Neutrosophic Sets and Systems

Volume 35 Article 7

7-7-2020

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Neutrosophic Sets and Systems, Vol. 35, 2020
University of New Mexico

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ABSTRACT:

Social media is a new observable fact in computer-based technology and neutrosophic theory. Researchers are now thinking of the power of social media in banks as it is the fastest expanding online noticeable fact and banks with poor presence in social media are facing identity crisis under uncertainty fields. Through social media we can share ideas and information through establishing virtual networks. Initially it was evident that people used it for personal interaction with friends and relatives but with changing time it is established that business houses and financial institutions including Banks are using this popular technology to reach out to the prospective customers. Especially in the banking industry digital communication is becoming most popular and powerful as here consumers' interface is obligatory. Online communication has become a powerful medium between banks and consumers. The power of social media is to connect and share information with people across globe. Social Media in Indian Bank is not only a medium of advertising but it also helps the Banks to be a part of their customers' life as this relation involves conversation beyond business under neutrosophic environment. The aim of this study is to find out the best social media as per users' preference and explore its impact on Banks' business in pentagonal neutrosophic (PNN) arena by increasing customer satisfaction and augment customer relationship management in banking industry.

Keywords: Social Media, Customer Relationship Management, Customer satisfaction, Banking Industry, PNN.

1. INTRODUCTION

1.1 Social Media:

The traditional marketing media consisting of radio, print, television etc offered a shotgun approach as they represent communication in One to Many modes which we may call as Passive Approach. However Social media marketing is following Many to Many mode, may be called Active Approach with the power of implementation of Word Of Mouth. They are interactive in nature and believe in peer to peer relationship [1] (Githa Heggde, 2018)

The substantial and considerable use of social media for last few years has elucidated that it is amongst a few powerful weapons that has shown tremendous impacts on social life of human beings and has hastened the mingling of people with each other. Previously, it was an encumbrance for us to keep ourselves in touch with all those who were a little distant from us. Things have apparently changed and social networking sites can take every credit for this prodigious platform which enabled people to create their own identity. Whether it is about uploading personal posts, surfing across the globe, getting all the indispensable information or even if one wants to express their cavernous feelings then social media can act as a gullible platform for everyone. At times a few of our problematic situations, disturbing sentiments need to get some succor and support by our loved ones. At times only a single post of ours explains everything about what we are actually feeling. Social media and its comprehensive enhancement is undeniable reality in this modern era. Verily speaking social networking sites has made our socialization a bit easier with the rest of the world. Data and statistics distinctly show the massive use of social media. Social Media has grown tremendously due to increase in penetration of Internet Connectivity and easy availability of smart phones and mobile gadgets. The conventional use of social media has changed from mere entertainment to opportunities for trade and commerce. An estimate confirms that nearly two third of Internet users are active on social media as well and this number is expected to cross approx three billion by the end of 2020.

1.2 Social Media Platforms:

Social Media is a blur of likes, tweets, shares, posts and contents. It has spread its wings in every corner of the world. The numbers are staggering. 70% of the total internet users are now using social media as per the research [2] (Bullas, 2014). In a research by Pew Research, 2014 [3] (DUGGAN, 2014) , it is established that globally people are getting addicted to social media regardless of age, gender and profession.

There are a variety of technological driven services in social media like sharing of pictures, videos and audios, blogging, social games, social networking, business networks, reviews and much more. Social media consists of a variety of internet-based mediums that enable users to network, share content, interact with each other, and create communities around common interests. Social media is therefore the media that we use to be sociable online and it can be divided into three main categories:

- Messaging and communication, e,g. blogging and micro-blogging such as Twitter.
- Communities and social groups, e.g. Facebook
- Photo and video sharing, e.g. YouTube

Statistically speaking, number of people using social media has considerably increased. The number of people across globe who uses social media has extended 3 billion. As per a report Face book reported 1.871, Whatsapp a billion and Instagram 600 million active users in January 2017 due to the intensified use of social media.

1.3 Social Media in Bank:

The bank with no social media marketing strategy is at a risk of being left behind its competitors as social media is playing a big role in marketing field. The tremendous growth and popularity of this

medium is forcing banks to learn different social media platforms available to them and their customers, different strategies to be adapted for proper selection of right social media channel so as to reach out to maximum customers and improve their business. [4] (L, 2010) Banks are opting social media channels due to the following main points:

- To increase engagement with customers
- To enhance their brand image by connecting with customers
- To find out ways to distinguish themselves with competitors
- To reduce cost as implementation of social media channels are less expensive in comparison to the traditional marketing methods and with higher results
- To boost innovations as through proper market research through social media more customized products/services can be incorporated
- To increase revenue as satisfies customers result in more business which in turn brings revenue

The advancement faced by the banking sector today in the field of digitalization is an amalgamation of social media and the wise users of this powerful tool which helps innumerable people in their everyday work. With the help of digital feed people can access different social media sites like Face book, Twitter, YouTube, Instagram etc to expand required knowledge about different products and services offered by banks.

Many people opined that the new generations with proper knowledge of digital technologies are more prone to use of social media but our response rate of seniors above 50 years was good. It was observed that this number is gradually on the rise. Customers are an integral part of Banking Industry and social media is an easiest and fastest way to reach to existing and prospective customers. All the leading banks worldwide are trying to create business opportunities through enhancing their creativity and innovative capacities. Through social media Banks can inform their customers about their product & services offered in a most unique, attractive and innovative way. It also helps the customers to consider sensibly about their investments and eradicate all the complexity involved with the traditional banking processes. Traditional banks focused on providing services to customers through different strategies such as advertising, direct mail or face to face whereas banks and other financial institutions' is focusing on establishing relations with customers through continue digital interaction vide different social media channels. By this continuous interaction through social media Banks can discover customers' interests, feelings and behavior. Customers of today look ahead to personalized services and they need to be heard and answered promptly. Banks may fulfill their expectations through different digital media platforms like face book, twitter and you tube instead of face to face interactions between customers and managers. Bank's Monitoring centers may follow comments, posts and tweets on social Medias which can give a broad standpoint of customer insight about products and services banks can achieve an accurate perceptive of customers. Today Banks need to have an effective presence in social media due to the customers' anticipation and their obsession for the same.

Now a day social media has become crucial tool for banks. Banks are using the platform to discover and keep up the relation with customers, motivating sales through advertisement and sales

endorsement, guess change in consumer behavior and follow their trends and finally providing customized services and support. Social media also helps in building customer relationships through its reliability programs. It is an emerging concept in marketing especially in relation to Banking Industry. Banks have now realized the influence of this medium over traditional form of marketing strategy as it is the fastest growing online trend. Its influence has increased to the power that the Banks with no social media connections are at a risk of being left out from competitors.

1.4 Survey of Uncertainty & Neutrosophic Theory:

In this current epoch, vagueness theory plays a vital position in social sciences and management fields. Initially, it was discovered by prof. L.A Zadeh [5] & further, advancement of triangular [6], trapezoidal [7], pentagonal [8], hexagonal [9], heptagonal [10] fuzzy number are established by distinct researchers. It was extended by Prof. Attasonov [11] incorporating the idea of intuitionistic fuzzy & further by Prof. Smarandache [12] discovering the concept of neutrosophic set. Nowadays, researchers from distinct area are specializing in neutrosophic idea and advanced lots of exciting articles in this domain. Recently, categorization of triangular [13], trapezoidal [14], pentagonal [15-18] neutrosophic numbers has been developed by Chakraborty et.al. Recently, some MCGDM based articles [19-23] are established in this neutrosophic arena which plays an essential impact in this research domain.

