27
Year 2	Observed	Non-Bankrupt	13.	9	68.18
		Bankrupt	9	13	59.09
	Overall Percent Correct				63.64
Year 3	Observed	Non-Bankrupt	14	8	81.82
		Bankrupt	9	13	50.00
	Overall Percent Correct				65.91

to bankruptcy.

The situation in three year prior to bankruptcy that is Year-3 shows that the observed non-bankrupt cases are 14 banks, which were predicted as non-bankrupt but 8 banks were wrongly predicted as bankrupt but they turned out to be non-bankrupt. Whereas, the 9 cases were predicted as non-bankrupt which further observed as non bankrupt and 13 were predicted correctly as bankrupt. Thus, the overall correct prediction percentage turned out to be 65.91 in two years prior to bankruptcy.

It has been observed that the model's accuracy rate falls from 77.27% one year prior to bankruptcy. However, the rate fell down to 63.64% two years prior to bankruptcy and then rises to 65.91% for the third year of bankruptcy.

Comparison of Results

This section compares the results of the three different methods used in this research that are shown in the table below.

These results presented in the table above indicate that neural network achieved the highest overall classification accuracy for all the three years prior to bankruptcy. Multiple discriminant analysis and logistic regression produce comparable results. This is so because neural networks have highly interconnected processing elements which process information by their dynamic state responses to external inputs.

TABLE 6 COMPARATIVE RESULTS OF THE BANKRUPTCY TECHNIQUES TESTED

Overall Percent Correct	Multiple Discriminant Analysis	Logistic Regression	Neural Network
Year 1	70.45	75.00	77.27
Year 2	61.36	59.09	63.64
Year 3	61.36	61.36	65.91

ONCLUSION

In this study the companies that were delisted from Bombay Stock Exchange or National Stock Exchange and who's latest net worth and the net worth prior to the year of delisting is negative were taken. And for the bankrupt companies the year of bankruptcy was the year in which its net worth became negative. Financial institutions, delisted companies merged with other companies and companies for whom at least three years full financial statements prior to the year of bankruptcy were not available are excluded from this research.

(Due to major structural changes that took place in the Indian economy from 1991, the study period considered is from 1991 to 2016. With the application of the bankruptcy as mentioned above, in this duration 72 companies resulted in a sample as bankrupt. Similar to Altman's (1968) study's procedure, a twin company was chosen that did not bankrupt from the same industry and approximately matched for asset size prior to the year of bankruptcy.) This process has also been applied in majority of previous bankruptcy prediction studies. In order to develop bankruptcy models the companies are matched or grouped into pairs so as to isolate key factors which distinguish otherwise similar firms (Morris, 1997). Thus, the total sample consisted of 138 companies.

The bankrupt and non-bankrupt companies are randomly splited to create distinct analysis and holdout samples. The analysis sample contains 50 bankrupt and 50 non-bankrupt companies and the holdout sample contains 22 bankrupt and 22 non-bankrupt companies.

This research attempts to develop and compare the performance of bankruptcy prediction models using multiple discriminant analysis, logistic regression and neural network for Indian listed companies. The dataset consists of 72 matched pairs of bankrupt and non-bankrupt companies. The bankrupt companies had failed between the period 1991 to 2016. Accuracy rates for one, two and three years prior to bankruptcy for neural network are 77.27, 63.64 and 65.91 percent respectively, and for logistic regression the values are 75.00, 59.09 and 61.36 percent. However, the accuracy rates for the multiple discriminant analysis 70.45, 61.36 and 61.36 percent.

The results have shown that compared to multiple discriminant analysis and logistic regression, the neural network has the highest prediction accuracy for all the three years prior to bankruptcy. This is so because neural networks have highly interconnected processing elements which

process information by their dynamic state responses to external inputs. Thus, it is suggested that neural network modeling should be used as a successful bankruptcy predictor in case of Indian companies.

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SERVQUAL: A Multi-Dimensional Scale for Perceptual Measure of Service Quality in the Mobile Telecommunication Industry

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ABSTRACT

This study broadly measures the customer's service quality perception toward different mobile service companies. SERVQUAL model with additional two dimensions Competitive Advantage and Network Quality was used as an instrument in the study. Factor Analysis along with MANOVA was used for analysis. Primary data was collected through the distribution of questionnaires to respondents in the working capital region of Uttarakhand, Dehradun. Results from Factor analysis explains that there is a significant difference in customer's perception for overall service quality of different mobile service companies. There was a significant MANOVA effect confirming difference in perception & level of understanding about service quality dimensions among the subscribers.

Keywords : *Service quality, SERVQUAL, Perception.*

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INTRODUCTION

Today in the highly competitive business scenario, survival of most of the business depends on the high-quality service delivery. Service Quality concept was highlighted first in the year 1980 when it was generalized by academicians & scholars that better service quality assures to ascertain competitive advantage (Vender et al. 2002). Telecommunication sector is one of the rapidly booming service sectors of the country, delivery of high quality service in this sector can lead to growth and long-term development of any country. Service sector has always been a significant contributor in GDP of the country. Service quality differs from the quality of goods due to three unique features of services: heterogeneity, inseparability and intangibility for production and consumption. Service quality is found to be one of the significant contributors of customer satisfaction as a result of which it is having high importance in service sector. A Large number of research has been carried out in the past which is bridging the gap between service quality and satisfaction. Service quality is required for creating customer satisfaction and for fulfilling customer perceptions and expectations. In today's competitive world, quality service is a key to success and survival of the business.

Service quality can be defined as a basis of the differences between the expectation and competence among the important quality dimensions. (Kotler & Keller, 2009) define service as "any intangible act or performance that one party offers to another that does not result in the ownership of anything". Service can be defined as an intangible offer by one party to another in exchange of money for pleasure. Service quality can be defined as expectations of the customers towards the service or products. Service quality is the consequence of human interaction between the service provider and the customer. Marketers realized that to leverage service quality as a competitive advantage, the first need is to correctly identify the antecedents of what the consumer perceives as "service quality". Zeithaml, Parasuraman, and Berry proposed a service quality scale (SERVQUAL), a generic instrument that has five service quality dimensions: Responsiveness, Assurance, Empathy, Tangibility and Reliability. Responsiveness means willingness of employees to provide service and giving prompt service. Assurance includes knowledge and courtesy of employees and their ability to carry trust and confidence. Empathy covers caring, individualized attention that the firm provides to its customers. Tangibility means the physical evidence, representations of the service and the inculcation of other customers in service facility. Reliability includes uniformity in performance and dependability, accuracy in keeping records and accomplishment of services right with in the stipulated time. SERVQUAL is a multiple-item scale designed to measure customers' service quality expectations and perceptions. SERVQUAL instrument consists of 22 declarations for measuring consumer perceptions and expectations about service quality. Perceived service quality results from comparison of consumer expectations with their perceptions of service delivered by the service providers (Zeithaml et al., 1990). As per (Wilson, 2008), service quality is a focused evaluation about the customer perception of reliability, assurance, responsiveness, empathy and tangibles while satisfaction is more inclusive and it is influenced by the perceptions of service quality, product quality, price and other situational and personal factors.

Indian telecommunication sector has shown a tremendous growth since 1990s and now has become the world's most competitive and one of the fastest growing tele-communication markets. Socioeconomic development of India has always been supported by telecommunication and this is one of those sectors which has played a significant role in narrowing down the rural-urban digital divide among its customers. India is world's second largest mobile phone user with more than 975.78 million users. Prevailing strong user base in this part of the globe generally avails two different types of services, Prepaid and Postpaid which are broadly understood with low and high level of commitment respectively.

As per the report of Department of Telecommunication India is divided into 22 Telecom Circles or Service Areas, which is further classified into four groups namely 'Metro', 'A', 'B', and 'C' circles. 'Metro circles' cover highly dense metropolitan cities. Further 'A', 'B', and 'C' circles comprise of geographic territories of varying population density. 'A' circles are the largest in terms of population coverage and 'C' circles contain the smallest population density. The Uttarakhand is divided into two administrative divisions Garhwal & Kumaon. Uttarakhand Telecommunication sector consist of 13 revenue districts, 7 from Garhwal region and 6 from Kumaon region. Since its inception from the year 2001 many new services were launched like Cellular mobile telephone service, Internet, ISDN etc. Majority of the geographical area under Uttarakhand Telecom sector is hilly region because of which Dehradun is considered as working capital region. Seven mobile service providers (BSNL, Airtel, Idea, Vodafone, Uninor, Tata Docomo & Reliance) operate in the working capital region of Uttarakhand.

The present study is driven by the need to empirically analyze service quality of mobile service providers in Dehradun. SERVQUAL model with slight modification was used to measure service quality perception among consumers. The study aims to identify consumer perception about select service quality dimensions and the consumer differentiation amongst service quality parameters.

EVIEW OF LITERATURE

The Service Quality studies have gained momentum in the past few years because of its contribution towards the long-term profit. Quality of services is entirely different from quality of goods. The reason behind this difference is the characteristics of the service like heterogeneity, inseparability, perishability and intangibility. Quality of service has a direct impact on institution such as superiority in performance (Poretla and Thanassoulis, 2005), high revenue (Kish, 2000; Duncan and Elliot, 2002), market share (Fisher, 2001),

enhancing customer relations, loyalty and corporate image (Newman, 2001; Caruana, 2002; Ehigie, 2006).

There was a general thought among researchers that service quality is a multi-dimensional phenomenon (Cronin and Taylor, 1992). There has always been a need for an appropriate scale for measuring consumer perception for service quality. One of the widely used and acknowledged instruments to measure service quality is SERVQUAL propounded by Parasuraman et al. (1988). It comprises of the following five dimensions Tangibility, Reliability, Responsiveness, Assurance, and Empathy. A similar model was developed to measure service quality named SERVPERF (Cronin and Taylor, 1994). Another instrument was developed to measure this multidimensional construct named ARCHSECRET (Vaughan, 2001). Numerous studies conducted in the past proves the appropriateness of SERVQUAL as an instrument to measure service quality.

SERVQUAL was tested by McKay et al. (1989) in his studies on Canadian Municipal Park and the results included the same five service quality dimensions which confirmed the reliability of the scale. Carman (1990) in his study on 800 consumers from four different firms found the stability of SERVQUAL dimensions to be impressive. A study conducted by Heung and Qu Hailin (2000) on 630 restaurant customers, service quality perception using SERVQUAL instrument identified satisfactory level of reliability for the scale. Brady and Robertson (2001) employed SERVQUAL to test the service quality received from travel agencies & found it to be a reliable and valid model to measure service quality. With the wider acceptance of SERVQUAL in measuring service quality, it has been predominantly employed in different service sectors like Telecommunication, Education, Banking Services, Healthcare etc. (Keuh and Voon, 2007). Buttle (1996) also mentioned about several researcher studies using the SERVQUAL in different industries namely Retailing, Restaurants, Banking, Telecommunication Industry, Airline catering, Local Government, Hotels, Hospitals, and Education.

Ostrowski et al. (1993) in their study on airline companies compared the promotional offers and concluded that company with better perceived service quality will have more number of customers. Akan, (1995) in his study on four star hotels using SERVQUAL model concluded that courtesy and competence along with assurance were found to be the most important factors affecting the perceptual service quality of customers. Angur et al. (1999) applied SERVQUAL in the retail banking industry to measure perceptual service quality of two major banks in India. Findings of the research indicated that respondents showed a high level of understanding toward Responsiveness and Reliability followed by Empathy and Tangibility. Assurance was perceived as the least important criterion for measuring service quality. The difference between the service quality of public and private hospitals in Turkey was analyzed and the outcome of the research indicated that patients in the public hospitals were more satisfied in comparison to private hospitals (Taner and Antony, 2006) . Negi (2009), used SERVQUAL in Telecommunication Industry to examine customer satisfaction through perceived service quality and identified that Empathy, Reliability and Network Quality were significantly effecting overall service quality and customer satisfaction of mobile services.

As per Leisen and Vance (2001), SERVQUAL has been used with minor modifications internationally in many service sectors to measure service quality. International application of SERVQUAL was generally hindered by culture. The influence of cultural difference should be considered while applying SERVQUAL to measure service quality in different countries (Kettinger et al.1994). SERVQUAL model was used by Kumar et al. (2009) in their research to examine the influence of critical factors in delivering service quality of banks in Malaysia. SERVQUAL model was modified & changed to six dimensions: Tangibility, Reliability, Responsiveness, Assurance, Empathy and Convenience. Convenience was considered because it was observed as the most significant element of satisfaction for banking customers in Malaysia. After they carried out this study, they identified that there are four factors which affect the customer satisfaction and they are: Convenience, Competence, Reliability and Tangibility. In the outcome of the study, the author recommended that bank requires to be more competent in delivering services, providing assurance and facilitating customers with convenience. Curry et al. (2002) applied SERVQUAL instrument in physiotherapy services in Scotland. They considered five service quality dimensions along with five other dimensions, in total ten dimensions to measure service quality. The study was related with measuring expectation and perception gaps. Based on the outcome of the study it was recommended that there is need for improvement in physiotherapy service with assurance & empathy being perceived as very important elements for service quality perception.

Under different cultural context, SERVQUAL has been widely used in Telecommunication Industry with high reliability and validity. (Stafford et al.1998, Hoffman & Bateson 2001, Sureschander et al.2002, Tyran & Ross 2006). Johnson et al. (1995) conducted research on measuring the perception and expectation of the service quality of mobile service providers in the UK. They also highlighted the importance of expected service quality. Van Der et al. (2002) undertook a study on service quality using SERVQUAL of mobile service companies. Outcome of the research indicated that there is no clear differentiation in customers' mind about the three service quality dimensions Responsiveness, Assurance and Empathy, since all of them loaded on a single factor. The two factors Tangibility and Reliability were clearly differentiated by customers. Wang and Lo (2002) conducted a study on service quality of mobile service companies and identified Network and after sales service to be the most significant factor. A study by Sridhar and Piyush (2004) identified that competitiveness of business depends on service quality. They also identified that infrastructure and customer service are the important determinants of service quality. Quality & infrastructure mainly includes network coverage, voice quality, call completion rate and call drop etc. A research study focusing on satisfaction of mobile phone users among 434 customers in Brazil indicated high rating for quality of Connections,

Ambience of outlets, Coverage and customer services (Souki and Filho, 2008). TRAI (2008) conducted a service quality study based on customer satisfaction for 11 mobile service operators. The dimensions for the survey are availability of network, customer care support, VAS, billing and sales. Based on these dimensions only five service operators achieved the service quality benchmark of 90%. Khan, M. A. (2010) studied the user's perceptual service quality about mobile telephone service providers in Pakistan. Questionnaire was designed using five SERVQUAL dimensions with additional dimension network quality and convenience. Network quality and Convenience were found to have the highest significance.

Uttarakhand and West Uttar Pradesh comprises of several industries & sectors. Certain service quality studies have been conducted in these industries & sectors. Sahney et al. (2004) in their study on total quality education used SERVQUAL model to ascertain quality of institutions from student's perspective. SERVQUAL was then used to identify the gap between expectation and perception of students which further lead to the identification of minimum number of quality components to bridge the gap between expectation and perception of students. Singh et al. (2014) undertook service quality gap analysis among customers of commercial bank using ex-post-facto survey. This study was conducted in different districts of Uttarakhand with a sample size of 273. Result of the study explained significant difference in the expectation and perception of customers leading to dissatisfaction. To understand, customer satisfaction in the two-wheeler automobile companies, Khan et al. (2015) conducted a study using SERVQUAL model in major cities of Uttar Pradesh. Data was collected through structured questionnaire. The results of the study indicated that automobile service company produces significant gap in consumer's expectation and perceived service quality. Sharma et al. (2015) in their research studied satisfaction and attitude of prepaid and post- paid customers of mobile telecommunication and the factors affecting the choice of mobile service providers. The study was conducted in the state of Uttarakhand with a sample size of 600. Data was collected through structured questionnaire. Outcome of the study revealed that most of the customers are using prepaid because of freedom, flexibility, monitoring and control.

