International Journal of Computer Information Systems and Industrial Management Applications.
ISSN 2150-7988 Volume 12 (2020) pp. 082-092

Received: 8 Jan, 2020; Accepted: 4 May, 2020; Published: 20 May, 2020

E-CRM Success Factors as Determinants of Customer Satisfaction Rate in Retail Website

Houda Zaim[1], Mohammed Ramdani[2] and Adil Haddi[3]

[1,2]Informatics Department, LIM Laboratory, Faculty of Sciences and Techniques of Mohammedia,
University Hassan II, Casablanca, Morocco
[1]*houdazaime@gmail.com*
[2]*ramdani@fstm.ac.ma*

[3] Informatics Department, LAVETE Laboratory, National School of Applied Sciences of Berrechid,
University Hassan I, Settat, Morocco
[3]*adil.haddi@gmail.com*

***Abstract*: Electronic Customer Relationship Management (E-CRM) is a marketing strategy that integrates all business activities for attracting and retaining customers over the internet to consolidate retention, cross-buying, brand loyalty and customer satisfaction. E-CRM features influencing customer satisfaction in retail website have not been well researched and analyzed through online customer experience. This study, which is an extension of work originally presented in the International Conference on Soft Computing and Pattern Recognition [1] attempts to uncover the presence of E-CRM features on retail websites, affect values and determine weights importance of these features over the customer satisfaction rate based on customer click stream and online reviews data.**

This paper makes a theoretical and methodological contribution for managers of online service industry in improving their E-CRM performance according to the online customer behavior and satisfaction level.

***Keywords*:** navigational data, fuzzy logic, weight establishment, multi criteria analysis decision making, satisfaction rate, class prototype, relevant index.

I. Introduction

Learn more about customer's characteristics, needs and behavior is central to e-CRM. This research presents a comprehensive approach to design, develop and improve e-CRM implicitly based on online customer's behavior. E-CRM system enables companies to collect massive amount of data to manage every changing needs of online customers. From the architecture point of view, the CRM framework is classified into analytical, operational and collaborative. Analytical CRM relies on the production, storage and analysis of data generated by operational and collaborative CRM. Based on these data, the various analysis tools are used for extracting knowledge that serves as a support for decision-making, and in particular for improving processes of operational CRM. Collaborative CRM is considered as a tool to directly contact customers. An organization strategy needs to set out these objectives before embarking on e-CRM strategy. This requires identifying the key strategic issues that relate to its proposed e-CRM initiatives: 1. Specifying critical factors and measures that have the most impact on E-CRM system for a specific retail website. 2. Presenting e-commerce website as alternative to the critical factors. 3. Applying E-CRM to support e-customer satisfaction survey. In order to achieve the best solution for these considerations, we have benefited from online customer behavior to affect scores to different E-CRM features according to the customer satisfaction level. Measure of these scores has been deduced from mining customer's reviews and in-store navigational click stream. Next, we have used these data as inputs of the proposed MCDM method which is performed by weighting method and ordering preference using similarity and dissimilarity to ideal satisfaction class prototype.

The remainder of this study is structured as follows: First, a fuzzy framework based on customer navigation is developed and adopted for data collection. Evaluation criteria are divided into effective factors regarding customer relationship management principles. Next section describes the theoretical proposed method. How the proposed model is used on a real example in order to compare and rank E-CRM indices is also explained. In final Section conclusions and suggestions are discussed.

II. Existing Related Bibliography

A. *E-CRM Antecedents*

Any variable that have possible impact toward customer satisfaction will also give a strong impact on E-CRM performance. Customer satisfaction is one of the major dimensions in E-CRM performance. Various studies have been done before by a number of researchers as far as the quality determinants of E-CRM strategies are concerned.