2. Literature Review and Preliminaries:

This study focuses on identifying the services provided by banks through social media and measuring its effect on customer satisfaction. The study also tries to find out the ways through which Bank support the customers with the help of social media and the problems faced by the customers to approach banks through social media.

Different customer services that can be provided by banks are;

- Sharing of financial offers and upcoming promotions
- Posting of education information and financial guidance
- Allow clients to post reviews, complaints and suggestions
- Reward them for recommending them

These virtual services are giving same level of personal interaction which was normally found in physical banking as well but the advantage is that clients need not physically visit the banks. The bank provides different services like Corporate banking, Investment banking, Asset Management, Treasury services, Retail Banking etc. With the growth of information technology and advent of Internet now banks are also using online banking. Internet banking is a convenient virtual banking activity that is available for all the customers of the banks with easy and secured access to their accounts. [2] Justified that now a day's social media is being regularly accessed by almost 72% of the internet users. Social Media helps the customers in providing utmost customer satisfaction through obtaining real time comments, suggestions, complaints and addressing them instantly.

2.1 Safety & Reliability as Social Media Attribute:

Users' Safety & Reliability is an important tool in consideration of social media channels. Data should be handled without breaching the users' privacy and data protection should be enormously scrutinized. The most grounded measure that needs to be taken is to make undaunted quality of one's privacy whoever has affiliated with the social media channel [24] (Senthil Kumar N*, 2016). Many a time's users' share their personal data intentionally and sometimes unknowingly. Often data are extracted from them extrinsically by offering them some payback , for e.g, Location-Based Social Network Services (LBSNS) like Google Latitude can trace the location of a person and his/her friends [25] (Paul Lowry, 2011).

According to the safety analytics viewpoint, many people supervise the benefits and threats associated while unveiling their credentials. It is often observed that customers are ready to forego some privacy for a satisfactory range of danger. But reliability may be attacked significantly if personal information is not utilized rationally and unvaryingly [26] (Patrick Van Eecke, 2010). Proper implementation of security settings may improvise the Safety & Reliability of users' data as per their will [27] (Gail-Joon Ahn, 2011). Hence the quality of services provided by the social media platforms, in terms of Safety & Reliability becomes an important criterion for its selection.

2.2 Responsiveness & Effectiveness as Social Media Attribute:

Responsiveness and Effectiveness of a social media site is measured by the internet speed, expediency, response time etc with which customers access and use bank's social media sites. [28]

(Frederic Marimon, 2012). Efficiency of a bank's social media is observed by timely and convenient completion of all required interaction [29] (Chung Tin Fah, 2012). Social media can enhance the conventional personnel–client bonding with an effective technological knowledge-based relationship [30] (Rahimi & Me, 2016) .

Prompt responses can effectively be done in social media by providing customers relevant and quick information as & when required. It is surely required for enhancement of quick responses to customers' queries for the improvement of e-services and improved customer satisfaction [31] (Chinedu-Okeke & Obi, 2016). Banks can provide unique banking experience to their clients by giving them services combined with technology [32] (Kalia, 2013). Banks may respond to its customers' query effectively through its social media sites but it needs to carefully monitor its personnel's' response on social media sites to assess effectiveness of its response.

2.3 Ease of Use & Customer's Satisfaction as Social Media Attribute:

Social media platform should fulfill the customers' requirement and should be easy to be used with minimum response time. Customers generally choose the media which is easy to operate. By ease of use it means the service reliability and methods to use relevant information provided on a bank's social media websites [33] (Emel Kursunluoglu, 2015). Customers need punctual response for acknowledgement of their complaints. The satisfaction dimension concentrates on evaluating the banks promptness in responding to customers' requirements [34] (Ajimon George, 2013). For getting customer loyalty the banks create user generated customized content for getting the customers' satisfaction dimension [35] (Norman Gwangwava, 2014). Customer's confidence on Bank's social media platform to the extent their requirements are satisfied is termed as fulfillment or satisfaction. Recently, several articles are established [36-40] in this research arena which plays an essential role in research domain.

Definition 2.4: Neutrosophic Set: A set $\widetilde{neuS}$ in the universal discourse X, symbolically denoted by x, it is called a neutrosophic set if $\widetilde{neuS} = \{\langle x; [T_{\widetilde{neuS}}(x), I_{\widetilde{neuS}}(x), \mathrm{F}_{\widetilde{neuS}}(x)]\rangle : x \in X\}$, where $T_{\widetilde{neuS}}(x): X \to]-0,1+[$ is said to be the true membership function, which has the degree of belongingness, $I_{\widetilde{neuS}}(x): X \to]-0,1+[$ is said to be the indeterminacy membership, having degree of uncertainty, and $F_{\widetilde{neuS}}(x): X \to]-0,1+[$ is said to be the incorrect membership, which has the degree of non-belongingness of the decision maker. $T_{\widetilde{neuS}}(x), I_{\widetilde{neuS}}(x) \& F_{\widetilde{neuS}}(x)$ exhibits the following relation:

$$-0 \leq Sup\{T_{\widetilde{neuS}}(x)\} + Sup\{I_{\widetilde{neuS}}(x)\} + Sup\{F_{\widetilde{neuS}}(x)\} \leq 3+.$$

Definition 2.5: Single Typed Neutrosophic Number: Single Typed Neutrosophic Number$(\tilde{n})$is denoted as $\tilde{n} = \langle[(u^1, v^1, w^1, x^1); \alpha], [(u^2, v^2, w^2, x^2); \beta], [(u^3, v^3, w^3, x^3); \gamma]\rangle$ where $\alpha, \beta, \gamma \in [0,1]$, where $(\varphi_{\tilde{n}}): \mathbb{R} \to [0, \alpha]$, $(\gamma_{\tilde{n}}): \mathbb{R} \to [\beta, 1]$ and $(\delta_{\tilde{n}}): \mathbb{R} \to [\gamma, 1]$ is given as:

$$\varphi_{\tilde{n}}(\in) = \begin{cases} \in_{\widetilde{nl}}(\in) u^1 \leq \in \leq v^1 \\ \alpha \quad v^1 \leq \in \leq w^1 \\ \in_{\widetilde{nu}}(\in) w^1 \leq \in \leq x^1 \\ 0 \quad otherwise \end{cases}, \pounds_{\tilde{n}}(\in) = \begin{cases} \gamma_{\widetilde{nl}}(\in) u^2 \leq \in \leq v^2 \\ \beta \quad v^2 \leq \in \leq w^2 \\ \gamma_{\widetilde{nu}}(\in) w^2 \leq \in \leq x^{2'} \\ 1 \quad otherwise \end{cases}$$

$$\delta_{\tilde{n}}(\in) = \begin{cases} \mu_{\widetilde{nl}}(\in) u^3 \leq \in \leq v^3 \\ \gamma \quad v^3 \leq \in \leq w^3 \\ \mu_{\widetilde{nu}}(\in) w^3 \leq \in \leq x^3 \\ 1 \quad otherwise \end{cases}$$