An intensive and thorough literature review suggests that a lot of research has been done with the use of SERVQUAL in various industries/ sectors. Most of the studies were done in relevance with the gap analysis and very few studies focussed on the perceptual measure of service quality especially in the region of Uttarakhand. It has been observed that the application of SERVQUAL largely depends upon the national culture because of which the dimensions of SERVQUAL are generally modified when applied internationally. Paucity of literature focusing on the usage of modified SERVQUAL instrument in measuring perceptual service quality for the telecommunication sector in the Uttarakhand region has been the motivation for this study. The study measures the significance & the level of understanding for service quality dimensions among customers and tries to bridge the gap in literature.

ESEARCH OBJECTIVE AND SCOPE OF THE STUDY

Measuring Service Quality is imperative for service sector as it helps to differentiate services in the minds of customers. This study was undertaken with a viewpoint to measure consumer's perception towards the service quality of mobile service operators in Dehradun, Uttarakhand. Perceptual aspect of service quality was measured through SERVQUAL with the following objectives:

- To examine as to what extent customers differentiate between the service quality dimensions of different service providers.
- To analyze the customers level of understanding with different service quality dimensions.

ESEARCH METHODOLOGY

SERVQUAL model (acronym for Service and Quality) is a measure of how customers perceive a company's quality of service when they receive it. Globally accepted five SERVQUAL dimensions: Responsiveness, Assurance, Empathy, Tangibility and Reliability developed by Parasuraman, Zeithamal, and Berry (1985) along with the additional dimensions Network Quality and Competitive Advantages propounded by Wang et al.(2004), Pezeshki et al.(2009) and Johnson and Sirikit (2002), in special relevance to mobile service industry were considered in the study. Wang et al.(2004) & Pezeshki et al. (2009) emphasized that call quality and strength of network defines network quality which is one of the significant contributors towards developing mobile service quality perception among customers. Wang et al.(2004) used network quality as a component of service quality perception in their study for Chinese tele-communication industry. Johnson and Sirikit (2002) in their study on Thai telecommunication industry highlighted that telecom sector can attain high profit and enhance its performance through competitive advantage which can be developed through better service, price & promotional strategies in comparison to their competitors.

This study is based on the primary data collected through a structured questionnaire designed on 7 point Likert scale (1 = completely agree, 7 = completely disagree). The questionnaire includes seven service quality dimensions, five dimensions of SERVQUAL model with additional two dimensions Network Quality and Competitive Advantages. The questionnaire comprises of total 24 statements based on Responsiveness, Assurance, Empathy, Tangibility, Reliability, Network Quality and Competitive Advantages. To have better understanding of empirical analysis the construct codes are represented in Table 1.

Sample for research includes diverse demography of respondents from the capital region of Uttarakhand, Dehradun. Dehradun being a capital region, consists of a vast number of telecom users of varied demographics. Telecom

TABLE 1 CONSTRUCT CODE

Sr. No.	Construct	Code	Statement
1	Tangibility	T1	The customer service is available as per your convenience.
2		T2	The Physical facilities of your service provider are visually appealing.
3		T3	The appearance of staff & usage of up to date equipments by your service provider.
4	Reliability	R1	Service provider shows interest in solving your problem
5		R2	Service is provided on time
6		R3	Service provider fulfills all its commitment
7		R4	Service executives provide accurate information
8	Empathy	E1	Service executives provide individualized attention
9		E2	Service provider keeps customer's best interest at their heart
10		E3	The service provider's operating hours suits you.
11		E4	Service operation is based on customer's needs
12	Responsiveness	Rs1	Service executives are willing to help customers
13		Rs2	Service provider gives prompt service
14		Rs3	Service support is easily accessible
15	Assurance	A1	You feel safe while availing service from your service provider
16		A2	Courtesy & professionalism of your service provider attracts you
17		A3	Service provider protects confidentiality of your personal information
18	Competitive Advantages	Ca1	Your service provider provides better price in comparison to others
19		Ca2	Your service provider provides better offers in comparison to others
20		Ca3	Your service provider provides better service in comparison to others
21		Ca4	Your service provider provides wider product assortment in comparison to others
22	Network Quality	Nq1	Your service provider has strong network connectivity
23		Nq2	Your service provider provides good call quality
24		Nq3	Your service provider has wider coverage

users in this region include students, professionals and individuals from different background. It was the researcher's interest to include sample based on varied socio economic parameters. Non-probability convenience sampling was used in the study. Dehradun being an education hub with a high growth of educational institutions in recent past, led to the convenience based selection of students from both graduate & post graduate courses. Professionals from private as well as public sector were selected and the same procedure was followed for business personnel & others as well. Questionnaires were distributed to the selected respondents. In total 670 questionnaires were distributed to the respondents & 626 questionnaires were returned. During verification, it was found that 600 questionnaires were complete in all respect. In order to make the objective of the study clear to the respondents and for the sake of simplicity, only perception about the service quality of respondents was measured through questionnaire and the expectation part was not included in the study (Lai et al. 2007). Both descriptive and inferential statistics has been used for data analysis. SPSS software was used for the statistical analysis of the data.

ATA ANALYSIS

Respondents Profile

A total of 600 responses were analyzed to measure consumer perception towards the service quality of mobile service providers. The demographic characteristics of the respondents can be seen from the Table 2.

TABLE 2 DEMOGRAPHIC CHARACTERISTICS

Sr. No.	Respondents	Characteristics	% of Respondents
1		**Gender**	
	Male		61.5
	Female		38.5
2		**Age Group**	
	15-30		76.7
	31-45		18.2
	46-60		3.8
	60+		1.3
3		**Occupation**	
	Services		40.0
	Business		11.0
	Student		31.3
	Other		17.7
4		**Service Usage Duration**	
	less than 3 months	3.3	
	3-6 months		21.8
	1-2 years		7.8
	2-3 years		40.6
	more than 3 years	26.5	
5		**Service Provider**	
	Airtel		16.7
	Uninor		5.8
	Tata Docomo		5.5
	Reliance		5.3
	Vodafone		7.2
	Idea		10.7
	BSNL		48.8

TABLE 3 RELIABILITY COEFFICIENTS

Dimension	Items	Number of Items	Cronbach's Alpha	Cronbach's Alpha if Item deleted
Tangibility	T1	3	.732	.726
	T2			.528
	T3			.676
Reliability	R1	4	.709	.570
	R2			.656
	R3			.609
	R4			.737
Empathy	E1	4	.709	.557
	E2			.655
	E3			.755
	E4			.602
Responsiveness	Rs1	3	.676	.537
	Rs2			.638
	Rs3			.567
Assurance	A1	3	.805	.804
	A2			.678
	A3			.704
Competitive Advantages	Ca1	4	.780	.721
	Ca2			.737
	Ca3			.707
	Ca4			.744
Network Quality	Nq1	3	.754	.574
	Nq2			.608
	Nq3			.794
Total Scale Reliability			.750	

The demographic profile of the respondents exhibited in table 2 shows that most of the respondents were male (about 61.5 per cent) and rest were female (about 38.5 per cent). Majority of the respondents were within the age group 15-30 years (about 76.7 per cent) and rest (about 23.3 per cent) fall under the age group of 31 years and above. Service personnel comprised of highest percentage (about 40 per cent), followed by students (about 31.3 per cent) with regard to occupation. Majority of the respondents use a specific service provider for a period of 2 – 3 years (about 40.5 per cent) followed by the period of more than 3 years (about 26.5 per cent). Largest portion of the respondents (about 48.8 per cent) was using the services of BSNL, followed by Airtel (about 16.7 per cent), Idea (about 10.7 per cent), Vodafone (about 7.2 per cent), Uninor (about 5.8 per cent), Tata Docomo (about 5.5 per cent) and Reliance (about 5.3 per cent).

Reliability & Factor Analysis

Cronbach's Alpha coefficient was computed to measure the reliability of SERVQUAL instrument. The overall scale reliability, Cronbach's Alpha is 0.75, that falls well within the acceptable range. As per the Table 3, Cronbach's Alpha coefficient for all dimensions are within the acceptable range. The value of Cronbach's Alpha for all the seven service quality dimensions ranges in between .676 to .805. The highest level of reliability was shown by Assurance (Cronbach's Alpha coefficient .805), followed by additional dimension Competitive Advantages (Cronbach's Alpha coefficient .780) & Network Quality (Cronbach's Alpha coefficient .754). All dimensions show high level of internal consistency and reliability, except Responsiveness (Cronbach's Alpha coefficient .676) which falls slightly behind the cutoff range .70 as advised in the literature (Nunnally and Bernstein 1994, DeVellis 2003).

As shown in the Table 4, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is .843, which indicates the presence of sufficient inter- correlations in the data set and appropriateness of factor analysis.Bartlett's test of Sphericity is significant at $\chi^2(276)= 7650$, p=.000 which indicates that correlation matrix is not an identity matrix.

TABLE 4 KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.795
Bartlett's Test of Sphericity	Approx. Chi-Square	7650.639
	Df	276
	Sig.	.000

The result from reliability statistics and measure of sampling adequacy, rivals the appropriateness of scales used and data gathered for this study.

Factor analysis was performed to validate the constructs underlying structural model. Only factors with an Eigen value of 1.0 and with factor loading above 0.5 were retained for

further investigation. Result of factor analysis represents that most of the items were with a factor loading above 0.6, that confirmed for high level of significance. The total variance explained by this seven-factor model is 68.18% which is well above 50%.

The values in the table represent the weight and correlation each item has to a factor. From table 5, it can be realized that items from different dimensions are regrouped under the same factor and some items from one dimension are found to fall in more than one factor like E1 and E2.

The three dimensions (Tangibility, Reliability and Responsiveness) of SERVQUAL Model by Parasuraman et al. (1988) were loaded on separate factors, indicating the clear distinction in consumers' mind about these service quality dimensions. The additional dimensions included in the study, Competitive Advantages and Network Quality were also loaded separately, confirming customer differentiation about the constructs.

Items under Empathy E1 and E2 show an overlapping with Assurance. Overlapping explains that the consumers were not able to differentiate between the constructs namely Empathy & Assurance. The Empathy items: E1 Service executives provide individualized attention, E2 Service provider keeps customer's best interest at their heart has significantly high factor loading of .895 & .827 on Assurance which means that consumers consider individualized attention & best interest as a part of Assurance.

Multivariate Analysis of Variance

Multivariate Analysis of Variance (MANOVA) is used for comparing the mean of service dimensions and demographic parameters. Multivariate Analysis of Variance MANOVA is an extension of ANOVA with a condition of two or more dependent variables. ANOVA is generally used to study the significant difference between dependent and independent variables individually, whereas MANOVA examines the significant difference between dependent and independent variables and helps to understand the significant effect of independent variable(s) on dependent variables.

As shown in Table 6 statistically significant MANOVA effect was obtained, Wilks 'λ' = .854, F (21, 1694) = 4.523, p <. 001. The significant F indicates that there is a significant difference among different age group people regarding the perception for

TABLE 5 FACTOR ANALYSIS

Items	Tangibility	Reliability	Empathy	Responsiveness	Assurance	Competitive Advantages	Network Quality
T1	.765						
T2	.811						
T3	.615						
R1		.756					
R2		.522					
R3		.714					
R4		.664					
E1			.475	.895			
E2			.478	.827			
E3			.820				
E4			.715				
Rs1				.578			
Rs2				.633			
Rs3				.809			
A1					.577		
A2					.785		
A3					.889		
Ca1						.758	
Ca2						.729	
Ca3						.802	
Ca4						.770	
Nq1							.697
Nq2							.684
Nq3							.806
Eigen Value %	5.64	3.51	2.21	1.42	1.37	1.15	1.03
Variance	9.16	9.92	6.56	7.28	15.92	10.40	8.92

Note: Factor Analysis- Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization.

TABLE 6 MANOVA FOR AGE

Dependent Variable	Source (Age)				F	Significance level
	15-30	31-45	46-60	60+		
Tangibility	3.2362	3.1315	2.2899	4.6667	6.874	.000
Reliability	3.0967	3.0390	2.5543	3.3125	2.098	.099
Empathy	4.7853	4.3624	4.0652	4.3438	4.647	.003
Responsiveness	3.4268	3.2385	2.7826	5.0833	6.958	.000
Assurance	5.0862	4.7920	4.2754	5.0833	2.538	.056
Competitive Advantages	2.9707	3.2982	2.7174	3.1567	2.055	.105
Network Quality	2.9464	3.4404	2.2899	3.2917	6.044	.000

TABLE 7 MANOVA FOR SERVICE DURATION

Dependent Variable	Source (Service Duration)					F	Significance level
	< 6 Months	6–12 Months	1–2 Years	2-3 Years	> 3 Years		
Tangibility	3.0333	3.0051	3.4752	3.4102	2.9790	3.765	.005
Reliability	3.2000	3.1508	3.5532	3.1235	2.7563	6.595	.000
Empathy	4.4375	4.3969	4.3969	4.7263	4.8035	2.146	.074
Responsiveness	3.2000	3.4733	3.2979	3.5720	3.0943	3.578	.007
Assurance	5.8333	4.6285	5.4043	4.8944	5.2495	5.002	.001
Competitive Advantage	2.6625	2.9924	3.1170	2.9671	3.150	9.843	.498
Network Quality	2.7000	2.8626	2.7660	3.4444	2.5996	10.930	.000

TABLE 8 MANOVA FOR OCCUPATION

Dependent Variable	Source (Occupation)				F	Significance level
	Business	Service	Student	Others		
Tangibility	3.0253	3.1014	3.4326	3.1195	2.741	.043
Reliability	3.0758	2.9990	3.2261	2.9410	2.260	.080
Empathy	4.1856	4.6469	4.8159	4.8013	3.818	.010
Responsiveness	3.4848	3.2986	3.5904	3.1824	2.906	.034
Assurance	4.6616	4.7944	5.2908	5.1698	4.638	.003
Competitive Advantage	3.0455	3.0885	3.0293	2.849	1.74	0.529
Network Quality	3.0354	3.2375	2.9060	2.6950	4.331	.005

TABLE 9 MANOVA FOR SERVICE PROVIDER

Dependent Variable	Source (Service Provider)							F	Significance level
	Airtel	Uninor	Tata Docomo	Reliance	Vodafone	Idea	BSNL		
Tangibility	2.906	2.68	2.4949	3.0833	3.5349	4.114	3.20	8.978	.000
Reliability	2.767	2.950	2.4470	2.8359	3.4477	3.562	3.11	7.357	.000
Empathy	5.115	4.05	4.5985	4.6328	3.8488	3.910	4.901	11.27	.000
Responsiveness	2.916	3.60	2.7677	3.3854	4.5349	4.380	3.211	19.09	.000
Assurance	5.726	4.88	5.4848	5.2083	3.5891	3.614	5.201	21.11	.000
Competitive Advantage	3.265	2.72	3.0076	3.3984	2.6744	3.121	2.966	1.773	.102
Network Quality	2.71	3.16	3.3434	2.4583	4.0775	4.218	2.707	19.43	.000

service quality parameters Responsiveness, Assurance, Empathy, Tangibility, Reliability, Network Quality and Competitive Advantages. Four out of seven service quality parameters namely Responsiveness, Empathy, Tangibility and Network Quality showed significant result which means different age group people clearly differentiate among these parameters and the rest of the three parameters were found to be insignificant. Among these parameters, respondents with age group above 60, understand Tangibility and Responsiveness better than any other age group. Respondents between the age group 15-30 years, show a better understanding for the Empathetic behavior of service provider. Respondents with the age group 31-45, give more importance to call quality, wider coverage & connectivity (Network Quality). Response from different age group people reflects that there is little difference in consumer perception about service quality dimensions. Reliability, Assurance and Competitive Advantage were found to be insignificant. Results shown in Table 7, show a significant relationship between

service usage duration and service quality dimensions, (Wilks' λ = .793, F (28, 2125) = 5.035, p <. 001). Two dimensions Empathy and Competitive Advantages were found insignificant but the other dimensions Responsiveness, Assurance, Tangibility, Reliability and Network Quality showed significant results. Respondents with service usage duration 1-2 years showed a better understanding of service quality dimension Tangibility & Reliability. Responsiveness and Network Quality were better understood by service users with the usage duration 2-3 years. Service users with less than 6 month of service usage duration showed highest inclination towards Assurance. Table 8 exhibits the relationship between occupation & Service quality measures. Responsiveness, Assurance, Empathy, Tangibility and Network Quality were found to be significant & statistically significant MANOVA effect was obtained, (Wilks' λ = .692, F (21, 1694) = 4.523, p <. 001). Students perceive better service quality regarding significant service quality dimensions Responsiveness, Assurance, Empathy, Tangibility and Network Quality than any other professional. As per Table 9, except Competitive Advantage, all other service quality dimensions showed significant results. The results are good enough to explain consumer's perceptual differentiation with service quality parameters, (Wilks' λ = .575, F (42, 2756) = 8.217, p <. 001). Result from Table 9 explains that respondents perceive better service quality for Idea in terms of Tangibility, Reliability & Network Quality. Airtel was perceived best in terms of Empathetic behavior and Assurance. Vodafone was perceived better in terms of Responsive behavior of staff. As per the description majority of the respondents were using BSNL but none of the service quality parameters was perceived best for BSNL which means the high number of customers with BSNL does not mean that the customers are happy.