The main objective of the study proposed by Wong Ke Er [2] was to examine the relationship between CRM and customer satisfaction on Taobao website. In this study, CRM was discussed by using four dimensions, which are e-service quality, website design, employee behavior and relationship development. The research [3] aimed to investigate the micro-

linkages between E-CRM and electronic loyalty of customers, through electronic banking satisfaction as a mediator variable. Specifically, the neglected roles for expected security and convenience of website design.
H. Al-Dmour et al. [4] provided researchers with an integrative framework, which linked ECRM success factors with customers' satisfaction, trust and retention. This research aimed to investigate the impact of ECRM success factors (process fit, customer information quality and system support) on the facilitation of the ECRM process. The study of Archanakumari and V. Selvan [5] was based on 150 respondents and analysis confirmed the conceptual model that convenience, trust and security have significant effect on customer satisfaction. This study enabled managers and marketers to implement the e-CRM in the best shape and match it with current needs and requirements of consumers. The work proposed by authors of the paper [6] discussed how e-commerce companies improved its competitiveness in the retail industry through innovative CRM. The company provided training for its staffs, managed the staff and style properly. For the work of E. Ardyan and G. Sugiyarti [7], co-information sharing activity and product competitiveness positively influenced E-CRM performance. According to authors of [8] [9] [10] [11], a set of e-crm antecedents that positively influence consumer's satisfaction (Efficiency, content and logistics of order processing, customer payment and billing) have arisen.

B. Usage of Fuzzy MCDM Methods for E-CRM Strategy

Study of Rouyendegh, B.D. et al. [12] presented a hybrid framework of Analytic hierarchy process and Intuitionistic Fuzzy Technique for Order of Preference by Similarity to Ideal Solution for the assessment and evaluation of E-commerce web site performance. The proposed hybrid model enabled decision makers to assess and efficiently used intuitionistic fuzzy numbers. In addition, human judgment can effectively be incorporated in the evaluation process. The research lead by Heidary Dahooie, J. et al. [13] developed a multi-attribute-decision-making technique rely on Step-Wise Weight Assessment Ratio Analysis and hesitant fuzzy weighted geometric Heronian mean decision-making methods, for evaluating e-government websites. The proposed framework overcome the limitations of previous investigations such as the possibility of aggregation of expert opinions using group decision-making and modeling the hesitancy of the experts. The focus of paper [14] was to consider Search Engine Optimization (SEO) criteria evaluation as a MCDM problem in which the criteria are in different priority levels and the criteria values take the form of hesitant fuzzy linguistic term sets to facilitate the elicitation of information in hesitate situations. A three-step solution approach was developed: (i) determination of 21 SEO criteria, such as page loading time, page size and meta-keyword (ii) prioritizing the criteria using hesitant fuzzy analytic hierarchy process, and (iii) ranking 70 Turkish websites of the industrial engineering departments using Technique for Order Preference by Similarity to Ideal Solution. Thus, this study assessed and prioritized factors for designing a successful B2C e-commerce website. The study of Li, R. and Sun, T. [15] conducted a thorough literature survey to screen important factors reported in past studies. Five main factors and nineteen sub-factors were selected for further prioritization. Later, FAHP prioritized factors based on their importance. Finally, based on the FAHP results, TOPSIS-Grey ranked five alternatives (e-commerce websites).
The article of Negi et al. [16] proposed a method to preprocess web services using the various classification technique. After that, a hybrid weight evaluation mechanism was employed to obtain the weight values of each nonfunctional parameter. In the end, the web services that were near to user expectations were selected out using the ranking method.
Assigning the relative importance of each attribute with an overall ranking can be done through the use of many pairwise comparisons based methods such as AHP (Analytic Hierarchy Process) which was applied to establish a set of all judgments based on decision-makers specific requirements in the comparison matrix to obtain a local weight of each criterion and sub criterion. With the objective of exercising judgment upon the ranking of the e-commerce sites, research of Sharma K. et al. [17] used AHP method to assign the criteria weights which in turn assist in generating the ranking of the web sites. AHP and ANP have also been extended to their fuzzy version by several researchers. Other classical multi criteria methods such as DEMATEl, MACBETH, CORPAS and MAUT have been extended under fuzzy environment [18] [19]. Negative and positive ideal solutions based methods TOPSIS and VIKOR have been developed under fuzziness and applied to many MCDM problems [20].
Only few applied MCDM algorithms consider quantitative, qualitative, imprecise and inconsistent information inherent in the evaluation data. In relation to the above-mentioned problem, it is suggested that the type of evaluation criteria should be increased and a dynamic customer-based MCDA method to evaluate online shops ought to be applied.
Approaches mentioned above required the real level of the e-crm factor's importance, which in turn helps to improve the website quality without considering implicit consumer perceptions of e service he receive. The areas where sequence of web events generated by each user should be required to assess the online service quality.