2.6 Definition: Single-Valued Pentagonal Neutrosophic Number: A Single-Valued Pentagonal Neutrosophic Number $(\tilde{S})$ is defined

as$\tilde{s} = \langle[(m^1, n^1, o^1, p^1, q^1); \pi], [(m^2, n^2, o^2, p^2, q^2); \rho], [(m^3, n^3, o^3, p^3, q^3); \sigma]\rangle$,

where $\pi, \rho, \sigma \in [0,1]$. The accuracy membership function$(\tau_{\tilde{s}}): R \to [0, \pi]$, the indeterminacy membership function $(\iota_{\tilde{s}}): R \to [\rho, 1]$ and the falsity membership function $(\varepsilon_{\tilde{s}}): R \to [\sigma, 1]$ are given as:

$$\tau_{\tilde{s}}(x) = \begin{cases} \tau_{\widetilde{sl1}}(x) m^1 \leq x < n^1 \\ \tau_{\widetilde{sl2}}(x) n^1 \leq x < o^1 \\ \mu \quad x = o^1 \\ \tau_{\widetilde{sr2}}(x) o^1 \leq x < p^1 \\ \tau_{\widetilde{sr1}}(x) p^1 \leq x < q^1 \\ 0 \quad O.W \end{cases}, \quad \iota_{\tilde{s}}(x) = \begin{cases} l_{\widetilde{sl1}}(x) m^2 \leq x < n^2 \\ l_{\widetilde{sl2}}(x) n^2 \leq x < o^2 \\ \vartheta \quad x = o^2 \\ l_{\widetilde{sr2}}(x) o^2 \leq x < p^2 \\ l_{\widetilde{sr1}}(x) p^2 \leq x < q^2 \\ 1 \quad O.W \end{cases}$$

$$\varepsilon_{\tilde{s}}(x) = \begin{cases} \varepsilon_{\widetilde{sl1}}(x) m^3 \leq x < n^3 \\ \varepsilon_{\widetilde{sl2}}(x) n^3 \leq x < o^3 \\ \vartheta \quad x = o^3 \\ \varepsilon_{\widetilde{sr2}}(x) o^3 \leq x < p^3 \\ \varepsilon_{\widetilde{sr1}}(x) p^3 \leq x < q^3 \\ 1 \quad O.W \end{cases}$$

2.7 Proposed Score Function:

Score function of a PNN completely depends on the value of truth, falsity and hesitation membership indicator degree. The necessity of score function is to draw comparison or transfer a PNN into a crisp number. In this section we will generate a score function as follows. For any Pentagonal Single typed Neutrosophic Number (PSNN)

$\tilde{A}_{Pt} = (s_1, s_2, s_3, s_4, s_5; \pi, \mu, \sigma)$

We define the score function as $S_{Pt} = \frac{1}{15}(s_1 + s_2 + s_3 + s_4 + s_5) \times (2 + \pi - \sigma - \mu)$

2.7.1 Relationship between any two pentagonal neutrosophic fuzzy numbers:

Let us consider any two pentagonal neutrosophic fuzzy number defined as follows

$A_{Pt1} = (\pi_{Pt1}, \mu_{Pt1}, \sigma_{Pt1}), A_{Pt2} = (\pi_{Pt2}, \mu_{Pt2}, \sigma_{Pt2})$

1) $S_{Pt1} > S_{Pt2}, A_{Pt1} > A_{Pt2}$

2) $S_{Pt1} < S_{Pt2}, A_{Pt1} < A_{Pt2}$

3) $S_{Pt1} = S_{Pt2}, A_{Pt1} = A_{Pt2}$

2.8 Basic Operations:

Let $\widetilde{m_1} = < (m_1, m_2, m_3, m_4, m_5); \pi_{\widetilde{m_1}}, \mu_{\widetilde{m_1}}, \sigma_{\widetilde{m_1}} >$ and $\widetilde{m_2} = < (n_1, n_2, n_3, n_4, n_5); \pi_{\widetilde{n_2}}, \mu_{\widetilde{n_2}}, \sigma_{\widetilde{n_2}} >$

be two IPFNs and $\alpha \geq 0$. Then the following operational relations hold:

2.8.1 $\widetilde{m_1} + \widetilde{m_2} = < (m_1+n_1, m_2+n_2, m_3+n_3, m_4+n_4, m_5+n_5); \pi_{\widetilde{m_1}} + \pi_{\widetilde{n_2}} - \pi_{\widetilde{m_1}} \pi_{\widetilde{n_2}}, \mu_{\widetilde{m_1}} . \mu_{\widetilde{n_2}}, \sigma_{\widetilde{m_1}} . \sigma_{\widetilde{n_2}} >$

2.8.2 $\widetilde{m_1} \widetilde{m_2} = < (m_1 n_1, m_2 n_2, m_3 n_3, m_4 n_4, m_5 n_5); \pi_{\widetilde{m_1}} \pi_{\widetilde{n_2}}, \mu_{\widetilde{m_1}} + \mu_{\widetilde{n_2}} - \mu_{\widetilde{m_1}} \mu_{\widetilde{n_2}}, \sigma_{\widetilde{m_1}} + \sigma_{\widetilde{n_2}} - \sigma_{\widetilde{m_1}} \sigma_{\widetilde{n_2}} >$

2.8.3 $\alpha\widetilde{m_1} = < (\alpha m_1, \alpha m_2, \alpha m_3, \alpha m_4, \alpha m_5); 1-(1-\pi_{\widetilde{m_1}})^{\alpha}, \mu_{\widetilde{m_1}}{}^{\alpha}, \sigma_{\widetilde{m_1}}{}^{\alpha} >$

2.8.4 $\widetilde{m_1}{}^{\alpha} = < (m_1{}^{\alpha}, m_2{}^{\alpha}, m_3{}^{\alpha}, m_4{}^{\alpha}, m_5{}^{\alpha}); \pi_{\widetilde{m_1}}{}^{\alpha}, (1-\mu_{\widetilde{m_1}})^{\alpha}, (1-\sigma_{\widetilde{m_1}})^{\alpha} >$

3. OBJECTIVE OF THE STUDY:

- To understand the factors affecting acceptance of Social Media Banking Technology across Gender.
- To understand the best suitable social media channel for Banking Industry as per customers' preference.

4. RESEARCH METHODOLOGY

The data have been collected from various respondents working in different organizations categorized mainly as education sector, service sectors as banks, hospitals, etc. engineering works and Government and Public sector companies in the Kolkata metro area. The study consisted of 94 respondents. A five point Likert scale is used where 5 indicates strongly agree, and 1 indicates strongly disagree. 40.43% respondents are female and 59.57% are male. Age wise respondents below the age <25 was 29.79 %, between 25 – 45 yrs was 52.13%, and >45 yrs was 18.08%

Research Instrument*:* The questinnaire is mainly focussed on: Social Media platforms used by the banks and users adaptability of the same.