ISCUSSION & IMPLICATION

The objective of the study was to measure consumers' perception towards the service quality of mobile service providers. Five SERVQUAL dimensions Responsiveness, Assurance, Empathy, Tangibility and Reliability followed by two additional measures Competitive Advantages and Network Quality were used to enhance perceptual service quality. A seven point Likert Scale was used to measure response of the respondents.

(It was found that the overall reliability of the scale, 0.75, falls well within the acceptable range.) The individual reliability of dimensions' ranges from 0.676 to 0.805. Assurance showed the highest reliability coefficient of 0.805. Reliability statistics and measure of sampling adequacy proved the appropriateness of scale used and adequacy of sample size for this study. Results from factor analysis indicated that the total variance explained by these seven factors was 68.18%. Most of the items were with a factor loading of above 0.6, confirming for high level of significance. All items except Empathy & Assurance were loaded on separate factors without any overlapping, indicating the clear difference in customers' mind about these service quality dimensions. The Empathy parameters-Individualized Attention, Customers' best interest at their heart has significantly high factor loading on Assurance which means that consumer considers individualized attention & best interest as a part of Assurance. Descriptive statistics explained that majority of the subscribers are from BSNL. Multivariate analysis of variance effect was found to be significant. None of the service quality parameters was perceived best for BSNL. Reason behind the large customer base of BSNL may be that it is the only government owned service operator while the rest are private. BSNL being one of the oldest service providers & high switching cost makes it a more preferred choice of the customers. Dehradun being a capital region, comprises population from the other hilly region of Uttarakhand also. This fact should also be taken into consideration that being one of the oldest service providers BSNL is having a strong presence in other hilly regions too in terms of coverage. However, company may not enjoy its current position in the long run if it does not focus on the perceptual measure of service quality dimensions in this competitive environment. Airtel, Idea, Vodafone and others are making slow inroads in the market by increasing customer's awareness regarding service quality dimensions. In comparison to other service providers Airtel, Idea & Vodafone were perceived better on service quality standards. Airtel being next to BSNL in terms of customer reach provides better service quality on more than one dimension namely Empathy and Assurance. Airtel should work more on the other service quality dimensions in order to increase the customer base. Idea, with relatively lesser number of customers shows maximum understanding on three service quality dimensions Tangibility, Reliability & Network Quality, which is a positive prospect for long term growth. There is no differentiation in consumer's mind about the promotional offers from the different service operators. Consumer perceives that the promotional offer by different service provider is almost similar. Competitive Advantage was not found to be a significant contributor in terms of developing perception towards service quality. Based on the findings of the study, it can also be concluded that almost all service quality dimensions indicate a clear differentiation & significant level of understanding by customers. It can be suggested that mobile service providers in Dehradun should focus more on developing better understanding for service quality dimensions among customers. As a major player in market, BSNL as well as new players like Uninor, Tata Docomo, Reliance should also focus on inculcating service quality dimensions in their service delivery to ensure that customers distinguish their service from that of their competitors. BSNL as a major player should focus more on customer satisfaction and educating their employees to address the problems related to responsiveness, assurance, reliability and empathy. Competitive advantage in terms of promotional offers and price also need to be unique to be distinct in market. Airtel and Idea are performing well but need to focus more on the insignificant service quality parameters to develop loyal customers and retain them for a longer period. This study provides valuable insight about the assessment of service quality mechanism and will help decision makers to improve in the quality of service to remain competitive.

UTURE RESEARCH

There are certain limitations associated with the study like it was limited to Dehradun with restricted sample size which provides for a future scope of research to be conducted in the entire state with a larger sample size. Present study is specific to telecommunication sector & the outcome of the research can't be generalized to other service sectors. Hence it opens the window for conducting similar kinds of studies in other service sectors too.

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Telemedicine : Integrating ICT and Health Care System

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ABSTRACT

Health is always considered as one of the strong pillars of sustainable development. Healthy citizens are regarded as the greatest asset of any nation. In a country like India where more than 70 percent of population still lives in rural and remote areas, accessibility to quality healthcare infrastructure as well as healthcare personnel is a big challenge for policy makers. Among the various alternative strategies available, the integration of ICT and healthcare system in the form of telemedicine is regarded as one of the most revolutionary innovation in healthcare management that can enhance the quality of delivery of healthcare services. Considering the significance of telemedicine, the present paper examines the various initiatives taken by the Indian Government along with other organizations to utilize expertise of India in ICT in the healthcare sector. Further, the paper also highlights the various challenges to successful implementation of telemedicine network in India as well as its future prospects.

Keywords : *Healthcare, Telemedicine, Telehealth, India.*

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INTRODUCTION

Health is always considered as one of the strong pillars of sustainable development. It is well said that healthy citizens are the greatest asset of any nation. The importance of health is also reflected in Indian Government's series of five year plans where healthcare sector is considered as one of the priority sectors. In the Union budget 2017-18, ₹489 billion has been allocated to health sector as compared to ₹399 billion in the previous year's budget. Though healthcare system is universal in India, there exists discrepancy in quality of delivery of healthcare services between rural and urban areas. In a country like India where more than 70 percent of population still lives in rural and remote areas, accessibility to quality healthcare infrastructure as well as healthcare personnel is a big challenge for policy makers. In such a scenario, Information and Communication Technologies (ICTs) can prove to be a beneficial tool in effectively dealing with such issues. The role of ICT in transforming the shape of healthcare sector cannot be ignored. The various ICT tools and services like internet, video conferencing etc. have brought revolution in the delivery of healthcare services throughout the world. Among the various alternative strategies available, the integration of ICT and healthcare system in the form of telemedicine can be considered as one of the most revolutionary innovation in healthcare management that can enhance the quality of delivery of healthcare services among individuals and communities. Telemedicine is a type of electronic health that can help in improving the clinical health status of patients by allowing medical information to be exchanged from one place to another with the help of various electronic communication tools like smart phones, email, two-way video and other wireless tools.

EVIEW OF LITERATURE

According to WHO (2010), telemedicine means "the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities". The roots of organised telemedicine programmes lie in United States of America. In 1993, the first survey on telemedicine programmes was conducted which reported only 10 such active programmes in USA. However, this number started growing rapidly during the period of 1930-1970s (Kim, 2004). In 2010, Hill et al. conducted a review of nineteen articles based on the performance of telemedicine in various healthcare outcomes. In the field of mental health diseases and chronic health issues, telemedicine was reported to be an effective health care delivery tool. American Well (2015), a telehealth company in USA, conducted an online survey to determine consumer perceptions and desires related to telehealth and telemedicine services. The findings showed that 64 percent of consumers were willing to have video visit with a doctor.

Amongst developing nations, Brazil is considered to be one of the most advanced countries in the field of telemedicine in Latin America and the Caribbean. Telemedicine units have been increasing in Brazil on a large scale.In Rio Grande do Sul, a telehealth platform was introduced by using Telessau´deRS/UFRGS in 2010. Since 2010, teleconsultations, teleeducation and telediagnosis activities have benefitted more than 15000 healthcare professionals through such program (Harzheim et al., 2016).Telemedicine can also prove to be beneficial in antimicrobial stewardship programmes as determined by study in community hospital in Southern Brazil. Healthcare expertise was provided to cardiology patients who were located at a distance of 575 km from the hospital. A secured website was used to complete antimicrobial prescriptions. Email and SMS were used to send a written reply to the prescriber. Overall compliance with the recommendations of the infectious diseases specialist was 100 per cent (Santos et al., 2013).

Like Brazil, telemedicine practices have also gained momentum in India. National Cancer Network (Onco-Net), National Rural Telemedicine Network and National Tele-ophthalmology Network are the main national projects of telemedicine being implemented in India. A number of studies have been conducted in India that address various issues related to successful adoption of telemedicine practices such as its awareness, feasibility, clinical effectiveness etc. In 2002, Deodhar carried out a study for 18 months to determine the effectiveness of telemedicine consultations provided by email. Such email consultations were found to be successful in the diagnosis as well as treatment of 38 babies. Meher et al. (2009) conducted a study to determine the level of awareness and opinion of both doctors and patients towards telemedicine in New Delhi. Findings of the study revealed that most of the doctors were aware of telemedicine application and also hold positive attitude towards its use in the treatment of patients. However, most of the patients were found to be unaware of the concept of telemedicine.

Literature also highlighted the studies related to clinical applications of telemedicine across the nation. Desai et al. (2004) analysed the effectiveness of telepathology consultations between Nargis Dutt Memorial Cancer hospital Barshi and Tata Memorial Centre, Maharashtra. Such teleconsultations were found to be successful in all the ninety three cases. Kaliyadan and Venkitakrishnan (2009) examined the case profile of 120 teledermatology consultations provided at Amrita Institute of Medical sciences, Kochi. The study reported that an ideal system of teledermatology consultation requires the combination of store and forward (SAF) and real time consultations (RTC). Nagarajappa et al. (2013) conducted a survey in Udaipur to assess the knowledge as well as attitude of dentists towards application of telemedicine in the field of dentistry. Study reported that dentists with less than ten years of work experience had more knowledge of teledentistry than those with more than ten years of experience. In addition, the study found that lack of training programmes was the main reason of less favourable attitude amongst dentists towards teledentistry.

EED AND OBJECTIVE OF STUDY

A careful inspection of literature review highlights that although numerous studies on different aspects of telemedicine have been conducted in developed nations and in a few developing nations, but limited studies have been conducted in India in this regard. Thus, considering the significance of telemedicine for uplifting the future of healthcare in India, the present paper attempts to examine the application of this concept in India. The main objectives of the study are as follows :

(a) To examine government as well as non-government initiatives in the field of telemedicine in India.

(b) To identify key challenges to successful implementation of telemedicine in India.

(c) To suggest suitable measures to combat the challenges to telemedicine applications.

ETHODOLOGY

The paper is based on secondary data obtained from various national and international journals, Government and private websites.The paper is divided into three sections. Section I discusses the types of telemedicine along with its significance. Section II highlights various initiatives taken by Government of India along with other organizations to expand telemedicine network in India. Section III mentions the main challenges in the successful implementation of telemedicine network in India as well as some measures to overcome such challenges. This section also throws light on the future prospects of telemedicine in India.

Section-I

Types of Telemedicine

Telemedicine can be classified mainly into three categories, which are as follows:

1. Store-and-Forward: It means there is no need for the physician to meet the patient in person. Patients' entire information including medical history, reports, images etc are stored by using telemedicine software. When such type of information is required, it can be send to healthcare professional or physician. Teleradiology is one of the extensively used applications of telemedicine based on store-and-forward approach that involves the transfer of medical images of patients from one location to another with the help of telecommunication system. Such application allows radiologists to provide consultation to patients without being physically present with them. Teleradiology Solutions, launched in 2002, is the first teleradiology company in India. Manipal group of hospitals and Wipro Technologies are among the companies who supported 3D reconstructions in the field of teleradiology. Factors such as low monetary costs, cheap labour, skilled support staff has contributed to the growth of teleradiology services in India to some extent (Burute & Jankharia, 2009).

2. Remote Monitoring: Also known as self-testing or self-monitoring, this approach allows patients to test their health themselves at their home by using various technological devices. The devices then send the data back to telemedicine system. Thus doctors can monitor health of their patients remotely. Telecardiology is one such application of telemedicine that involves remote transmission of electrocardiographic data between healthcare professionals and doctors for the diagnosis and treatment of heart diseases of patients with the help of ICT tools.

3. Real-Time Interactive Services: In such services doctors can provide immediate advice to patients with the help of various mediums such as phone, home visits, online etc.Teleneurology is an example of such type of telemedicine that allows a neurological doctor to provide consultations at a distance with the help of various telecommunication devices. The number of qualified trained neurologists in India is around 1100 which are too few to treat such a large population in the nation (Khadilkar, 2012). In such a scenario, teleneurology can prove to be a useful tool to deliver healthcare services in neurology to patients suffering from stroke, dementia or multiple sclerosis.

Significance of Telemedicine

Telemedicine applications have the potential to improve the accessibility of medical care by enabling the physicians to diagnose and treat the patients earlier and improve the quality of healthcare. The following points highlight the significance of telemedicine in detail.

1. Patient's access: Telemedicine increases patient's access to care. Many companies permit patients to access medical care with an on-call doctor. Various hospitals and health centres allow their physicians to interact with their patients virtually by using telemedicine platform. With the advancement of technology in health care, it has become easy for the patients to use various consumer friendly mobile health applications to keep a track of their own health. Patients can also keep a record of their medical information by using various home-use medical devices. In this way telemedicine allows various healthcare providers to expand their reach.

2. Deals with shortage of healthcare professionals: Another important aspect of telemedicine is its ability to deal with problem of shortage of healthcare professionals and staff. Telemedicine services and applications such as teledentistry, telecardiology, teledermatology allows better utilization of available staff.

3. Improved patient outcomes: Telemedicine has the ability to improve patient outcomes and care.Shaikh et al. (2008) examined the impact of telemedicine consultations on paediatric obesity among patients. In this regard, 139 children and adolescents were given paediatric weight management consultations. Findings revealed that 80.7 percent patients showed improvement in clinical outcomes.

4. Reduces operational costs: Remote analysis services, like telepathology and teleradiology, allows use of services of highly trained professionals. This can lead to lower cost and high care. Such remote services enable low-volume providers to have around the clock coverage at a lower cost. Services such as televisits with physicians reduce expensive use of emergency room visits. Further, the home-bound patients can seek medical-help without actually going to the hospitals through ambulance.Fauchier et al. (2005) examined the potential cost savings for home monitoring (HM) of cardioverter defibrillators with its automated wireless remote data access. Database included 502 patients from six university hospitals. Over the 5 years of expected life of the device, decrease in costs for follow up visits was estimated to be $2,149. The study concluded that home monitoring may reduce overall costs by saving on transportation costs especially when distance between home and medical facility is more than 100 kms.