III. E-CRM Evaluation Data

A. Candidate Attributes

The entire dimensions used are adapted from the background research. The present study uses 5 criteria with 30 sub criteria in the proposed analysis of e-CRM. Fig. 1 shows the complete list of features which are described below:

Usability: is defined as the degree to which a user can complete tasks effectively and efficiently. Usability is concerned with functionality/usefulness, ease of learning, ease of use, aesthetics, user satisfaction and quality of enormous amounts of information available in the internet. Therefore, sites offer efficiency feature to allow the user to filter the content they see and to suit his tastes and preferences. User friendliness feature acts as self-help for customers looking for answer to their queries. This feature allows the company to collect personal information from users, when the user registers for the membership. It also allows them to track the customer's behavior at the site over time.
Content Adequacy: This feature allows the visitor to quickly locate the required content on the web site where is looking

for a specific piece of information. As sub criteria, we consider electronic bulletin which allows visitors to share information with others. A visitor can post a message or can respond to a posted message on a special web page. This interaction, over time, creates a community of users around the company's service or product. Product highlights feature allows the company to highlight products or services that may be relevant in a particular context.

Reliability: This feature contains shipping policies, return policies, warranty, guarantee and other company commitments. Customers are more likely to feel satisfied if they know of the status of their order than if they do not. Most of customers use customer service to find out when they can expect delivery of their order. This feature depends also on privacy policy. Today, most sites have a privacy policy and post it on their web site. This not only assures the customer that his information is protected, but will also protect the company from violations.

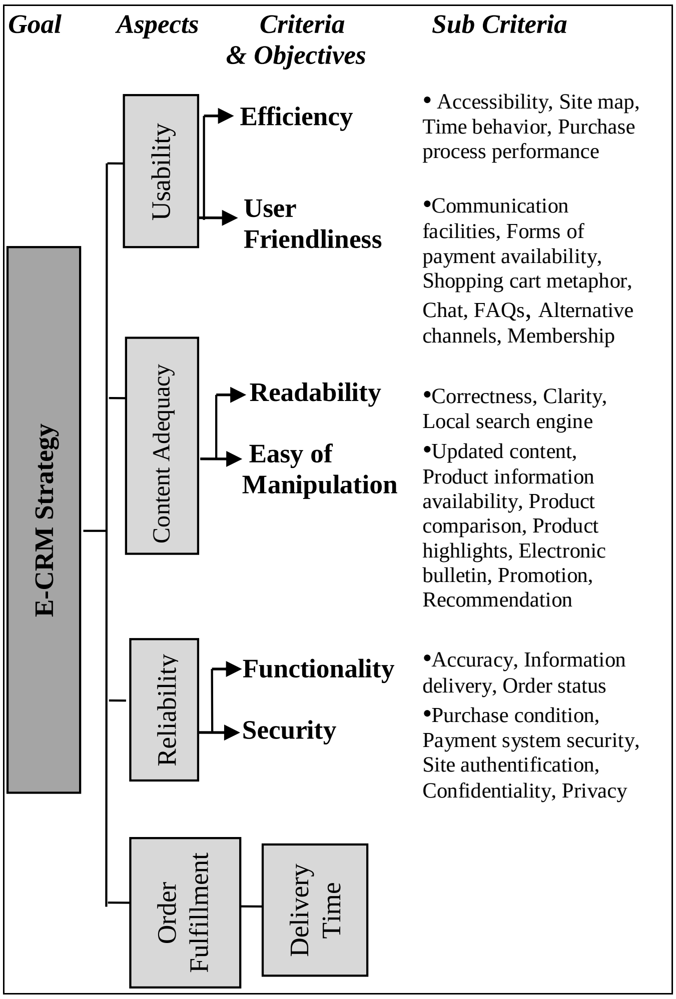

Figure 1. Census of e-CRM Attributes

The proposed data preprocessing model for customer analysis tracks various online activities of customers to construct logical user sessions and affect values to relevant entries variables for our proposed e-CRM system which takes into account new set of variables; categorical, continuous and fuzzy variables for evaluating online service quality.