TABLE 4.1 DEMOGRAPPHIC DETAILS OF RESPONDENTS

CHARACTERISTICS		FREQUENCY	%
GENDER	MALE	56	59.57
	FEMALE	38	40.43
AGE	<25	28	29.79
	25-45	49	52.13
	>45	17	18.08

SOURCE: QUESTIONNAIRE

Table 4.2 Indicate acceptance of Online Banking Technology across Gender																
GENDER	**ATTRIBUTES**	**Safety & Reliability**					**Responsiveness & Effectiveness**					**Ease of Use & Customer's Satisfaction**				
		SD	**D**	**N**	**A**	**SA**	**SD**	**D**	**N**	**A**	**SA**	**SD**	**D**	**N**	**A**	**SA**
M	**TWITTER**	5	20	28	34	7	3	18	39	28	6	6	24	29	29	6
		5.32	21.28	29.79	36.17	7.45	3.19	19.15	41.49	29.79	6.38	6.38	25.53	30.85	30.85	6.38
	FACEBOOK	3	24	26	30	11	5	19	45	20	5	4	22	39	20	9
		3.19	25.53	27.66	31.91	11.70	5.32	20.21	47.87	21.28	5.32	4.26	23.40	41.49	21.28	9.57
	YOU TUBE	5	18	23	39	9	7	15	42	26	4	5	22	29	31	7
		5.32	19.15	24.47	41.49	9.57	7.45	15.96	44.68	27.66	4.26	5.32	23.40	30.85	32.98	7.45
F	**TWITTER**	9	31	26	24	4	9	21	44	16	4	3	26	38	21	6
		9.57	32.98	27.66	25.53	4.26	9.57	22.34	46.81	17.02	4.26	3.19	27.66	40.43	22.34	6.38
	FACEBOOK	8	23	22	34	7	5	19	34	30	6	6	21	34	25	8
		8.51	24.47	23.40	36.17	7.45	5.32	20.21	36.17	31.91	6.38	6.38	22.34	36.17	26.60	8.51
	YOU TUBE	7	32	20	29	6	4	30	31	24	5	7	27	28	25	7
		7.45	34.04	21.28	30.85	6.38	4.26	31.91	32.98	25.53	5.32	7.45	28.72	29.79	26.60	7.45

Table 4.3 Indicate acceptance of Social Media in Online Banking Technology across Age Gap				
GENDER	**ATTRIBUTES**	**Safety & Reliability**	**Responsiveness & Effectiveness**	**Ease of Use & Customer's Satisfaction**
<25	**TWITTER**	16	6	6
		57.14	21.43	21.43
	FACEBOOK	16	7	5
		57.14	25.00	17.86
	YOU TUBE	17	5	6
		60.71	17.86	21.43
25-45	**TWITTER**	29	11	8
		59.18	22.45	16.33
	FACEBOOK	29	14	6

		59.18	28.57	12.24
	YOU TUBE	31	12	8
		63.27	24.49	16.33
>45	TWITTER	9	5	3
		52.94	29.41	17.65
	FACEBOOK	8	4	5
		47.06	23.53	29.41
	YOU TUBE	10	4	3
		58.82	23.53	17.65

5. Multi-Criteria Group Decision Making Problem in Pentagonal Neutrosophic Environment

In this current decade, researchers are very much interested in doing MCGDM problem in different fields. Its main goal of this problem is to find out the best option among finite number of different options in presence of distinct attributes, different decision maker's choice and hesitation in human thinking.

5.1 Illustration of the MCGDM problem

Let $G = \{ G_1, G_2, G_3 \dots \dots \dots \dots G_m \}$ is the distinct alternative set and $H = \{ H_1, H_2, H_3 \dots \dots \dots \dots H_n \}$ is the distinct attribute set respectively. Let $\omega = \{ \omega_1, \omega_2, \omega_3 \dots \dots \dots \dots \omega_n \}$ be the weight set associated with the decision maker $D = \{ D_1, D_2, D_3 \dots \dots \dots \dots D_K \}$ and each $\omega \geq 0$ and also satisfies the relation $\sum_{i=1}^{n} \omega_i = 1$. Also, weight vector of the attribute function is defined as $\delta = \{\delta_1, \delta_2, \delta_3 \dots \dots \dots \dots \delta_k\}$ where each $\delta_i \geq 0$ and also satisfies the relation $\sum_{i=1}^{k} \delta_i = 1$.

5.2 Normalisation Algorithm of MCGDM Problem:

Step 1: Framework of Decision Matrices

Here, we considered all decision matrices according to the decision maker's choice related with finite alternatives and finite attribute functions. It is noted that the member's y_{ij} for each matrices are of triangular fuzzy numbers. Thus, the final matrix is defined as follows:

$$X^K = \begin{pmatrix} . & R_1 & R_2 & R_3 & . & . & . & R_n \\ P_1 & y_{11}^k & y_{12}^k & y_{13}^k & . & .. & . & y_{1n}^k \\ P_2 & y_{21}^k & y_{22}^k & y_{23}^k & . & . & . & y_{2n}^k \\ P_3 & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ P_m & y_{m1}^k & y_{m2}^k & y_{m3}^k & . & . & . & y_{mn}^k \end{pmatrix} \text{.....(4.1)}$$

Step 2: Framework of Standardized Decision matrix

We consider the following skill of normalization to obtain the standardized decision matrix where $V^*=(\bar{y}_{ij})_{mn}$ in which the entity $\bar{y}_{ij} = ([\bar{y}_{ij}^1, \bar{y}_{ij}^2, \bar{y}_{ij}^3, \bar{y}_{ij}^4, \bar{y}_{ij}^5]; \bar{T}_{pt}, \bar{I}_{pt}, \bar{F}_{pt})$ is formulated as $\bar{Y}_{ij} = ([\frac{y_{ij}^1}{S}, \frac{y_{ij}^2}{S}, \frac{y_{ij}^3}{S}, \frac{y_{ij}^4}{S}, \frac{y_{ij}^5}{S}]; T_{pt}, I_{pt}, F_{pt})$ where $S= \sqrt{y_{ij}^{1\,2} + y_{ij}^{2\,2} + y_{ij}^{3\,2} + y_{ij}^{4\,2} + y_{ij}^{5\,2}}$.

Hence the new matrix becomes,

$$M^K = \begin{pmatrix} . & R_1 & R_2 & R_3 & . & . & . & R_n \\ P_1 & Y_{11}^k & Y_{12}^k & Y_{13}^k & . & .. & . & Y_{1n}^k \\ P_2 & Y_{21}^k & Y_{22}^k & Y_{23}^k & . & . & . & Y_{2n}^k \\ P_3 & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ P_m & Y_{m1}^k & Y_{m2}^k & Y_{m3}^k & . & . & . & Y_{mn}^k \end{pmatrix} \text{.....(5.2)}$$

Step 3: Framework of Single Decision matrix

To formulate a single group decision matrix M we utilized these logical operations of PNN [2.8] $S_{ij}^{'} = \{\sum_{i=1}^k \omega_i M^i\} where\ \omega_i$ are the weights of the decision makers for individual decision matrix M^i. So, the matrix becomes as follows:

$$M = \begin{pmatrix} . & R_1 & R_2 & R_3 & . & . & . & R_n \\ P_1 & S_{11}^{'} & S_{12}^{'} & S_{13}^{'} & . & .. & . & S_{1n}^{'} \\ P_2 & S_{21}^{'} & S_{22}^{'} & S_{23}^{'} & . & . & . & S_{2n}^{'} \\ P_3 & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ P_m & S_{m1}^{'} & S_{m2}^{'} & S_{m3}^{'} & . & . & . & S_{mn}^{'} \end{pmatrix} \text{..... (5.3)}$$

Step 4: Framework of Final matrix

To make the final decision matrix we used the logical operation [2.8] for different weights of the attribute values and also finally operated $R_1^{'} = R_1 + R_2 + \cdots + R_n$ and converted the total matrix into a Colum matrix form, finally we get the decision matrix as,

$$M = \begin{pmatrix} . & R_1 \\ P_1 & S''_{11} \\ P_2 & S''_{21} \\ . & . \\ P_m & S''_{m1} \end{pmatrix} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.4)$$

Step 5: Ranking

Now, by considering the Score value (2.7) and converting the matrix (5.3) into crisp form, so that we could evaluate the best alternative corresponding to the best attributes.