5. Availability of technology: Availability of technology support services such as Face time, Microsoft Lync, Skype, WebEx services, or simply Google Video Chat video conferencing makes the adoption of telemedicine easy and successful. Many states in India have their own agencies for the development of technology in their areas like West Bengal Electronics Industry Development Corporation Limited (WEBEL) which has undertaken various initiatives to support telemedicine activities in rural areas in West Bengal.

Section-II

Telemedicine initiatives in India

Government of India has been working with various organizations and agencies such as Indian Space Research Organization (ISRO), Ministry of Health & Family Welfare, Department of IT etc. for the successful implementation of telemedicine projects in India.The Apollo group of hospitals played a crucial role in shaping the future of medical care in India. In fact, it was pioneer in introducing the concept of telemedicine in India. An initiative was taken in 1997 to make medical expertise available in suburban and rural areas of India by using ICT devices. It leads to the establishment of Apollo Telemedicine Networking Foundation (ATNF) which is the largest multispecialty telemedicine network that provides more than 57,000 teleconsultations (Ganapathy & Ravindra, 2009).

ISRO too has undertaken various telemedicine pilot projects. Such projects involve various super speciality hospitals located in major cities and smaller health centres in distant and rural areas. In 2001, ISRO conducted a pilot project on telemedicine in which Apollo Hospital at Chennai was linked with the Apollo Rural Hospital at Aragonda village in the Chittor district of Andhra Pradesh. In the same year, ISRO also started Odisha telemedicine network with the support of Government of Odisha. The first phase of the project was implemented in 2003 in which VSAT connectivity was used to connect Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Lucknow with three Government medical colleges. In 2004, telemedicine network expanded to include Sriram Chandra Bhanj (SCB)Medical College, Cuttack; All India Institute of Medical Sciences (AIIMS),New Delhi, and Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh. During implementation of second phase of project in 2007, 6 district headquarter hospitals were linked with three medical colleges in Odisha. The third phase of the project was launched in 2011. This phase focuses on linking 3 medical colleges and hospitals with 15 district headquarters hospitals.

Another telemedicine program was started by ISRO in Karnataka in 2002. Such program focuses on providing better emergency cardiac care to the patients. Telemedicine project in Karnataka is coordinated by Karnataka State Remote Sensing Applications Centre (KSRSAC). The project allows patients to interact with the speciality doctors by using satellites to link health centres and remote hospitals. A super specialty hospital for cardiac care, Narayana Hrudayalaya, Bangalore was linked with the Vivekananda Memorial Trust Hospital, Saragur and district hospital, Chamarajanagar under the Karnataka telemedicine project. Narayana Hrudayalaya has provided telecardiology consultations to various patients with the support of ISRO.

To provide healthcare services to people suffering from cancer in North East region of the country, a telemedicine centre was established at Dr. Bhubaneswar Borooah Cancer Institute (BBCI), Guwahati in 2003. The financial support for the implementation of project was provided by Assam Government, North Eastern Council and Department of Atomic Energy. ISRO provided technical support such as satellite connectivity to link BBCI with Tata Memorial Hospital, Mumbai.

In Punjab state also, ISRO has provided assistance to Sub District Hospitals at Amritsar, Hoshiarpur and Mata Kaushalya Hospital, Patiala. In 2006, eSanjeevani, Punjab Health Systems Corporation and Department of Information Technology launched Punjab state wide telemedicine project. Under this project, more than 15 telemedicine sites were established in the remote and rural areas of Punjab. These sites were connected to PGIMER, Chandigarh through Virtual Private Network (VPN) with broadband connectivity. The telemedicine sites located at Civil Hospital in Amritsar, Hoshiarpur, Kapurthala and Sangrur have provided more than 200 consultations each upto July, 2012[3]. The Ministry of Health and Family Welfare also funded Mobile Tele-Ophthalmology Project, in Punjab, in 2007 to deliver eye care services to 100 villages in the district of Ropar.

Similarly, Maharashtra Government also launched a pilot project on telemedicine in 2007 that primarily focuses on tribal areas in Maharashtra such as Satara, Nandurbar, Beed and Sindhudurg. The specialist end of telemedicine project was located at King Edward Memorial Hospital at Mumbai. ISRO provided technical support during the first phase of telemedicine in Maharashtra. During the second phase,

[3] *Punjab Health Systems Corporation, Department of Health and family welfare, Government of Punjab, Telemedicine reports, Retrieved from http://punjabhealth.co.in/downloads.aspx?ID=6s2R5ZOLv4c=&&Header=8ZK01RUjWG96iUXHPGooEBZYYMkAhfmB*

Maharashtra telemedicine project was expanded to 5 specialist ends such as KEM Hospital, Mumbai; B. J. Medical College, Pune; GMC Aurangabad; GMC Nagpur and Sir J. J. Hospital, Mumbai, 23 district hospitals and 4 sub-district hospitals (Kumar et al., 2012).

In 2007-2008, telemedicine project was launched in Madhya Pradesh by the joint efforts of ISRO, Department of Health, Government of Madhya Pradesh and Madhya Pradesh Council of Science & Technology. The telemedicine network provided various services such as teledermatology, teleradiology, telecardiology etc. to certain tertiary centres connected to district level hospitals in Madhya Pradesh (Bali et al., 2016).

Apart from the above discussed telemedicine projects, Ministry of External Affairs (MEA), Government of India has also implemented other projects such as Pan-African e-Network project and the SAARC e-Network Tele-Medicine project to provide specialist healthcare facilities to citizens living in these countries and to share expertise in medical knowledge among doctors. Further, to ensure realistic implementation of telemedicine projects, Indian Government allocated a grant of ₹122 crore for e-health including telemedicine in the 12thfive year plan. In the past, ₹19.83 crore was granted to National Rural Telemedicine Network in 2007-08 and 2008-09. This whole amount was released immediately, at that moment, to the States/UTs to kick start the ambitious project at the earliest. In 2012-13 also a grant of ₹2032.78 lakhs was released to seven States/UTs as mentioned in Table 1.

TABLE 1: ALLOCATION OF FUNDS TO KEY STATES FOR TELEMEDICINE ACTIVITIES

Sr. No.	State	Grant (in lakhs) ₹
1.	Assam	1559.92
2.	Maharashtra	317.82
3.	Himachal Pradesh	50
4.	West Bengal	45
5.	Punjab	40
6.	Dadra & Nagar Havelli	10.69
7.	Tripura	9.35

Source:http://pib.nic.in/newsite/PrintRelease.aspx?relid=98549

Section-III

Challenges for Telemedicine in India

The major challenges in the successful implementation of telemedicine in India are as follows:

1. Security and Privacy issues: One of the most important challenges in implementing telemedicine technology is to ensure security and privacy of patients' information and data.While telemedicine technology provides various means to access and transfer medical information, it also compromises on the security of the patients' information due to ease of manipulation and replication through various security related attacks such as masquerade, modification of messages and denial of service (Zain & Clarke, 2005; Das & Mukhopadhya, 2011). Telemedicine security concerns include the problems of confidentiality, authentication, integrity and accountability (Savastano et al., 2008; Garg & Brewer, 2011). Medical Council of India's Code of Ethics Regulations, 2002 necessitates that physicians must protect the confidentiality of patients including their personal and domestic lives. However various security attacks such as interruption, interception, modification makes protection of patients' electronically stored and transmitted data difficult.

2. Technical issues: Telemedicine systems also face the problem of technical failures or malfunctions. Effective execution of telehealth and telemedicine practices requires uninterrupted and continuous availability of power supply, but in India, especially in rural areas, frequent occurrence of long power cuts poses a challenge to the successful implementation of telemedicine applications. Gulube & Wynchank (2001) evaluated the performance of a national telemedicine system in South Africa and found that one of the major reasons for unsuccessful implementation of telemedicine system in South Africa includes technical problems experienced during the first year of operation. Acharya and Rai (2016) conducted a study to determine the problems encountered during delivery of healthcare services through telemedicine at Apollo Tele Health Services, Hyderabad. Findings of the study revealed that 47 percent of the problems encountered during telemedicine consultations were related to technical issues.

3. Medical malpractice: Medical malpractice involves injury or death of a patient due to deviation from the accepted standards of practice in medical community. Moreover, in case of medical malpractice especially during cross border consultations, it may become difficult to identify the party liable for such practice.

4. Shortage of trained staff and healthcare professionals/ manpower: The doctor-patient ratio in India is very poor as indicated by National Health Profile (2015). Every Government allopathic doctor serves 11528 persons on an average. In a country like India with a population of over 1.3 billion, such poor doctor-patient ratio poses a big hindrance to effective implementation of telemedicine applications.

5. Linguistic diversity: India is one of the most multilingual countries in the world. As per Census of India (2001)there are 122 languages and 234 mother tongues in India. Another survey known as People's Linguistic Survey of India (2013), reported that total number of languages in India has increased to 780[4].The presence of such diversity in languages might pose a threat to effective communication between patient and healthcare professional belonging to different regions of the country.

6. Depersonalization of patient-doctor relationship: Evidence suggests that telemedicine may negatively impact interpersonal relationship between patients and doctors (Matusitz & Breen, 2007; Miller, 2010). During a teleconsultation, images of both patient and doctor can be seen on the monitor and all interactions between two parties are indirect. Ones perceptions of what is seen on a monitor are

[4] *Retrieved from http://www.hindustantimes.com/books/780-languages-spoken-in-india-250-died-out-in-last-50-years/story-Y3by8ooYbXRA77xP2AEWKN.html*

very much influenced by his experience of watching television, therefore it is quite possible that both the parties involved in teleconsultation might not consider it as a real experience (Hjelm, 2005). The absence of personal face to face contact with the doctor during teleconsultation also contributes to the dissatisfaction with the treatment amongst the patients (Acharya & Rai, 2016).

7. Perspective of health care professionals and patients: Realizing the increased usage of ICT in healthcare sector in the present scenario, many institutions have been providing training programmes to make medical professionals proficient in the use of ICT tools. However, healthcare professionals in rural and remote areas of India might not be well trained and comfortable in using such ICT tools. Moreover fear of the patients regarding effectiveness of telemedicine outcomes makes them reluctant to accept and adopt telemedicine practices.

8. Absence of law related with telemedicine: Telemedicine activities in India are governed by laws like Indian Medical Council Act, 1956; Code of Ethics Regulations, 2002; Information Technology Act, 2000 etc. However, as such there is no law that is solely dedicated to telemedicine in India. Thus, the absence of legislation that directly deals with telemedicine makes it difficult for the healthcare professionals to keep track of so many legislations governing telemedicine in India.

UGGESTIONS

To confront the above mentioned challenges, following measures can be adopted by the concerned authorities for the advancement of telemedicine in India.

- Data security solutions: Advance data security solutions such as data masking, backups, disk encryption, data erasure, and disk encryption etc[5]. must be implemented to protect patients' electronic data from various security attacks and to ensure the privacy and confidentiality of data.
- Custom electronic health records: With the help of dedicated software, medical records of patients must be converted into electronic form in such a way that it integrates their medical data and records from all the hospitals and clinics at one place. Moreover patients must be allowed to access their medical records at any time or from any place all over the world. Such electronic health records offer various benefits such as reduced medical errors and costs, improved quality and other operational benefits. Realising such benefits of electronic health records, the Health Information Technology for Economic and Clinical Health (HITECH) Act has been introduced in 2009 in U.S.A. to focus on the promotion of adoption and meaningful usage of health information technology (Menachemi& Collum, 2011).
- Portable equipments: Effective portable equipments such as telemedicine carts, electronic stethoscopes, smart band-aids or plasters, mobile medical devices etc. must be provided to ensure the availability of effective healthcare services to people especially living in the rural or remote areas.
- Collaboration of public and private sector: Effective implementation of telemedicine applications in India requires the support of both Government and private sector. Active participation of NGOs can also prove to be very beneficial.
- Training programmes: Appropriate training programmes must be conducted on regular intervals of time to make the healthcare professionals and staff proficient in advanced ICT tools to implement telemedicine applications effectively.

UTURE PROSPECTS OF TELEMEDICINE

Government of India and other organizations have been planning and gradually implementing various telemedicine projects to provide better healthcare services to people throughout the country. A healthcare initiative called Social Endeavour for Health and Telemedicine (SEHAT) has been launched in 2015 by Government of India based on the vision of 'Digital India'. SEHAT focuses on usage of digital technologies to allow people living in rural areas to easily and efficiently access knowledge, skills, information and other services in various sectors[6]. To extend healthcare facilities to the remotest and rural areas of country through telemedicine networks, ISRO has decided to collaborate with Union Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homoeopathy) to launch a project called "Tele-AYUSH" (Pharmabiz, 2016).

Telemedicine and health care practices are expected to grow in India due to prioritization by the Government in telecommunication and health sectors. With the development of state-of-art technologies and infrastructure in India, telemedicine projects have been able to extend healthcare services even to remote areas. Telemedicine market has also emerged as a fast growing healthcare sector in India. According to a study conducted by the Associated Chambers of Commerce & Industry of India (2016), telemedicine market in India is expected to be around $32 million by 2020. Establishment of legal framework, availability of trained human resources, development of national e-health policies, availability of regular and adequate funds are some of the factors that will determine growth of sustainable telemedicine network in India.

ONCLUSIONS

In a nutshell, telemedicine consists of various procedures, that makes it more beneficial from other healthcare practices. In the current scenario of rising healthcare costs, shortage of trained healthcare professionals, rising chronic diseases, application of ICT in healthcare sector in the form of telemedicine plays a vital role in improving the efficiency and

[5] *Retrieved from https://en.wikipedia.org/wiki/Data_security*
[6] *Press Information Bureau, Government of India, Ministry of Communications & Information Technology, Retrieved from, http://www.pib.nic.in/newsite/printrelease.aspx?relid=126318*

effectiveness of healthcare system. The healthcare sector in India is facing a growing demand for diagnostic and expensive therapeutic resources. To meet such demand, measures such as data security solutions, portable equipments, collaboration of public and private sector can be adopted. The presence of electronic interconnectedness in telemedicine allows physicians to keep a better record of patients' health. A large number of initiatives have been undertaken at the Government level along with other public and private organizations to use telemedicine as an effective tool to extend healthcare services and health education to people of India. Thus, it can be said that telemedicine applications have a bright promising scope in India. An ideal integration of health care system and ICT tools will play an important role in redefining health care in India.

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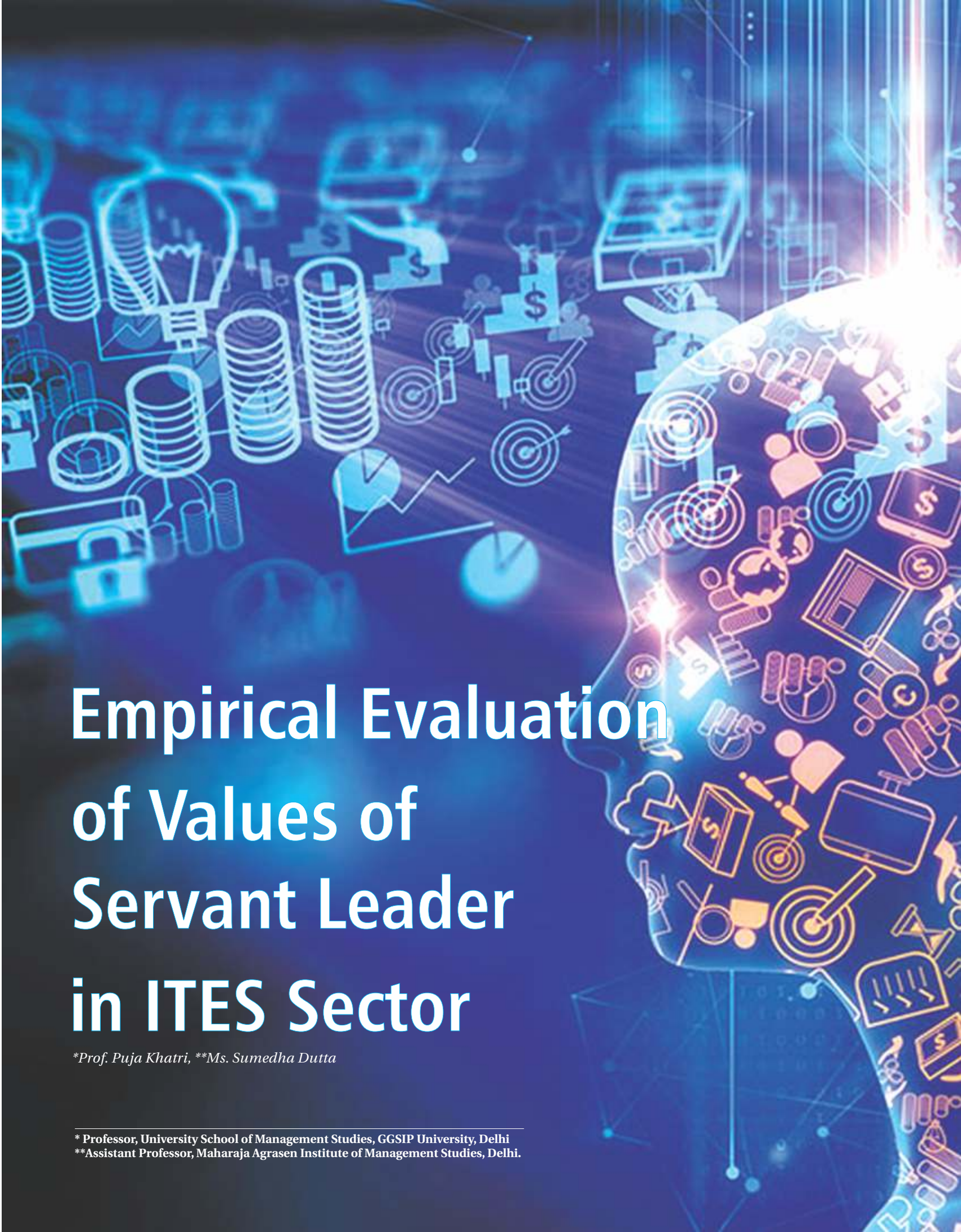

Empirical Evaluation of Values of Servant Leader in ITES Sector

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ABSTRACT

Servant leadership has emerged as a promising leadership style on a global platform. It centres on peoples' growth; taking organization's and community's performance to the next level. Research on servant leader's traits and tools to quantify them are profusely available; however a tool to measure a servant leader's value system is left unexplored. In the present work, literature concerning servant leader's values was examined as they offer a unique perspective to servant leadership. This helped the researchers in drafting a questionnaire for the same. The purpose of study is to indentify a definite value – set of a servant leader by conducting Exploratory Factor Analysis (EFA). The data of 181 ITES employees was analyzed using SPSS 19.0. The overall reliability of scale capturing values of a servant leader is 0.97.The empirical work resulted in identifying three pertinent values comprising a servant leader's value system, namely, Team Orientation, Altruistic Orientation and Ethical Orientation.

Keywords : *Servant leadership; Values; Factor analysis; Team Orientation; Altruistic Orientation; Ethical Orientation.*

INTRODUCTION

India's diversity has awed many philosophers and management thinkers to pen down their perceptions of the country's rich cultural heritage. The value – laden soil of India has a significant role to play while regulating the personal, social as well as professional life of Indians. The thriving culture with its sturdy core values acts as a shield protecting and supporting Indians to bounce back with greater zest and zeal in the midst of any adversity. The sweeping globalization opened numerous competing avenues for India, requiring changes which were growth – oriented though radical and challenging. These drastic changes made the Indian organizations realize that they need to adopt a leadership style which is value based- servant leadership.

The traditional styles of leadership have made way for a leadership style which firmly rests on team work, participative decision - making and ethical approach. Servant leadership as a concept has materialized from the legacy of charismatic leadership theory (Graham, 1991). Greenleaf (1904-1990), presented a unique style of leadership, "servant-leadership" in his essay, The Servant as Leader (1970). Greenleaf strongly believed that the strong desire to help others grow serves as the motivating factor that keeps the true leader to go on. Thus, the concept of servant leadership was born. In the voluminous work related to servant leadership, Greenleaf always focussed on 'serving others selflessly' as the basis of this new model of leadership. Servant leadership believes in taking a holistic approach to work, seeking active involvement in decision – making and encouraging a sense of community at heart. The stigma attached to the word "servant" was duly recognized by Greenleaf, but the usage of the word 'servant' strengthened the foundation on which he was building this novel leadership approach.

Moreover, dearth of "published, well – designed, empirical research" (Northhouse, 1997, p. 245) pertaining to servant leadership shows that the academic research in this field is in its infant stage. The servant leadership literature base is philosophical in nature. The various examples backing the theory are mostly "anecdotal in nature" (Northouse, 1997, p. 245); making servant leadership as an undefined and ambiguous style of leadership. In specific terms, the paucity of empirical result in the domain of servant leadership makes its acceptance a challenging task.

However, in recent times, there has been a resurgence of research in this field, primarily driven from an elucidated construct and measure (Barbuto & Wheeler, 2006). This was pursued by rigorous endeavours to study the construct and its influence on organizational working (Liden, Wayne, Zhao & Henderson, 2008; Neubert, Kacmar, Carlson, Chonko & Roberts, 2008). Since, presently the construct of servant leadership can be measured and tested, its organizational influence and other dimensions pertaining to it can be taken further.

EVIEW OF LITERATURE

Servant Leadership "begins with the natural feeling that one wants to serve, to serve first. Then conscious choice brings one to aspire to lead" (Greenleaf, 1970). In other words, a servant leader's primary concern is to serve others, be their servant and then follow the decision to lead others. This seemingly simple style, rooted firmly in 21st century, has many layers of realization and is awakening at its core.

The central tenet of servant leadership is attaining a balance between serving and leading. As a leader, one should be aware that their prime responsibility is to provide service to others. As a follower, the concept encourages one to go beyond the expected set of roles and thus, explore situational prospects to provide leadership. This revolving around leading and serving augments not only encourages our growth as individuals but also helps to create organizations of great depth and quality. Servant leadership establishes equilibrium between power and responsibility; thereby improving the position of most individuals and organizations. By encouraging both individuals and organizations to serve while leading, the quality of life throughout the community is raised, this being the grace of a servant leader. The traits of servant leaders extracted from Greenleaf's writings (1977) are healing, listening, awareness, empathy, persuasion, foresight, conceptualization, stewardship, commitment to the growth of people and building community. Social and ethical considerations are seen as the pillars of strength for servant leadership to flourish and develop a value – based management. The employees' empowerment and their active involvement in the decision – making process makes a servant leader, a democratic leader.

In the servant leadership style, values occupy a noteworthy place as they offer a set of firm, distinguishable traits of leadership. Values of a servant leader help to establish interpersonal and organizational trust (Russell, 2001). Accepting the importance of values in servant leader, the present research is undertaken to identify basic value – set in servant leadership style. This would help in providing a new perspective to leadership educators. Moreover, such knowledge would throw light on the multifaceted dynamics working between the leaders and their followers; and thus, enlightening the educators about the potential influence the leader's style may cast upon the significant establishment of an effective relationship. Therefore, identifying the values of a servant leader is both a timely and a necessary effort.

OLE OF VALUES IN SERVANT LEADERSHIP

A leader's individual as well as collective values act as the driving force behind every organization. These values provide "prescriptive, enduring standards" (Rokeach, 1973) and basic design to arrive at the results and handle difficulties (Russell, 2001). These values may be consciously articulated or unconsciously dominant, verbal or non verbal, written or unwritten (Rokeach, 1973). Leaders must be able to

cast their influence through their values since position power is being washed away in many organizations (Huey, 1994). Values signify the soul of leadership since the leader's values eventually permeate the organizations led by them. Values occupy paramount importance in the servant leadership since they provide a set of purposeful, distinguishable leadership traits. Also, Russell (2001) stated that servant leader's values help in creating interpersonal and organizational trust as it connects servant-led organizations with the same thread.

The work on servant leadership enumerates various values of a servant leader which have been considered in drafting the questionnaire pertaining to the same. Integrity, an innate quality of servant leaders, refers to the apparent level of equivalence amid values expressed verbally as well as values translated into action (Simmons, 1999). It helps in establishing trust - interpersonal as well as organizational. Integrity includes and goes beyond honesty (Covey, 1989). Integrity of a leader plays an important role in inculcating and sustaining trust among the followers in an organization. Greenleaf (1977) stated that trust was vital to servant leadership since trust fuels leadership's legitimacy. Moreover, Greenleaf also emphasized that servant leaders were more likely to win the trust of the followers. Relationships marked with trust and service serve as the basis for casting the influence of servant leaders on the followers (Sarkus, 1996; Tatum, 1995). Thus, servant leaders earn followers' trust by empowering and involving employees in initial stages, valuing commitments, fostering a mentoring skills and risk – taking ability amongst employees, through their behavioural consistency, integrity and competency. An absence of arrogance in a servant leader (Bower, 1997) clears space for humility in their value system. The baggage of job titles is shed by servant leaders and thus, they interact with people irrespective of their positions.Humility helps in viewing things from another's perspective which makes appreciating and respecting others an effortless move (Crom, 1998). Simply stated, humility in leaders makes them aware and appreciative of the follower's contributions in-lieu of self-promotion and this humility in servant leader makes them serve others from a genuine need to help. Greenleaf, (1998) stated that a servant leader sincerely works on and serves as a caring leader so that the followers can take their potential and calibre to the next level. The motivating principle, providing service to followers, makes servant leadership a special type of leadership practice (De Pree, 1997; Sendjaya and Sarros, 2002). A servant leader forsakes personal rights to search for greatness in serving people (Wilkes, 1996). In addition, servant leaders attach significance to equality and strive towards boosting the individual as well professional growth of the entire workforce. They look for treating everyone with radical equality; developing an altruistic approach towards one and all (Berry & Cartwright, 2000). Amalgamation of humility, modesty, unselfish motives and altruistic outlook in servant leaders help to identify the best not for themselves, but for others (Patterson, 2003). Such an altruistic approach is an essence for the mentality of servant leadership.

Servant leaders are strongly aware of their social responsibility. This awareness induces them to encourage and empower the followers to implement moral and ethical actions benefitting all stakeholders. The success earned by a servant leader lies strongly on the values of honesty, integrity and sincere concern for the welfare of those being served. A flow of genuine endeavours towards the growth of people and community at large can concretize only when the leader is able to surpass his/her personal interest and thus, leading the team towards a goal reaping benefits to both followers and organization.

The aforementioned literature review strongly asserted that values of a leader eventually infuse in the culture of the organization they lead (Russell, 2001). It is essential for leaders to "develop a value system that serves" (Kuczmarski & Kuczmarski, 1995, p. 83). A significant importance is attached to a servant leader's beliefs, values and principles (Covey, 1990; Ford, 1991). Led by the importance occupied by the values in a servant leader, the present study aims at identifying the building blocks of a servant leader's value system by conducting an exploratory factor analysis.

Objective

- To identify critical factors forming the value system of a servant leader.
- To develop and test a concise measure of value system of a servant leader.

ESEARCH METHODOLOGY

The transition of India from an agrarian economy to a service economy is attributed to the significant contribution of the Information Technology Enabled Services (ITES) industry. Its contribution to GDP is 9%, while the per capita GDP contribution of ITES employees is almost 80 times that of agriculture. According to the NASSCOM report, the Indian ITES industry will account for 10% of India's GDP and 18-20% of India's exports are estimated to be generated from this promising sector by 2020 (http://www.nasscom.in/nasscom-bpo-forum-indian-bpos-insight-future). Thus, ITES serves as the backbone for the growth of the Indian economy which explains the rationale in selecting the sample from the ITES companies.

Stratified random sampling has been used wherein a list of ITES companies operating in Delhi – NCR universities was drawn from NASSCOM website. Then, using fish bowl technique three companies under the category of leading companies and three companies categorized as emerging companies to work for, were selected from the list using fish-bowl sampling. 40 employees each from leading companies and emerging companies to work for were personally contacted for survey and hard copies were administered personally by the researchers for mapping their responses. Out of 240 filled, 181 valid questionnaires were selected for the study signifying a response rate of 75.41%.

Completely filled 181 questionnaires (133 male and 48 female) were analyzed for this study. The analysis reported a high

percent of sampled employees aged between 25 – 35 years (N= 140, 77.34%) and 41 of sample participants (22.65%) aged above 36 years. The employees' length of service and designation is shown below in a tabular form (Table 1).

TABLE 1 DEMOGRAPHIC DETAIL OF SAMPLED PARTICIPANTS

Demographic Variables	Levels	Number (Count)	Percent (%)
Gender	Male	143	73.48
	Female	48	26.51
Age	20-35 years	140	77.34
	Above 36 years	41	22.65
Tenure (Length of Service)	1-5 years	112	61.87
	6-10 years	52	28.72
	Above 10 years	17	9.39
Designation	NA/ Blank	7	3.86
	Executive	113	62.43
	Middle Manager	44	24.30
	Senior Manager	17	9.39

TABLE 2: KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.892
Bartlett's Test of SphericityApprox. Chi-square	5.433E3
df	276
Sig.	.000

In the first section of the questionnaire, demographic information, such as age, gender, highest qualification, employment tenure (ie. < 1 year, 1- 3 years, 3 - 5 years and > than 5 years) and department (marketing, finance, HR, R&D, and other). To understand and examine the value system of servant leaders, a self constructed questionnaire, Value-System Assessment Questionnaire was given to the team members/followers. The Value-System Assessment Questionnaire assesses a leader on the values; honesty, integrity, social justice, humility, trusts, spirit of sacrifice and service motive (values of a servant leader). Respondent's age and gender were taken as control variables and were dummy coded (1> 30 years else 0; 1 for male and 0 for females). A 5-point Likert scale with response options – Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree was employed for all the variables measurement. The overall reliability of the Scale capturing the values of a servant leader is reported as 0.97. According to Nunnally (1978), the instruments used in basic research have reliability of about .70 or better.

ATA ANALYSIS

Exploratory Factor Analysis has been used to extract the significant values making up the value system of a servant leader. Factor Analysis refers to the technique of attaining parsimony through categorizing the smallest number of descriptive terms in order to explain the maximum amount of common variance in a correlation matrix (Tinsley & Tinsley, 1987).

In factor analysis, the descriptive terms created, summarized the longer list of items; replacing it with a shorter, more feasible useful list of derived items. To assess the strength of the relationships and seeking factorability of the variables, Kaiser – Meyer – Olkin (KMO) test of sampling adequacy and Bartlett's Test of Sphericity was utilized. The value of KMO (Table 2) was reported as .892 which indicates the existence of a high measure of shared variance in the items. The value of Bartlett's test of Sphericity was less than 0.05 representing responses' validity and suitability towards addressing the objective of the study.