5.3 Flowchart:

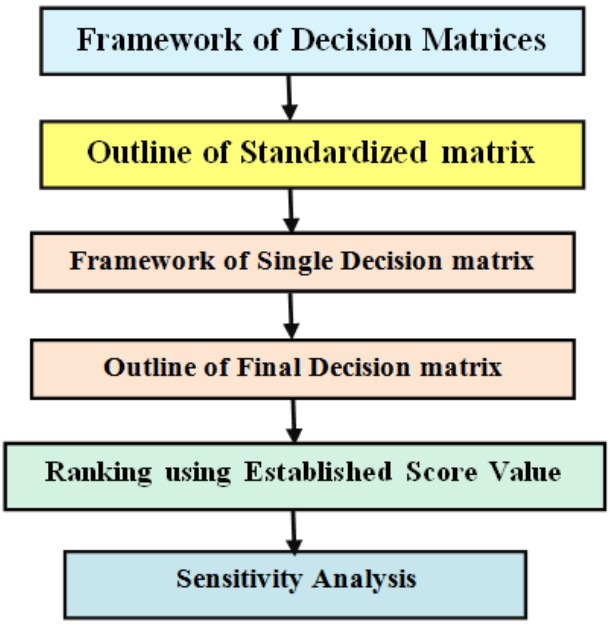

Figure 5.3.1: Flowchart for the problem

5.4 Illustrative Example: Here, we constructed a social media selection problem based on the questionnaire table from which we have three different social medias are available. The problem is to find out the best social media platform among these after computing the decision maker's opinion and maintain the attribute weights properly for this problem. Generally, social media platforms are related with the attributes like safety & reliability, Responsiveness & Effectiveness, Ease of Use & Customer's Satisfaction of the system. Keeping these points in mind decision maker's (Male/Female) gives their opinion in hesitation arena and using verbal phrase we set the problem in pentagonal neutrosophic domain. According to their suggestions we constructed the distinct decision matrices in PNN environment as shows below:

$G_1 = Twitter, G_2 = Facebook, G_3 = Youtube$ are the alternatives.

$$H_1 = Safety\ \&\ Reliability,$$

$$H_2 = Responsiveness\ \&\ Effectivness\ ,$$

$H_3 = Ease\ of\ Use\ \&\ Customer's\ Satisfaction$ are the attributes.

According to our problem there are two distinct decision makers are available in our environment, $D_1 = Male's Opinion,\ D_2 = Female's\ Opinion$ having weight distribution $D = \{0.55, 0.45\}$ and the weight vector related with the attribute function $\delta = \{0.32, 0.30, 0.38\}$.

5.5 List of Verbal Phrase

No.	Quantitative Attributes	Verbal phrase
1	$Safety\ \&\ Reliability$	Strongly Agree (SA), Agree(A), Neutral(N), Disagree(D), Strongly Disagree (SD)
2	$Responsiveness\ \&\ Effectivness$	Strongly Agree (SA), Agree(A), Neutral(N), Disagree(D), Strongly Disagree (SD)
3	$Ease\ of\ Use\ \&\ Customer's\ Satisfaction$	Strongly Agree (SA), Agree(A), Neutral(N), Disagree(D), Strongly Disagree (SD)

Step 1

According to the decision maker's opinion from the questionnaire table we constructed the decision matrices are as follows:

$$D^1 = \begin{pmatrix} \cdot & H_1 & H_2 & H_3 \\ G_1 & <5.3, 7.4, 21.3, 29.8, 36.2; 0.6, 0.7, 0.6> & <3.2, 6.38, 19.1, 29.8, 41.5; 0.7, 0.5, 0.7> & <6.3, 6.4, 25.5, 30.8, 31.0; 0.7, 0.4, 0.5> \\ G_2 & <3.2, 11.7, 25.5, 27.7, 31.9; 0.7, 0.6, 0.7> & <5.3, 5.35, 20.2, 21.3; 0.8, 0.6, 0.7> & <4.3, 9.8, 21.9, 23.4, 41.5; 0.6, 0.7, 0.4> \\ G_3 & <5.3, 9.6, 19.2, 24.5, 41.8; 0.8, 0.3, 0.6> & <4.3, 7.5, 15.9, 27.7, 44.7; 0.7, 0.4, 0.6> & <5.3, 7.5, 23.4, 30.8, 32.9; 0.7, 0.3, 0.5> \end{pmatrix}$$

$Male's\ opinion$

$$D^2 = \begin{pmatrix} \cdot & H_1 & H_2 & H_3 \\ G_1 & <4.26, 9.58, 25.5, 27.7, 32.9; 0.6, 0.7, 0.5> & <4.3, 9.6, 17.1, 22.3, 46.8; 0.7, 0.8, 0.3> & <3.2, 6.4, 22.3, 27.7, 40.4; 0.3, 0.5, 0.6> \\ G_2 & <7.45, 8.5, 23.4, 24.5, 36.2; 0.6, 0.5, 0.4> & <5.3, 6.4, 20.2, 31.9, 36.2; 0.6, 0.5, 0.3> & <6.4, 8.5, 22.4, 26.6, 36.2; 0.8, 0.8, 0.4> \\ G_3 & <6.38, 7.45, 21.28, 30.8, 34.1; 0.7, 0.5, 0.7> & <4.3, 5.3, 25.5, 31.9, 33.0; 0.8, 0.6, 0.7> & <7.4, 7.6, 26.6, 28.8, 29.8; 0.5, 0.7, 0.6> \end{pmatrix}$$

$Female's\ Opinion$

Step 2: Framework of Standardized decision matrix

$$D^1 = \begin{pmatrix} \cdot & H_1 & H_2 & H_3 \\ G_1 & <0.10,0.141,0.407,0.57,0.692;0.6,0.7,0.6,> & <0.058,0.116,0.347,0.542,0.754;0.7,0.5,0.7> & <0.123,0.124,0.496,0.599,0.608;0.7,0.4,0.5> \\ G_2 & <0.063,0.023,0.502,0.545,0.628;0.7,0.6,0.7> & <0.096,0.098,0.368,0.459,0.798;0.8,0.6,0.7> & <0.080,0.183,0.409,0.437,0.776;0.6,0.7,0.4> \\ G_3 & <0.099,0.18,0.36,0.46,0.785;0.8,0.3,0.6> & <0.077,0.135,0.286,0.498,0.804;0.7,0.4,0.6> & <0.102,0.146,0.454,0.598,0.639;0.7,0.3,0.5> \end{pmatrix}$$

Male's opinion

$$D^2 = \begin{pmatrix} \cdot & H_1 & H_2 & H_3 \\ G_1 & <0.083,0.188,0.499,0.542,0.644;0.6,0.7,0.5> & <0.077,0.173,0.308,0.401,0.842;0.7,0.8,0.3> & <0.058,0.118,0.411,0.51,0.744;0.3,0.5,0.6> \\ G_2 & <0.146,0.167,0.459,0.48,0.709;0.6,0.5,0.4> & <0.1,0.121,0.381,0.602,0.683;0.6,0.5,0.3> & <0.125,0.166,0.437,0.518,0.705;0.8,0.8,0.4> \\ G_3 & <0.124,0.144,0.412,0.597,0.661;0.7,0.5,0.7> & <0.081,0.1,0.481,0.602,0.623;0.8,0.6,0.7> & <0.147,0.151,0.528,0.571,0.591;0.5,0.7,0.6> \end{pmatrix}$$