Total Variance Explained (Table 3) elucidates the associated eigen values with each factor before and after extraction and post rotation (Field, 2000). We can observe that prior to extraction; there were 24 components in which all variables are listed.

In the Table 3 'Total Variance Explained', the Eigen value has to be 1 or more than 1 to be significant. The factors having Eigen value greater than 1 are considered together as 1. This clearly indicates that out of 24 components, 3 factors have been extracted. Factor 1 (*later labelled as team orientation*) explains 63.252% of the variance, Factor 2 (*labelled as altruistic orientation*) explains 6.389 more, followed by Factor 3 (*labelled as ethical orientation*) which explains 4.181 more. Taken collectively, these 3 factors account for 73.822 explanations to the value system of a servant leader.

TABLE 3: TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.18	63.252	63.252	15.181	63.252	63.252	8.255	34.397	34.397
2	1.533	6.389	69.641	1.533	6.389	69.641	4.944	20.600	54.997
3	1.003	4.181	73.822	1.003	4.181	73.822	4.518	18.826	73.822
4	.925	3.852	77.675						
5	.776	3.233	80.908						
6	.772	3.219	84.126						
7	.629	2.622	86.748						
8	.473	1.972	88.720						
9	.411	1.712	90.432						
10	.366	1.523	91.955						
11	.337	1.405	93.360						
12	.270	1.125	94.485						
13	.244	1.019	95.504						
14	.217	.903	96.407						
15	.165	.685	97.092						

TABLE 3: TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
16	.137	.570	97.662						
17	.117	.487	98.148						
18	.108	.451	98.599						
19	.086	.358	98.957						
20	.073	.303	99.260						
21	.063	.261	99.520						
22	.050	.206	99.727						
23	.035	.147	99.874						
24	.030	.126	100.000						

Extraction Method: Principal Component Analysis.

TABLE 4: ROTATED COMPONENT MATRIX[a]

	Component		
	1	2	3
I know my leader will keep his/her word.	.837		
I believe my leader is straight forward.	.836		
I feel free to discuss my work related problems with my leader.	.829		
The leader acknowledges the followers' achievements.	.751		
The leader is worthy of confidence.	.719		
The leader shows consistency in behaviour.	.717		
My leader willingly gives up privileges if the team requires them.	.716		
My leader treats team members with dignity and respect.	.684		
The leader has created a fair and an open environment in the organization.	.682		
I believe my leader is willing to surrender his/her self – interest for the good of team/organization at large.	.660		
I can depend on my leader for an open conversation.	.656		
My leader keeps promises and commitments and expects others to keep theirs.	.617		
The leader provides fair and equal opportunities for advancement to all.	.601		
I can always seek a frank opinion from my leader.	.579	.552	
My leader is quick to apologize sincerely.		.783	
Serving team members is given due importance by my leader.		.762	
My leader lets go his/her interest to meet my needs.		.752	
Sincere efforts are taken by my leader to ensure team member's progress.		.728	
Sufficient initiatives are taken by my leader for the welfare of the society		.667	
The leader works hard to enrich the lives of less fortunate ones..		.733	
My leader sees the organization for its potential to contribute to the society.		.686	
The leader believes that the organization needs to play a moral role in society.	.673		
The leader is open to admitting his/her mistakes.		.648	
The leader demonstrates beliefs that are consistent with actions.	.647		

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 9 iterations.

INDINGS

To estimate the correlations between each of the variables and the estimated components, rotated component matrix, Table 4, also sometimes referred as the loadings, was used. We have included only those items having factor loading greater than 0.4 as it is considered appropriate for interpretative purposes Steven (1992). This table presents the result of Exploratory Factor Analysis. As we can observe, there exists a cross loading in the statement 'I can always seek a frank opinion from my leader'. On the basis of nomological validity and expert's view, we have put this item in Factor 1. And thus, we have arrived at a three factor solution.

Description of the Factors extracted: A value system of a leader is like their inner compass that assists them in distinguishing between good and bad, thus motivating and directing them to employ their skill – set for noble purposes. The analysis helped in identifying three core values building up the value system of a servant leader, namely, Team Orientation, Altruistic Orientation and Ethical Orientation. These core values are explained below:

1. Factor 1 - Team Orientation: In an organization, spirit of teamwork and collaboration can go a long way in strengthening individual strengths of the employees. Synergistic effects are the by - products of an effective team functioning. Acknowledging and appreciating the team efforts, working towards achieving consensus and involvement of team members, conducting open and honest communication, being accountable for problems, showing concern for others and making an effort to view things from other points of view, etc. help in fostering an effective team orientation among members. Moreover, an honest and open conversation helps the team members to vent their frustrations and air their grievances, thus leaving a room for healthy competition to breed.

'Team Orientation' basically tries to capture the relation between servant leader and followers. The lens through which the followers view their leader is reflected in this dimension. For this dimension, Cornbach's alpha (α), a measure of internal consistent reliability, was reported as 0.96.

TABLE 5 ITEMS LOADING ON FACTOR 1, TEAM ORIENTATION

Items	Loading
15. I believe my leader is straight forward.	.836
6. I know my leader will keep his/her word.	.837
7. I feel free to discuss my work related problems with my leader.	.829
16. The leader shows consistency in behaviour.	.717
17. The leader is worthy of confidence.	.719
8. The leader acknowledges the followers' achievements.	.751
12. The leader has created a fair and an open environment in the organization.	.682
10. My leader willingly gives up privileges if the team requires them.	.716
13. My leader treats team members with dignity and respect.	.684
14. The leader provides fair and equal opportunities for advancement to all.	.601
5. I can depend on my leader for an open conversation.	.656
11. My leader keeps promises and commitments and expects others to keep theirs.	.617
4. I believe my leader is willing to surrender his/her self – interest for the good of team/ organization at large.	.660
21. I can always seek a frank opinion from my leader.	.579*

**Cross loading – explained in Table 4*

2. Factor 2 - Altruistic Orientation: Altruism is "the willingness to do things which brings advantages to other people, even if it results in disadvantage for yourself" (Cambridge online dictionary). Therefore, altruism refers to the tendency to do well to others, irrespective of the discomfort caused to self. In the views of Simmons, 1991, altruism is a voluntary, intentional feeling or tendency which seeks to work for others welfare without any expectation of reward.

The competitive environment of current times makes altruism a misfit characteristic in the organizational settings (Kanungo & Conger, 1993). This view is endorsed by many prominent scholars like Smith, Organ & Near, (1983) and Friedman, (2002). However, altruism as a feature present in various leadership styles such as transformational, spiritual, servant, ethical and authentic styles is rapidly gaining acceptance (Brown & Trevino, 2006; Barbuto & Wheeler, 2006). Altruism implies that leaders or people care about others as an end in itself (Sober & Wilson, 1998). It can be seen as a selfless concern for the wellbeing of others.

Altruism is the hallmark of a servant leader. A servant leader with his self less giving attitude strikes an earnest effort towards the betterment of his / her team members and the society at large. For this dimension, Cornbach's alpha (α) came out to be 0.93.

3. Factor 3 - Ethical Orientation: Leadership involves offering direction to people, formulating objectives, and achieving results. Leaders with high integrity coupled with a clear understanding of their own personal ethics are successful in formulating and nurturing values into the fabric of their organizational culture. In other words, ethical thinking drives effective leadership.

TABLE 6 ITEMS LOADING ON FACTOR 2, ALTRUISTIC ORIENTATION

Items	Loading
24. Serving team members is given due importance by my leader.	.762
22. My leader is quick to apologize sincerely.	.783
20. My leader lets go his/her interest to meet my needs.	.752
23. Sufficient initiatives are taken by my leader for the welfare of the society.	.667
19. Sincere efforts are taken by my leader to ensure team member's progress.	.728

A prime responsibility of leadership is to ensure that employees in the organization can 'do the right thing' with ease. This can be attained when leaders are successful in fostering an organizational culture that supports doing the right thing, performing it rightly and for the right purposes – that is, purposes bearing ethical values. When employees feel they have no place to raise their ethical concerns, it can result in moral distress, which may lead to employee turnover (Biscoff, DeTienne & Quick, 1999).

Ethical behaviour is necessary and expected from leaders. When leaders get involved in unethical acts, devastation and damage follow soon. Ethical behaviour guides a leader towards right and best decision or actions. A servant leader not only attaches importance to adhering to ethics in all aspects but also sees the organization for its potential to contribute towards the improvement of the society. The Cornbach's alpha (α) for this dimension is 0.86.

TABLE 7 ITEMS LOADING ON FACTOR 3, ETHICAL ORIENTATION

Items	Loading
9. The leader believes that the organization needs to play a moral role in society.	.673
3. The leader works hard to enrich the lives of less fortunate ones.	.733
2. The leader is open to admitting his/her mistakes.	.648
18. My leader sees the organization for its potential to contribute to the society.	.686
1. The leader demonstrates beliefs that are consistent with actions.	.647

ONCLUSION AND IMPLICATIONS

In contemporary world plagued by numerous unethical practices, leadership styles based on human values such as altruism are gaining momentum (Sendjaya & Sarros, 2002). So, an altruistic orientation is an important value to be inculcated in a servant leader's value system. Servant leaders are people – centric, value serving others and are strongly guided by the belief that they have a duty of stewardship. Also, the desirable results reaped by an organization if a leader's value system absorbs the values of a servant leader are manifold, since this style of leadership rests on virtues of humility, love, empowerment, altruism, trust, vision, and service (Kaplan, 2000; Patterson, 2003; Veronesi, 2001; Wis, 2002). Servant leaders boost organizational performance as it strengthens relationships of trust (Greenleaf, 1977). Reinke (2004) and Joseph & Winston (2005) observed that servant leaders influences performance of an organization by empirically

testing the relationship between servant leadership and trust. Leaders selflessly working towards others' welfare create an environment marked with trust and cooperation making it easier to learn, try-out, contribute, take risks, culminate in higher levels of performance, as these factors in view of Chiva, Alegre & Lapiedra (2007) facilitate organizational learning and also share relation with organizational performance (Alegre & Chiva, 2008). Servant leaders give ample space to others to voice their concerns since it is a style of leading others through a desire to serve (Prosser, 2007). They create an approachable environment wherein members speak up their perspective and thoughts freely and confidently. In organizations, servant leadership is translated through an approach of partnership and amalgamation with others. The success of servant leadership exists in their capability to make bridges and win over others by earning their trust. The intention of servant leadership resides in others, instead of oneself, and in comprehending the role of a leader as a servant.

A Leader's value strongly influences followers and ultimately performance of the organization as a whole. In order to set up effective leadership practices, a leader must first begin with observing their own value system. Subsequently, they should focus on the present organizational values. The leaders will benefit by knowing the value – set they should inculcate, so as to make the employees realize and surpass their potential. Values occupy paramount importance in the concept of servant-leadership as the values of servant leader provide a set of purposeful, distinguishable leadership traits. The leaders will benefit by knowing the value – set they should inculcate, so as to take the employees, their legacy, organization and community to a higher platform.

"Not until we have considered our leadership model at the level of its values, assumptions and principles, can we discern to what extent we are leading from a power or a servant base" (Rinehart, 1998. Pp. 30). (With an increase in emphasis on the leader's style grounded on values, the present research work offers assurance that identifying and comprehending value system is a necessity.) The present study findings may stimulate leaders to confront their individual value system as well as the values making up their organization's culture. This will help the leaders to identify and realize their own value system. Such deep probing about one's self awareness serves as a significant element in leadership development. A measure of servant leadership orientation on the basis of the identified values can offer a productive input to leadership development seeking 'insightful awareness'. It would also offer help to organizational leaders aspiring to establish a servant- led organization. Identification and measurement of values of a servant leader may be employed as a criterion for selecting candidates or promoting employees in an organization.

Leadership educators should consider the derived value set of servant leaders for incorporation in curriculums when educating about the influence of servant leadership. Multiple organizational benefits can be reaped, if leadership educators can effectively develop future leaders to increase their use of servant leadership values. Empirical work on servant leadership helps in identifying a new dimension pertaining to the existing reservoir of knowledge. Additionally, it also presents prospects for application and study in the servant leadership arena to future researchers and practitioners.

UTURE RESEARCH

Leadership is not guarded by environment since it is exhibited in every area of human relations, including education, industry, politics, government and everyday social exchanges. Extending this stream of thought, the proposed set of values should be tested separately in other sectors, such as manufacturing, banking and insurance, etc. This is because the immediate work environment in other organisations differs significantly from ITES sector. This can also help in drawing valuable comparison amongst different sectors of the economy. In other words, the predictive characteristic of servant leader's value system may vary across sectors. Future research may focus on conducting Confirmatory Factor Analysis to establish construct validity. This will guide the future researchers to appreciate the role of value system of a servant leader in leadership and organizational dynamics and thus, benefitting the functioning of corporate. Aspiring researchers may empirically study the impact of these values on organizational outcomes, such as empowerment, job involvement, turnover intentions, productivity, motivation, job satisfaction, etc. to effectively quantify its worth to leadership education and practice.

Previously, servant leadership has been viewed as folklore in the leadership classroom, owing to limited empirical work carried out on the construct. Now is the right time to test the true significance of servant leadership as its measures has been validated, making empirical testing feasible.

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A STUDY OF RELATIONSHIP BETWEEN CORPORATE SOCIAL RESPONSIBILITY INITIATIVES AND ITS DISCLOSURE(S) AND CORPORATE FINANCIAL PERFORMANCE OF SELECT COMPANIES IN AUTOMOTIVE SECTOR IN INDIA

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INTRODUCTION

A recent upsurge of illegal and ethical misconduct incidents spanning the globe has intensified public scrutiny of corporate behavior. Corporate Social Responsibility (CSR) is not a mere business buzzword or a fad, rather it is one of the most promising management topics of mounting significance for businesses. Proponents argue that there is a robust business case for CSR, as the corporations benefit in multiple ways by operating with a wider perspective which goes beyond their short-term profits. Some critics argue that CSR sidetracks from the essential economic role of businesses; others opine that it is nothing more than artificial window-dressing; others yet are of the belief that it is an endeavor to pre-empt the role of governments as a watchdog over influential multinational corporations. In the foreign studies studied till date, possibly the maximum studied facet of CSR has been its link to Corporate Financial Performance (CFP). India has a lot of scope for research in this area. There is a dearth of such literature and need for the study on CSR Initiatives and its disclosure and CFP, is being deeply felt, especially in the Automotive Sector. (Unlike prior research, this study, out of the total population of 492 companies, examined 26, automotive companies for a period of five years, to study the relationship between Disclosure(s) of CSR initiatives and the Financial Performance of the companies using Content Analysis and Multiple Regression Analysis.) Then, through questionnaires served to 450 middle level and senior level employees, the perception of employees regarding the implementation of the new Companies Act 2013 provisions being followed by the companies was studied and analysed using Percentage and Pie Charts followed by a detailed analysis of the relationship between CSR initiatives and the CFP through Exploratory Factor Analysis (EFA) and Structural Equation Modelling (SEM) using statistical program IBM SPSS (Statistical Product and Service Solutions, developed by SPSS Company of America,) Statistics 20 and AMOS 22. The results indicated that there has been a substantial increase in the disclosure of CSR initiatives by the companies. However the results are not evident of any relationship between the CSR information disclosure and CFP of the firm. The study also found that the employees' perception about the CSR initiatives taken by their companies confirm that there exists a weak but significant and positive relationship between corporate social responsibility initiatives taken by the companies and corporate financial performance.

Since, not much research has been done in the field of CSR and its disclosure in India, especially in the automotive sector, this study would be a significant contribution to the existing body of knowledge. The managers of the Indian companies can be acquainted with the reporting guidelines followed internationally and the same can be made a strict and mandatory internal policy, to make themselves globally competitive in the area of social responsibility. The study of relationship between CSR and CFP may give an insight to the companies to take a judicious decision regarding investment in CSR initiatives.