Female's Opinion

Step 3: Framework of weighted Single Decision matrix

$$D^1 = \begin{pmatrix} \cdot & H_1 & H_2 & H_3 \\ G_1 & <0.0923,0.1621,0.448,0.557,0.670;0.6,0.7,0.5> & <0.0665,0.1416,0.3294,0.4785,0.794;0.7,0.5,0.3> & <0.0937,0.1213,0.4577,0.559,0.669;0.7,0.4,0.5> \\ G_2 & <0.101,0.0878,0.483,0.5157,0.664;0.7,0.5,0.4> & <0.0978,0.1083,0.3738,0.523,0.746;0.8,0.6,0.7> & <0.10025,0.1753,0.4216,0.4734,0.744;0.6,0.7,0.4> \\ G_3 & <0.1103,0.1638,0.3834,0.52165,0.7292;0.8,0.3,0.6> & <0.0788,0.11923,0.3737,0.5448,0.722;0.7,0.4,0.6> & <0.122,0.148,0.487,0.586,0.617;0.7,0.3,0.5> \end{pmatrix}$$

Step 4: Framework of Final Single Decision matrix

$$M = \begin{pmatrix} <1.2974,1.559,2.184,2.376,2.597;0.65,0.52,0.43> \\ <1.392,1.476,2.212,2.336,2.609;0.69,0.39,0.43> \\ <1.406,1.564,2.188,2.386,2.574;0.62,0.54,0.46> \end{pmatrix}$$

Step 4: Ranking

Now, we consider the established Score function (2.7), to convert the pentagonal neutrosophic numbers into crisp one, thus we get the final ideal decision matrix as

$$M = \begin{pmatrix} <1.135> \\ <1.249> \\ <1.093> \end{pmatrix}$$

Thus, ranking of the social media service is as $G_2 > G_1 > G_3$.

5.6 Results and Sensitivity Analysis

To understand how the attribute weights of each criterion affecting the relative matrix and their ranking a sensitivity analysis is done. The below table is the evaluation table which shows the sensitivity results.

Decision Maker's Weight	Final Decision Matrix	Ordering
$\langle(0.55,0.45)\rangle$	$\begin{pmatrix} < 1.135 > \\ < 1.249 > \\ < 1.093 > \end{pmatrix}$	$G_2 > G_1 > G_3$
$\langle(0.45,0.55)\rangle$	$\begin{pmatrix} < 1.024 > \\ < 1.132 > \\ < 1.048 > \end{pmatrix}$	$G_2 > G_3 > G_1$
$\langle(0.48,0.52)\rangle$	$\begin{pmatrix} < 1.035 > \\ < 1.185 > \\ < 1.042 > \end{pmatrix}$	$G_2 > G_3 > G_1$
$\langle(0.52,0.48)\rangle$	$\begin{pmatrix} < 1.078 > \\ < 1.202 > \\ < 1.044 > \end{pmatrix}$	$G_2 > G_1 > G_3$
$\langle(0.5,0.5)\rangle$	$\begin{pmatrix} < 1.062 > \\ < 1.195 > \\ < 1.046 > \end{pmatrix}$	$G_2 > G_1 > G_3$

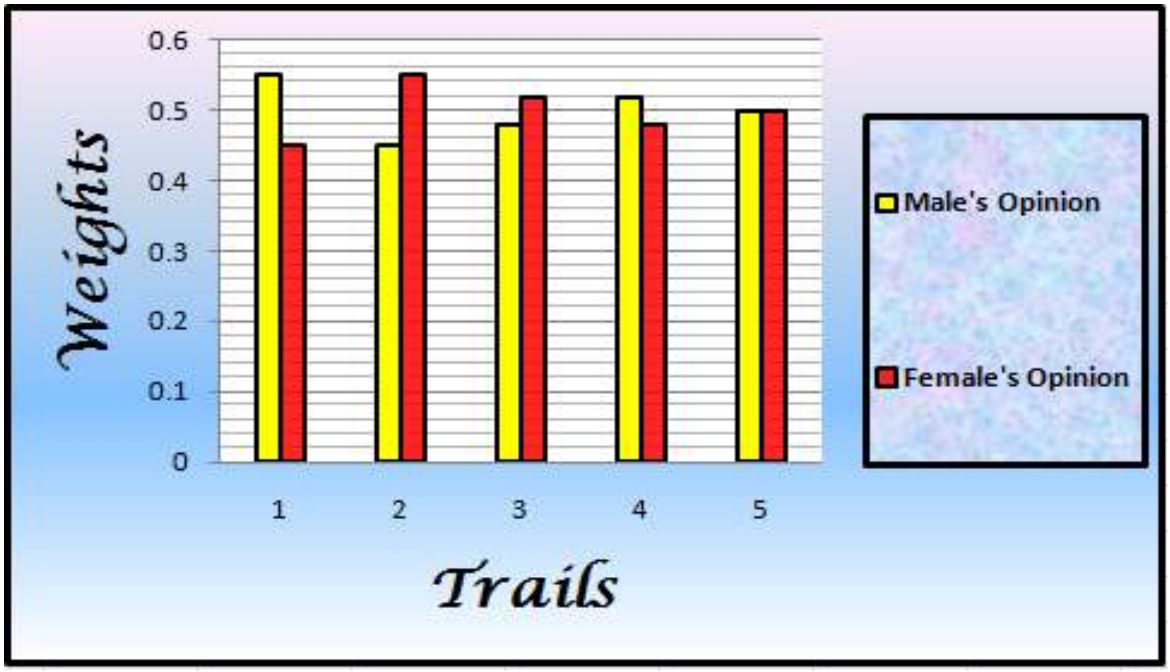

Figure 5.6.1: Sensitivity analysis table on Decision Maker's Weight.

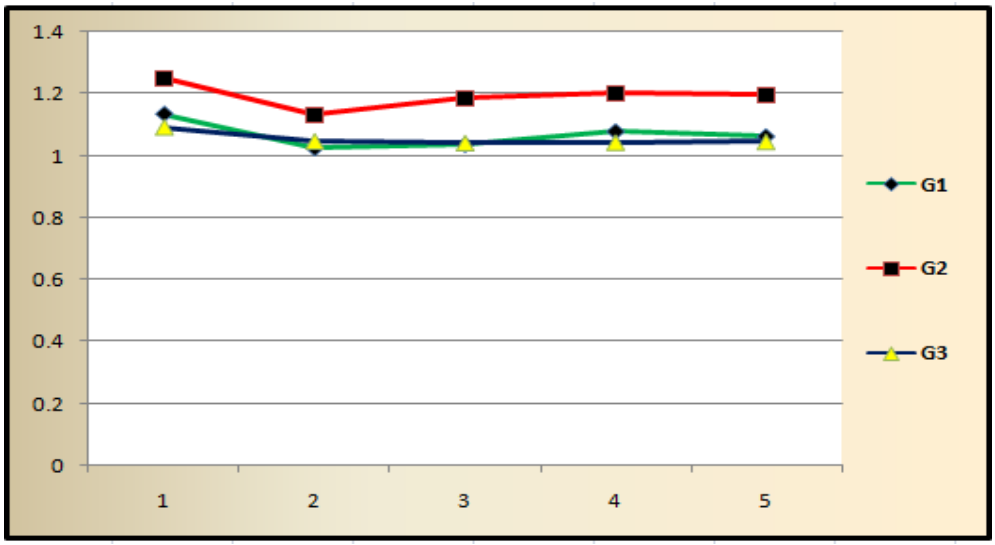

Figure 5.6.2: Best Alternative Social Media Service Table

5.7 Comparison Table

We compared this proposed work with the established works proposed by the researchers to find the best social media and it is noticed that in each cases the alternative G_2 becomes the best social media service. The comparative table given as follows:

Approach	***Ranking***
(Chakraborty et al.) [18]	$G_2 > G_1 > G_3$
(Biswas et al.) [41]	$G_2 > G_3 > G_1$
Our Proposed	$G_2 > G_1 > G_3$

6. Implication:

Different social media platforms are available for communication with customers and digital marketing like face book, twitter, Google plus, linked in, you tube etc. This study was primarily done to identify the best suited social media platform for Banking Industry especially for customers of West Bengal. We wanted to discover the right social media platform based on different attributes as desired by customers. The perception of neutrosophy plays a critical role in designing

mathematical calculations. In this research work, we set the MCGDM problem in PNN environment using the realistic data set. Applying the verbal phrases we formulate the MCGDM problem and hence applied our logical operations of PNN on it to get the best alternatives. Finally, sensitivity analysis is also performed here to which has a crucial impact in the ranking results. This novel thought will help the other researchers in doing MCGDM problem from realistic data in social media platform.

There are a lot of researches already done in social media implementation in Banking Industry. However many results are still unknown. Our work is to explore the idea in the following points:

- Defining the attributes necessary for social media platform for Banking Industry in West Bengal.
- Discovering the best suitable social media site for Banking Industry in West Bengal as per customers' preference.
- Finding the best social media site which satisfies customers and generate revenue by increasing business.
- The graphical representation of adaptation of social media platform based on its attributes.
- Covert the problem into PNN environment using verbal phrases.
- Apply proposed MCGDM method in PNN arena.
- Sensitivity analysis for Ranking in different cases.

7. Discussion

The main focus of this study was to find out the best social media platform for Banks. In total 94 respondents were asked varied questions and their choices and preferences about use of social media in banks. Three parameters focusing their requirement were fixed as Safety, Efficiency and Ease of use. The study examined different social media platform like Messaging and communication, e,g. Twitter, Communities and social groups, e.g. Face book and Photo and video sharing, e.g. YouTube. Face book was found to be most preferred channels both by the male and female considering all the three factors. However other two channels have different opinion based on different factors. In the sample considered here men respondents are more than women; most of the respondents are under 45 years of age and they frequently uses social media. Both men and women are equally boasting the use of social media however the worldwide trend also applied here as it was observed that youngsters are dominating the social media sites. Social media mainly has not only impacted the life of youngsters but it has also become drastically momentous since last ten years across all age groups. It was also observed that awareness about the use of social media for banking transactions is comparatively low in this region. It is agreed that Banks must publicize the use of social media as an important tool for banking transactions. Social media has proven to be the fastest communication mode and banks may use it for satisfying the ever increasing customized needs of its customers. The more satisfied customers would result in more improved business for banks. Moreover in the long run these satisfied customers would foster the brand loyalty and customer loyalty would further result in improved customer relationship management.

Quantification of social media quality and its effects has got very less attention in the state. It is accepted that the overall social media quality should be measured by banks to satisfy customers.

Long tern connectivity with banks will improve if the services experienced by customers are satisfactory. Better customer satisfaction in turn will bring customer loyalty. The objective of adaption of social media for banking sector is not merely for likes and shares but it goes beyond that. It is more of creating brand awareness and brand advocacy. Hence Banks should design their social media strategy focusing realistic goals.

8. Findings:

Customers basically want three things from Banks like, better and responsive services, easier way to bank and most importantly they want to be understood. Customers do not want generic ads and offers, they want products and services tailored to them and will exchange data in order to receive this. All the above is possible if the banks implement social media methodically and keep a proper follow up for the same. As of now it is the best, easier and fastest responsive way to communicate with customers. The following findings were done:

- Face book is most preferred social media medium in comparison to other options like you tube and twitter etc. considering all the three attributes
- After applying pentagonal neutrosophic numbers into crisp one, we get the final ideal decision matrix which gives the ranking of the social media as follows, Facebook>Twitter>YouTube.
- In spite of changing the weight age of attributes Face book remains the most preferred choice across gender.
- The three different attributes like Security, Efficiency and Ease of use have a strong impact on overall customers' satisfaction which resulted in selection of Bank's social media platform
- Banks profit margin would be boosted with the help of proper implementation of social media strategies. This will increase customers' base without expansion of physical branches which will result in reduction in cost..

9. Conclusions:

It may be concluded that Social Medias can greatly influence and enhance the function which is being carried out in banks. This research found out that almost big banks in the state are using social media for banking operations. On the questionnaire received from respondents the main concern or obstacle for using social media was Security and privacy issues. Almost majority preferred social media in terms of its efficiency and ease of use. Face book was found to be most acceptable mode compare to any other media across gender and age. Majority of the respondents showed positive indications for use of social media for banking operations in case of higher security. Hence we can conclude that customers are willing to accept the social media for banking operations if Banks take complete care of their security and privacy of data. Therefore for banks in West Bengal all conditions are met and it is up to the Banks' policy of achieving the highest security in order to help the customers to adapt the transactional social media. Our forecast is that transactional social media will become more acceptable and popular in banking industry in coming years.

Our future study includes more questionnaire collection and feedback received from customers and banks to analysis the functionality of transactional social media and to suggest the ways to improve the same.

Reference:

[1] Githa Heggde, G. S. (2018). *Social Media Marketing: Emerging Concepts and Applications.* Singapore: Springer Nature.

[2] Bullas, J. (2014). *Social Media facts and statistics you should know in 2014.* Springer.

[3] DUGGAN, A. L. (2014). *COUPLES, THE INTERNET, AND SOCIAL MEDIA.* America: Pew Research Centre.

[4] L, E. (2010). *Social Media Marketing, Strategies for engaging in facebook, twitter and other social media.* Que Publishing.

[5] Zadeh L.A; (1965); Fuzzy sets. Information and Control, 8(5): 338- 353.

[6] Yen, K. K.; Ghoshray, S.; Roig, G.; (1999); A linear regression model using triangular fuzzy number coefficients, fuzzy sets and system, doi: 10.1016/S0165-0114(97)00269-8.

[7] Abbasbandy, S. and Hajjari, T.; (2009); A new approach for ranking of trapezoidal fuzzy numbers; Computers and Mathematics with Applications, 57(3), 413-419.

[8] A.Chakraborty, S.P Mondal, A.Ahmadian, N.Senu, D.Dey, S.Alam, S.Salahshour; (2019); The Pentagonal Fuzzy Number: Its Different Representations, Properties, Ranking, Defuzzification and Application in Game Problem, Symmetry, Vol-11(2), 248; doi: 10.3390/sym11020248.

[9] A.Chakraborty, S. Maity, S.Jain, S.P Mondal, S.Alam; (2020); Hexagonal Fuzzy Number and its Distinctive Representation, Ranking, Defuzzification Technique and Application in Production Inventory Management Problem, Granular Computing, Springer, DOI: 10.1007/s41066-020-00212-8.

[10] S. Maity, A.Chakraborty, S.K De, S.P.Mondal, S.Alam; (2019); A comprehensive study of a backlogging EOQ model with nonlinear heptagonal dense fuzzy environment,Rairo Operations Research; DOI: 10.1051/ro/2018114.

[11] Atanassov K.;(1986); Intuitionistic fuzzy sets. Fuzzy Sets and Systems 20: 87-96.

[12] Smarandache, F. A unifying field in logics neutrosophy: neutrosophic probability, set and logic.American Research Press, Rehoboth. 1998.

[13] A.Chakraborty, S.P Mondal, A.Ahmadian, N.Senu, S.Alam and S.Salahshour; (2018); Different Forms of Triangular Neutrosophic Numbers, De-Neutrosophication Techniques, and their Applications, Symmetry, Vol-10, 327.

[14] A. Chakraborty, S. P Mondal, S.Alam, A. Mahata; (2019); Different Linear and Non-linear Form of Trapezoidal Neutrosophic Numbers, De-Neutrosophication Techniques and its Application in Time-Cost Optimization Technique, Sequencing Problem; Rairo Operations Research, doi: 10.1051/ro/2019090.

[15] A. Chakraborty, S. Broumi, P.K Singh; (2019); Some properties of Pentagonal Neutrosophic Numbers and its Applications in Transportation Problem Environment, Neutrosophic Sets and Systems, vol.28, pp.200-215.

[16] A. Chakraborty, S. Mondal, S. Broumi; (2019); De-neutrosophication technique of pentagonal neutrosophic number and application in minimal spanning tree; Neutrosophic Sets and Systems; vol. 29, pp. 1-18, doi: 10.5281/zenodo.3514383.

[17] A. Chakraborty ; (2020); A New Score Function of Pentagonal Neutrosophic Number and its Application in Networking Problem; International Journal of Neutrosophic Science; Vol-1(1), p.p-35-46.

[18] A. Chakraborty, B. Banik, S. P. Mondal and S. Alam; (2020); Arithmetic and Geometric Operators of Pentagonal Neutrosophic Number and its Application in Mobile Communication Based MCGDM Problem; Neutrosophic Sets and System, Vol 32, pp: 61-79, DOI: 10.5281/zenodo.3723145.

[19] A. Mahata, S.P Mondal , S. Alam, A. Chakraborty, A. Goswami, S. Dey; (2018); Mathematical model for diabetes in fuzzy environment and stability analysis- Journal of of intelligent and Fuzzy System, doi: https://doi.org/10.3233/JIFS-171571.

[20] A.Chakraborty; (2019); Minimal Spanning Tree in Cylindrical Single-Valued Neutrosophic Arena; Neutrosophic Graph theory and algorithm; DOI-10.4018/978-1-7998-1313-2.ch009.

[16] A. Chakraborty, S. P Mondal, S.Alam, A. Mahata; (2020); Cylindrical Neutrosophic Single-Valued Number and its Application in Networking problem, Multi Criterion Decision Making Problem and Graph Theory; CAAI Transactions on Intelligence Technology, Vol-5(2), pp:68-77 , DOI: 10.1049/trit.2019.0083.

[21] T.S. Haque, A. Chakraborty, S. P Mondal, S.Alam, A. Mahata; (2020); A new approach to solve multi criteria group decision making problems by exponential law in generalized spherical fuzzy environment; CAAI Transactions on Intelligence Technology, Vol-5(2), pp: 106-114, DOI: 10.1049/trit.2019.0078.

[22] S. Broumi, A. Bakali, M. Talea, Prem Kumar Singh, F. Smarandache;(2019); Energy and Spectrum Analysis of Interval-valued Neutrosophic graph Using MATLAB, Neutrosophic Set and Systems, vol. 24, pp. 46-60.

[23] A. Chakraborty, S. P Mondal, S. Alam ,A. Ahmadian, N. Senu, D. De and S. Salahshour; (2019); Disjunctive Representation of Triangular Bipolar Neutrosophic Numbers, De-Bipolarization Technique and Application in Multi-Criteria Decision-Making Problems, Symmetry, Vol-11(7), 932.

[24] Senthil Kumar N, S. K. (2016). On Privacy and Security in Social Media – A Comprehensive Study. *Procedia Computer Science* (pp. 114-119). Nagpur, India: Elsevier.

[25] Paul Lowry, J. C. (2011). Privacy Concerns versus Desire for Interpersonal Awareness in Driving the Use of Self-Disclosure. *Journal of Management Information Systems* , 163-200.

[26] Patrick Van Eecke, M. T. (2010). Privacy and social networks. *Computer Law & Security Review* , 533-546.

[27] Gail-Joon Ahn, M. S. (2011). Security and Privacy in Social Networks. *IEEE Internet Computing* , 10-12.

[28] Frederic Marimon, L. H. (2012). Impact of e-Quality and service recovery on loyalty: A study of e-banking in Spain. *Total Quality Management and Business Excellence* .

[29] Chung Tin Fah, M. A. (2012). Money Supply, Interest Rate, Liquidity and Share Prices: A Test of Their Linkage. *Global Finance Journal* .

[30] Rahimi, R., & Me, K. (2016). Impact of Customer Relationship Management on Customer Satisfaction: The Case of a Budget Hotel Chain. *Journal of Travel & Tourism Marketing* .

[31] Chinedu-Okeke, C. F., & Obi, I. (2016). Social Media As A Political Platform In Nigeria: A Focus On Electorates In South-Eastern Nigeria. *IOSR Journal of Humanities And Social Science*

[32] Kalia, G. (2013). A Research Paper on Social media: An Innovative Educational Tool.

[33] Emel Kursunluoglu, I. (2015). A Review of Service and E-Service Quality Measurements: Previous Literature and Extension. *Journal of Economic and Social Studies* .

[34] Ajimon George, G. G. (2013). Antecedents of Customer Satisfaction in Internet Banking: Technology acceptance Model Redefined. *Global Business Review* .

[35] Norman Gwangwava, M. M. (2014). *E- Manufacturing and E-Servise Strategies in contemporary organizations.* Hershey-USA: IGI Global.

[36] Abdel-Basset, M., El-hoseny, M., Gamal, A., & Smarandache, F. (2019). A novel model for evaluation Hospital medical care systems based on plithogenic sets. Artificial intelligence in medicine, 100, 101710.

[37] Abdel-Basset, M., Manogaran, G., Gamal, A., & Chang, V. (2019). A Novel Intelligent Medical Decision Support Model Based on Soft Computing and IoT. IEEE Internet of Things Journal.

[38] Abdel-Basset, M., Mohamed, R., Zaied, A. E. N. H., & Smarandache, F. (2019). A hybrid plithogenic decision-making approach with quality function deployment for selecting supply chain sustainability metrics. Symmetry, 11(7), 903.

[39] Abdel-Basset, M., Nabeeh, N. A., El-Ghareeb, H. A., & Aboelfetouh, A. (2019). Utilising neutrosophic theory to solve transition difficulties of IoT-based enterprises. Enterprise Information Systems, 1-21.

[40] Abdel-Baset, M., Chang, V., & Gamal, A. (2019). Evaluation of the green supply chain management practices: A novel neutrosophic approach. Computers in Industry, 108, 210-220.

[41] P. Biswas, S. Pramanik and B. C. Giri, Topsis method for multiattribute group decision-making under single-valued neutrosophic environment, Neural Computing and Applications, 27(3)(2016), 727–737.

Received: Apr 17, 2020 Accepted: July 7, 2020.