ESEARCH GAP

In India, among accessible literature, only few studies on CSR and CFP exists. Therefore, the lack of authentic measures in Indian studies impelled a study with more dependable measures and indicators, thereby crafting a rationale for conducting further research and providing empirical evidence. The other research gaps that have been identified are:

1. No research has been conducted till date that examines the degree of CSR disclosure by companies in the Automotive Sector. Various researches have been conducted to analyze CSP and CFP in mining companies, FMCG Companies, textile companies, etc. establishing a negative or positive or a neutral relation. But examining the association of CSR Initiatives and its disclosure with the financial performance of the companies in automotive sector has rarely been in the purview of there researches.

2. The CSR Disclosure has not been examined through a Self-Composed Disclosure Index formed by considering both the Global Guidelines and Indian Guidelines. The GRI-G-3 guidelines have been the basis of understanding the CSR Reporting for many studies. Some studies had also considered ISO-26000, AA-1000 and the Ministry of Corporate Affairs issued National Voluntary Guidelines. No study has made an attempt to compare both the global and Indian guidelines to establish the CSR Reporting dimensions.

3. India has a lot of scope for research in this area. CSR, known as the concept of West, is deliberated to be more of an emerging activity in the Indian commercial sector than a recognized trend in general. Although wide-ranging research on CSR-CFP has been conducted in advanced and established countries, there is a paucity of similar researches in India.

4. The new Companies Act 2013 has made CSR expenditure to be a mandate. It becomes necessary to understand the perception of the employees of the automotive companies towards the implementation of the new provisions.

ITERATURE REVIEW

The global development of the concept of CSR has led to more scholars pay their consideration for CSR in the arena of business practices. Among these studies, the major focus has been the association between corporate social responsibility and corporate financial performance enabling corporate to fulfill the most fundamental target of an organization i.e. to generate monetary benefits, and the most fundamental social responsibility i.e. responsibility to stockholders (Qui Yang 2012) between 1971 and 2001, more than hundred published studies observed the relationship between corporate social responsibility and financial performance (Margolis and Walsh, 2002) with a negative relationship (Wright and Ferris, 1997) or a positive relationship (Posnikoff 1997) or no relationship (Welch and Wazzan 1999) between CSR and financial performance

(Tsoutsoura 2004).

Ghosh Sumona (2015) conducted an analytical study which explored the design of disclosures of corporate social responsibility (CSR) activities made by the private sector corporations in the public documents. CSR participation was measured by analyzing the companies' websites for a period of two years and 'number of sentences' was used as a unit of measurement. Correlation, multiple regression analysis along with conjoint analysis was applied and it was determined that the major contributing and favored CSR areas were education, health and environment.

Ahamed et.al (2014) examined three Malaysian firms for the period from 2007 to 2011 to understand if the CSR dimensions like environment, community, market place and work place have positive, negative or neutral relationship with corporate financial performance dimensions like Return on Asset (ROA) and Return on Equity (ROA). The secondary data collected from corporate annual report was analysed using content analysis and then the relationship was tested by using regression analysis. The study concluded a positive relationship between CFP and CSR practices collectively with the size of the firm and the revenue of the firm as control variables.

Moenna (2014) investigated the top fifty listed companies from the European Union (E.U.) for the association of CSR with CFP using one accounting-based measure ROA and one market-based measure EPS. Risk, firm size, industry, R and D intensity were taken as controlled variables. The relationship was analysed applying two regression models and the results suggested a positive association between CSR and CFP.

Singh Shruti (2014) investigated the corporate social responsibility (CSR) disclosure impact on the firm's financial performance in three UK industries viz., crude petroleum and natural gas, mining and pharmaceutical products manufacturing, over five years ranging from 2008 to 2012. The CSR disclosures were measured in terms of published CSR keywords in the annual reports of the firms and the financial dimensions were return on assets(ROA) and total shareholder returns (TSR). A linear regression on the data validated no significant CSR disclosure impact on the financial performance for the chosen industries in the UK.

Valmohammadi Changiz (2014), in his study of 207 Iranian organisations provided valid paradigms of CSR and a dimension instrument of the core subjects of ISO 26000 standard. The statistical analysis using structural equation modeling revealed number of noteworthy relationships between organizational performance and CSR initiatives. The practices like community participation and progress plays a significant role in augmenting performance of the organizations.

Zaborek Piotr(2014) explored the link between social responsibility involvement and financial performance between Polish small and medium manufacturing companies in food and cosmetics industries. A structural model was developed and tested on the data from a survey of 187 managers. The outcomes suggested a weak and significant positive correlation between the CSR construct and sales profit margin, no discernible direct effect of CSR on ROA.

Aile and Bausy (2013) examined the relationship between CSR activities subdivided in five categories (workplace, market place, environment, community and other CSR) and firm financial performance measured through ROA in the Baltic States of Latvia, Lithuania and Estonia. The content analysis methodology to measure CSR and regressions are run and results showed that certain CSR categories had an impact on ROA. CSR activities related to market place and environment seem to decrease firm is financial performance, while other CSR activities, like adherence to CSR standards increase ROA. In the Baltic societies, people are apprehensive to pay more for products delivered by socially responsible companies.

Ghelli Caterina (2013) understood the existence of "industry effect" by examining the direction of the correlation between CSR and CFP. The regression results confirm the presence of a significant positive relationship between corporate social responsibility and financial performance. This relationship focused on both directions, as CSR is influenced by the firms' financial performance and at the same time influences it too.

Khanand Hassan (2013) engrossed on understanding a relationship between CSR and CFP for Pakistani public companies. These annual reports were descriptively analysed and it was observed that CSR activities of the companies involved in areas regarding these activities cover at least two or three pages of reports but are not completely covering the monetary aspect. The focus was on the association between quantity consumed on CSR activities and association with the ROE and Net Income.

Abiodun (2012) examined the association between corporate social responsibility and firms' profitability in Nigeria. Ten (10) firms were randomly selected and their annual reports between"1999-2008"were studied for the research. Ordinary least square method was used for the analysis and it was showed that the investment by sample firms to social responsibility is less than ten percent of their profits in a year. It was also analysed that the variations in selected firms' corporate social responsibility (CSR) in Nigeria caused changes in performance (PAT).

Cahan et.al (2012) investigated a global sample of companies drawn from 22 countries to understand the connection between CSR disclosures and firm's performance. There sults indicated no relation between the two which suggested that these disclosures are uninformative. It was summarized that profits from CSR activities are not realized with immediate effect. Hence, firms with not so good CSR accounts might emulate the increased level of disclosures of great CSR performers, lowering the significance of CSR disclosures.

Iqbal and Ahmad (2012) estimated the relationship of CSR, CFP, financial leverage and market value of the share. They studied 156 companies listed on Karachi Stock Exchange (KSE)

from chemical, textile, tobacco and cement sectors for the period 2010 and 2011. The study concluded that corporate social performance (CSP)has negative effect on the share's market value, no effect on corporate financial performance (CFP) as well as D/Ebehavior.

Qui Yang (2012) used regression analysis on the accounting indicators of 839 Chinese listed companies in 2010 and measured the association between the companies' social responsibilities and their financial performance and established that social responsibilities to employees had moderate positive influence on the financial performance unlike that to other investors who do not significantly influence the financial performance of Chinese listed companies. There is not so optimistic CSR situation in China.

Razaet.al.(2012)using content analysis to examine the connection between corporate social responsibility (CSR) and corporate financial performance (CFP) from 1972 to 2012. They concluded the existence of a strong and positive relationship between CSR and CFP. Tobin's Q was used as a financial performance measure and the study consented the other researches which found positive relationship between CSR and CFP using ROA, ROE and ROS as financial performance measure. The study differentiated from the studies which by stock market returns as financial performance measures, found relationship between CSR and CFP to be negative.

Yin (2012) researched to comprehend CSR development in China over the last few years and measured the CSR effects on performance of the firm by inspecting the CSR reports for 2008-2009. With Chinese companies progressing in their CSR practices, the research exhibited that the financial performance of the previous year is positively connected to CSR disclosure and in the next year the CSR disclosure has a positive noteworthy effect on the firm's financial performance.

Esra Nemli Caliskan and Yusuf Ayturk (2011) examined the relationship between financial performance and reputation of the businesses in Turkey for the period (2000 and 2010). The results of this research indicated that there is no causal association between corporate reputation and corporate financial performance measures of MBV and ROA. The results also indicated that ROE improves corporate reputation but corporate reputation has no impact on ROE.

Montoya Monica (2011) conducted the study to inspect the effect of innovation on the CSP-FP relationship. CSR data was collected from Sustainalytics (for 2008 and 2009) and the financial data from Capital IQ (2007 and 2009) was used to carry out regression analysis. The analysis suggested that there is no effect of role of innovation on the CSR-FP. Also, there does not exist statistical significance on the relationships among CSP, FP and innovation.

Singhania (2011) determined the influence of score of corporate governance on financial performance of Indian corporate on Nifty 50 companies between the years 2000 and 2009. The study gauged the effect of corporate governance on performance of firm by computing corporate governance score. The study also analyzed the influence of the newly constructed corporate governance score and eight variables on financial performance. The analysis highlights that corporate governance scores, when controlled with other variables, significantly impacts Tobin's Q of Indian companies.

Choi and Kwak (2010) studied the connection between corporate social responsibility (CSR) and corporate financial performance, empirically on 1222 Korean firms for a period of 6 years. The methods used were both an equal-weighted CSR index and a stakeholder-weighted CSR index. Return on assets, return on equity, and Tobin's Q were variables used for measuring CFP. The relationship between corporate financial performance and the stakeholder- weighted CSR index were found to be positive and significant but not positive with the equal-weighted CSRindex.

Harpreet Singh Bedi (2010) examined for the financial year 2007-08, 37 companies rated by Karmyog (Mumbai base NGO), using correlation and regression as a statistical tool. The study revealed the existence of a positive relationship between CSR and financial performance and the inferential measures showed the dependence of Corporate social expenditure on the financial performance of the company. A minimal and negligible spending on part of the companies' social responsibilities was observed.

Gamerschlag Ram et.al (2010) showed a positive association between CSR disclosure and shareholder ownership arrangement. The company's profitability and firm size affects the CSR disclosure. (It was observed that a higher level of environmental disclosures was made by the ''polluting industries'' companies the disclosure by small companies was less than that by big companies).

Mishra and Suar (2010) studied whether CSR towards primary investors had an influence on the Financial Performance (FP) and the Non-Financial Performance (NFP) of Indian firms. The CSR and NFP information was collected through a questionnaire survey (6 CSR dimensions) from 150 senior level Indian managers and the data related to financial variables of the firms was sourced from secondary sources. It was found that listed firms displayed better socially responsible practices and financial performance than the firms which were not-listed.

Saleh Mustarding and Muhamad Rusnah (2010) using longitudinal data analysis, examined the link of CSR to financial performance for Malaysian companies. Although CSR disclosure concept is at a budding stage in Malaysia, still it was established that CSR disclosure and financial performance are positively related. The findings confirmed that the social activities by local firms help them achieve advanced levels of financial performance.

Yang Fu-Ju, Lin Ching Wen and Chang Yung-Ning (2010) studied corporations listed in the TSEC Taiwan 50 Index and using regression analysis analyzed the connection between CSP and CFP. The study highlighted that former CSP impacted

ROA positively.

Sweeney L (2009) through semi structured interviews with some large firms and SMEs in Ireland, found that CSR was established to have a strong association with social reputation, motivation and retention, employee attraction and consumer attraction and loyalty and with other business profits projected to result from CSR, a weaker relationship

ESEARCH METHODOLOGY

Research objectives

1. To examine the Corporate Social Responsibility initiatives of the select companies in Automotive Sector in India.

2. To analyse the relationship between Disclosure(s) of Corporate Social Responsibility initiatives and the Financial Performance of the companies.

3. To examine the perception of employees regarding the implementation of the provisions of the new Companies Act 2013 being followed by the companies.

4. To analyse the relationship between Corporate Social Responsibility initiatives and the Financial Performance of the companies.

Target Population

The target population was the Indian companies in the Automotive Sector and the foreign automotive companies with operations in India. For research purposes, four hundred ninety two companies listed in PROWESS DATABASE were taken as the total population.

Sample for the Study

The Section 135 and Schedule VII of the Companies Act, 2013 effective from 29th August 2013 and Companies (Corporate Social Responsibility Policy) Rules, 2014 effective from April 1, 2014 imposed obligatory corporate social responsibility provisions upon Indian companies and foreign companies operating in India. The criteria to be met by companies for any financial year, for a mandatory CSR contribution to the society are:

a) Having net profit of five crores rupees or more; or

b) Having net worth of five hundred crores rupees or more; or

c) Having turnover of thousand crores rupees or more

Out of the target population of 492 companies, 278 companies satisfied the mandatory criteria for CSR contribution imposed by the Companies Act 2013. The requirement of listing of the companies and the availability of the financial data of these companies for five years (2009-2014) further reduced the sample to 59 companies. Thereafter, the websites of these companies were visited for exclusive CSR reports or annual reports disclosing CSR initiatives of the companies. It was noted that the companies were not disclosing the CSR initiatives in their reports. Some of the companies had just started reporting 1-2 years back, the reporting framework of the selected 59 companies was not available and all could not fall within the scope of the study. Hence, a list of 26 companies was finalized as a sample for the study for justifying Objective 1 and Objective 2 of the study. To justify Objective 3 and Objective 4 of the study, primary data was collected through questionnaires and the total population comprised of the middle level and senior level employees of 26 companies. The survey was sent to 450 employees.

Period of Study

Data was collected for a period of five years from 2009-10 to 2013-14

Data Collection

The data for the study was collected both from primary sources and secondary sources. Since the nature of study was purely exploratory in nature, the primary data had to be collected from the employees of the sample companies in the automotive sector, in the form of surveys which were designed using the website "monkey survey.com" and the link of the same was sent to the employees.

The secondary data was collected from CSR/Sustainability reports, annual reports and web pages of the companies, management journals, business magazines, newspaper articles etc.

Identification of variables

a. Independent Variables: Disclosure of CSR information (economic, environmental and social) made by the companies. A Self- Composed CSR Disclosure Index which has formed the base for many studies, has been created taking into account the National Voluntary Guidelines prescribed by Ministry of Corporate Affairs (NVG-MCA), G-3 Guidelines given by Global Reporting Initiative (GRI-G-3), UN Global Compact, ISO- 2600, OECD Guidelines, AA1000 and CSR provisions of Companies Act, 2013.

b. Dependent Variables: Return on Equity (ROE), Return on assets (ROA), Debt-Equity (D/E) , Profit after Tax (PAT).

c. Controlled Variables: Firm Size

Hypotheses Development

Hypothesis 1: There is a positive relationship between the disclosure of Sustainability performance information and Return on Equity.

Hypothesis 2: There is a positive relationship between the disclosure of Sustainability performance information and Profit after Tax.

Hypothesis 3: There is a positive relationship between the disclosure of Sustainability performance information and Return on Assets.

Hypothesis 4: There is a negative relationship between the

disclosure of Sustainability performance information and Debt/Equity.

Hypothesis 5: There is a positive relationship between the disclosure of Sustainability performance information and Return on Equity after controlling the size of the firm.

Hypothesis 6: There is a positive relationship between the disclosure of Sustainability performance information and Profit after tax after controlling the size of the firm

Hypothesis 7: There is a positive relationship between the disclosure of Sustainability performance information and Return on Assets after controlling the size of the firm

Hypothesis 8: There is a negative relationship between the disclosure of Sustainability performance information and Debt/Equity after controlling the size of the firm.

Hypothesis 9: There is a positive relationship between the Corporate Social Responsibility initiatives taken by the firms and the Corporate Financial Performance of the firm.

Statistical Tools and Techniques

- To test Hypothesis1 to Hypothesis 8
- Content Analysis
- Multiple Regression Analysis
- To test the Hypothesis 9
- Exploratory Factor Analysis (EFA)
- Structural Equation Modelling (SEM)

are used as the statistical techniques that are used in the present study.

The statistical program IBM SPSS (Statistical Product and Service Solutions, developed by SPSS Company of America,) Statistics 20 and AMOS 22 is employed.

INDINGS AND CONCLUSIONS

CSR has become a buy-in at all levels of the company (Oron Emmanuel 2011). Merely following CSR as a strategy by the companies is not enough, its reporting to the Stock holders is equally significant. CSR reports are a communication tool not merely to help stakeholders' understand how the companies pursue CSR activities, but also to make companies globally competitive and sustainable. With the introduction of CSR provision in the Companies Act, India Inc. is increasingly getting involved in conducting and reporting of CSR activities that contribute to the society and various stakeholders. The new act is a welcome step and all companies satisfying the CSR criteria will have to undertake CSR activities under the new CSR regime. The step would eventually, boost much required social projects with some professional management of the private sector (Lal Mansukh 2013).

The conclusions that may be drawn from the present study, objective wise are discussed below:

Objective 1: To examine the Corporate Social Responsibility initiatives of the select companies in Automotive Sector in India.

The companies in the automotive sector are active in taking CSR initiatives fulfilling the 3Ps of Triple Bottom Line: economic (profit), environmental (planet) and social (people). Most of the automotive companies disclose their CSR initiatives in the form of a separate section 'Corporate Social Responsibility' in their annual reports or in Director's report. Most of the sample companies are not following some stipulated guidelines or a standard reporting structure for CSR disclosure. A few automotive companies follow global guidelines given by GRI and UNGC. With the increased awareness of the significance of CSR contribution, the companies have eventually increased their CSR initiatives. There has been marginal increase in the CSR (Economic) disclosure score from 2009-10 to 2013-14. The CSR (Environmental) disclosure score has also increased from 2009-10 to 2013-14. The CSR (Social) disclosures core has increased to a large extent during the period of five years. A major reason is also the latest clause of Companies Act 2013, that every company satisfying a certain criteria is mandatorily required to invest 2% of their average profits of the preceeding three years in CSR activities, failing which the company has to submit a report to the Ministry of Corporate Affairs stating the reason of non-contribution.

Objective 2: To analyse the relationship between disclosure of Corporate Social Responsibility initiatives and the Financial Performance of the companies.

This objective has been fulfilled by doing content analysis followed by multiple regression analysis on 26 sample automotive companies. The CSR Disclosure Index was created and the effect of the disclosure of sustainability information was studied on the CFP variables (ROE, PAT, ROA, D/E) with and without controlling the size of the firm. The conclusion drawn was that: There is no positive relationship between the CSR information (economic, environmental and social) variables and CFP (return on equity, return on assets and debt on equity) before and after controlling the size of the firm. However, there exists a positive relationship between the CSR information (economic and social) variables and profit after tax before controlling the size of the firm but there is no significant relation between CSR information (environmental) and profit after tax, after controlling the size of the firm.

Objective 3: To examine the perception of employees regarding the implementation of the provision of the new Companies Act 2013, being followed by the companies.

The study revealed the employees' perception of the provisions of Companies Act 2013 regarding the mandatory expenditure on CSR activities. The employees of all the sample automotive companies perceive that their companies should follow all the provisions of Companies Act 2013, relating to CSR initiatives.

Objective 4: To analyse the relationship between Corporate Social Responsibility initiatives and the Financial Performance of the companies.

The said objective was fulfilled using Exploratory Factor Analysis and Structure Equation Modelling. The analysis was done by conducting a survey on 153 employees (middle level and senior level management) of select automotive companies. The CSR initiatives (Economic, Environmental and Social) taken by the select automotive companies were listed and the employees' perception was studied to analyse the relationship between CSR and CFP of the select companies. The conclusions that may be drawn from the analysis were:

- The companies are actively demonstrating their participation in the CSR initiatives for the economic, environmental and social benefit.
- The economic activities that may affect the profitability of the companies are : Customers and consumers satisfaction, protecting Stockholders and investors interest, community focusing on quality as a core value and handling investor grievances.
- The CSR initiatives (Environmental) that may affect the profitability of the firm are: Following the system of reduce, reuse and recycle, development and diffusion of environmentally friendly technologies.
- The CSR initiatives (Social) that may affect the profitability of the firm are: Taking greater employee satisfaction measures, following occupational health and safety policies, skills and career development of employees, providing a good work-life balance for employees (flexible working hours or work from home facility), non-discrimination, diversity and equal opportunity, prevention of forced and compulsory labour and adopting poverty alleviation measures.
- It may also be concluded that there exists a weak but significant and positive relationship between corporate social responsibility initiatives taken by the companies and corporate financial performance.

ECOMMENDATIONS

On the basis of the findings of the study, the following suggestions can be made to the companies:

1. With respect to the provisions of Companies Act,2013

a. The companies should conduct research for undertaking CSR activities in an effective manner, irrespective of the high cost involved.

b. The companies should follow CSR practices and the practices should not be a one-time charity or donation but should be project based.

c. The companies should join hands with some other organization (like an NGO) for conduct of CSR activities in a more effective manner.

d. The companies should have a separate CSR Department to conduct CSR activities.

e. The companies should invest every year, 2% of their average profits of preceding three years for CSR activities.

2. Companies should be responsible for adding value to the community through their operations. The corporate world commitment towards CSR can give them an opportunity to explore the potentially viable areas to augment the company's profits portfolio. It should be taken as a strategic decision by the companies and to deepen it as a core business.

3. It is of utmost importance to the companies to share with their Stockholders, the kind and amount of investment they are making in the field of CSR and how are they working towards betterment of the society. This necessitates the creation of awareness of CSR amongst the general public. The companies should increase the intensity and frequency of making CSR disclosure through reporting.

4. Organizations must realize that upliftment of the society is not the sole responsibility of the government; corporates have a dominant role instead. Hence, the companies should invest more in the projects which help in societal development at large.

5. The government should also mandate the provisions of the new Companies Act 2013, obligating the companies to take initiatives and then disclose them on a regular basis.

6. The Government should introduce a regulatory mechanism through an independent agency for main streaming and institutionalizing CSR in the main business framework of the companies.

The companies should aim at ingraining CSR into the DNA of the core business activities.

UTURE RESEARCH

There is a substantial amount of research that still needs to bed one concerning the link between corporate social responsibility and financial performance.

1. The corporate financial performance is studied only on accounting based financial variables, which are considered to be a better indicator of profitability. However, market based financial variables like earning per share and Tobin Q can be used as a measure for corporate financial performance.

2. It can be observed from the results in this research that companies' CSR scores predominantly increased in the years 2009-2014 and future research could be more significant in coming years as companies will expand its CSR investments following the latest provisions of new Companies Act 2013, relating to mandatory CSR investments by companies fulfilling a certain criteria.

3. Another suggestion for future research is to study a larger

sample than the one observed in this research. Due to the adoption of criteria as per new Companies Act 2013, the sample was limited to 26 companies. Considering that the total number of companies in the automotive companies in the PROWESS data is 492, future research could apply another research design, which allows the inclusion of the total population of the companies. An increased sample size in future studies may allow higher levels of generalization.

4. The present study is confined to only automotive sector in India, the future researchers can select some other industries for the purpose of study and some more options of implementation of the concept of CSR.

5. This research should act as a guiding force for the managers in the companies to formulate strategies for implementing CSR as a full time activity.

ONTRIBUTION OF THE STUDY

Apart from increasing the number of scholarly works with neutral outcomes as far as the link between CSR and CFP is contemplated, this study contributes, theoretically and practically, to the existing literature body of CSR and financial performance relationship research field in a number of ways:

1. The results outline that during the time span of 2009-2014, there was no significant relationship between CSR performance and financial performance (in terms of ROA, ROE, PAT and D/E) across the Indian automotive companies. The information about the existence of this insignificant relationship has a significant practical implication. This in turn, could influence the extent to which companies choose to invest in CSR activities if these financial measures are considered important.

2. The findings of the study that investment in CSR activities by the companies has an effect on profitability, sales and credibility of the firm, provides further evidence for managers that CSR may develop customer trust, mitigate reputation risks, and create long-term share holder value.

3. The detailed examination of the global and Indian guidelines for CSR disclosure in the study, has offered an insight to the companies that to be globally competitive and sustainable, not only Indian guidelines but global guidelines like GRI or UNGC guidelines should be followed for CSR reporting. Moreover, inconsistency with the international standards makes cross-border comparisons difficult.

4. The outcomes are arguably more trustworthy than some other studies because of directly asking managers about their perceptions of how CSR is used in their companies rather than relying on more general ratings derived from third-party databases.

Although CSR is still at a nascent stage in India, management should be cognizant of the strategic benefits that firms may realize from engaging in CSR activities. A better understanding and practice of CSR among companies will not only augment companies' sustainability, but also advance the development of CSR in India.

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DELHI INSTITUTE OF ADVANCED STUDIES

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We strive to provide a dynamic learning environment for imparting holistic education that inculcates professional excellence, induces competitive spirit, instils leadership quality to carve a niche in the changing global scenario

THE INSTITUTE

DELHI INSTITUTE OF ADVANCED STUDIES is 'A' grade NAAC accredited Institution, affiliated to G.G.S. Indraprastha University. Established by Shri Laxman Das Sachdeva Memorial Educational Society, the Institute is providing dynamic learning environment that is changing in response to changing needs of society. At DIAS, pursuit of Excellence is a way of life. The guiding philosophy behind all the academic activities of the Institute is to inculcate professionalism in management and to enhance the effectiveness of organization. The Institute seeks professional excellence through ethics, passion and perseverance.

Shri S.K. Sachdeva, a well- known name in the educational world, is the Chairman of the Institute. Dr. S. N. Maheshwari, former Principal of Hindu College, Delhi University is its Professor Emeritus & Academic Advisor while Dr. N. Malati is its Director.

The Institute runs the following programmes affiliated with Guru Gobind Singh Indraprastha University.

Programme	Duration	No. of Seats
MBA (Full Time)	2 Years	120
MCA (Full Time)	3 Years	60
BBA (Full Time)	3 Years	60
B.Com.(H) (Full Time)	3 Years	60

The success of a professional educational Institution is evaluated and judged both on its academic performance and the placement of its students. DIAS has been successful on both these fronts.

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MBA: Ms. Pratibha Manchanda (Batch 2000-2002), Ms. Manpreet Kaur (Batch 2001-2003), Ms. Silky Mahajan (Batch 2002-2004), Ms. Kavita Sharma (Batch 2003-2005), Mr. Rahul Gupta (Batch 2004-2006), Ms. Priyanka Rastogi (Batch 2008- 2010), Ms. Ruchika (Batch 2009-2011), Ms. Swati Jain (Batch 2012-2014), Ms. Niti Chopra (2013-2015)

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DIAS provides excellent placement opportunities for its students in prestigious organizations. Some of the companies where our students have been placed include: Tata Consulantacy Services, IBM, Nucleus Software Ltd. , Accenture, Intersolutions, American Express , Standard Chartered, ICICI Prudential, Infosys, Adobe , Hughes, Thomas Cook, MAspar, Quark, Syntel, BEC Foods, Grapecity, NIIT, Safenet , Indus Valley Partners, Capital IQ, Federal Bank, Ernst & Young, Pepsico, Ameriprise Financials, Axis Bank, Newgen software and many.

MISSION

DIAS believes in learning to excel and excelling to serve. The aim of the Institute is to develop a unique culture that seeks to scale heights of glory through ethics, passion and perseverance. The guiding philosophy of the Institute is to enhance team spirit, integrity and commitment to serve the cause of humanity.

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(NAAC Accredited 'A' Grade Institution)

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I. QUALIFICATIONS & EXPERIENCE

MBA PROGRAMME

1. Assistant Professor: (MBA)	First Class or equivalent in Masters Degree in Business Administration or equivalent and two years relevant experience is desirable.
2. Associate Professor: (All Programmes)	(I) Qualifications as above i.e. for the post of Assistant Professor, as applicable and PhD or equivalent, in appropriate discipline. (II) Post PhD publications and guiding PhD students is highly desirable. (III) Min. 5 yrs experience in teaching/research/industry of which at least 2 yrs post PhD is desirable.
3. Professor (All Programmes)	(I) Qualifications as above i.e. for the post of Associate Professor, as applicable. (II) Post PhD publications, guiding PhD students, demonstrating leadership in planning and organizing academic, research, industrial and/or professional activities, and capacity to undertake/lead sponsored R&D consultancy and related activities are highly desirable. (III) Min. 10 yrs experience in teaching/ research/industry of which at least 5 yrs should be at the level of Associate Professor Or Min. 13 yrs experience in teaching/ research/industry. In case of Research experience, good academic record and books/research paper publications/IPR/ patents record shall be required as deemed fit by the expert members in Selection Committee. In case of Industry experience, the same should be at managerial level equivalent to Associate Professor with active participation record in devising/designing, planning, executing, analyzing, quality control, innovating, training, technical books, research paper publications/IPR/ patents, etc. as deemed fit by the expert members in Selection Committee.

BBA/B.COM (H) PROGRAMMES

1. Assistant Professor:I (BBA/B.Com (H))	(I) Good Academic record with at least 55% marks or equivalent grade at Master's degree level in the relevant subject from Indian University or from Foreign University. (II) Passing of NET/SLET/SET.
2. Associate Professor: (All Programmes)	(I) Eminent scholar with Ph.D qualification(s) in the concerned /allied/relevant discipline with high quality published work. Minimum of 10 publications as books and/or research / policy. (II) Min. 10 yrs of teaching experience in university/ college / research at the University/ National level Institutions/Industries, including guiding Ph.D students. (III) Contribution to educational innovation, design of new curricula and courses, and technology – mediated teaching learning process. (IV) A minimum score as stipulated in the Academic performance indicator (API) as per the UGC 2010 Regulations. OR An outstanding professional, with established reputation in the relevant field with significant contributions in the concerned/allied/relevant discipline, to be substantiated by credentials.

RESEARCH ASSISTANT

1. Research Assistant	First class or equivalent in Master's Degree in Management or allied subjects from an Indian University or from a Foreign University. Flair for research is highly desirable.

LIBRARIAN

1. Librarian	B.Lib/M.Lib degree(s) preferably with 2 yrs. of working experience in a computerized Library & well versed in English language.

II. EMOLUMENTS

Designation	Pay Scale	Other Admissible Allowances
Assistant Professor	Rs.15,600-39,100 AGP 6,000	Other allowances and benefits as per norms
Associate Professor	Rs.37,400-67,000 AGP 9,000	
Professor	Rs.37,400-67,000 AGP 10,000 (Minimum Basic Rs.43,000)	
Research Assistant/Librarian	As per Norms	

III OTHER REQUIREMENTS

- Candidates who have cleared NET or having Industry experience will be preferred for the position of Assistant Professor in MBA.
- Recently retired persons with Phds may also apply.
- Application has to be in the prescribed form. Applications not in the prescribed form or having incomplete details are likely to be rejected.
- Duly filled in application form can either be submitted online or in person at the Institute's address mentioned above.
- Command over English Language and Computer Skill is essential.

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