After the customer's order is shipped, we detect its feedback information to assign values to Order Fulfillment as a categorical variable and Delivery Time which is numeric one. According to the Fig. 1, we have three other variables: Usability, Content Adequacy and Reliability which are considered as fuzzy attributes.

B. Navigational Data Collection

Fig.2. shows the OOHDM navigational schema for an online store. We have partitioned the navigational design space between navigational nodes and activity nodes; we use UML stereotypes <<entity>> and <<activity>>, to indicate which partition an item belongs to. Thus, on the top side of the Figure 2 you find activities and the corresponding process and entity nodes (bottom). Typically, a business process like CheckOut is composed of several activities like Login, ConfirmItems, and so on. The composition is represented by an aggregation relationship. A basic activity such as Login collaborates with application entities such as Customer to create an output page that lets the user enter or modify data.

A business process defines the sequence in which its child activities should be executed, that is, the control flow among these activities. For example, the CheckOut process defines a strict one-way sequence for the activities that comprise it.

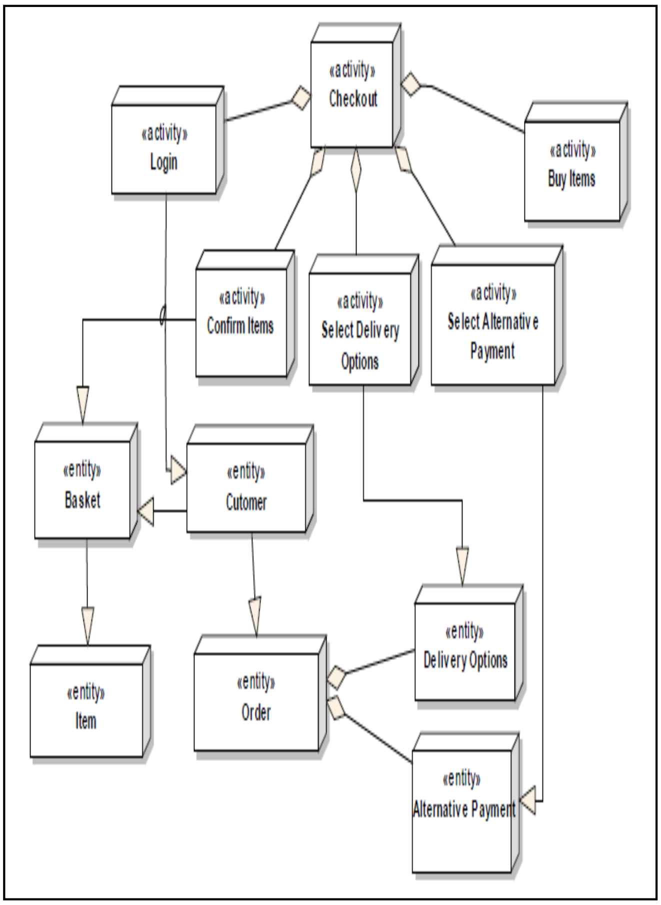

Figure 2. Object-Oriented Hypermedia Design Method (OOHDM) Navigational Schema

To emphasize the separation of concerns between process execution and navigation, we add a UML activity diagram (Figure 3) to the conceptual schema to describe the data flow [21]. From the navigational schema viewpoint, the Checkout parent activity first starts the Login child activity, which returns control to CheckOut after the user completes or cancels it. After a successful login, CheckOut starts the ConfirmItems child activity and passes control to it until that activity returns control, and so on. A composed activity is responsible for passing control among its child activities;

Select Delivery Options and Select Alternative Payment activity for buying.

The timeout threshold $t0$: time period for website access without discovering product(s).

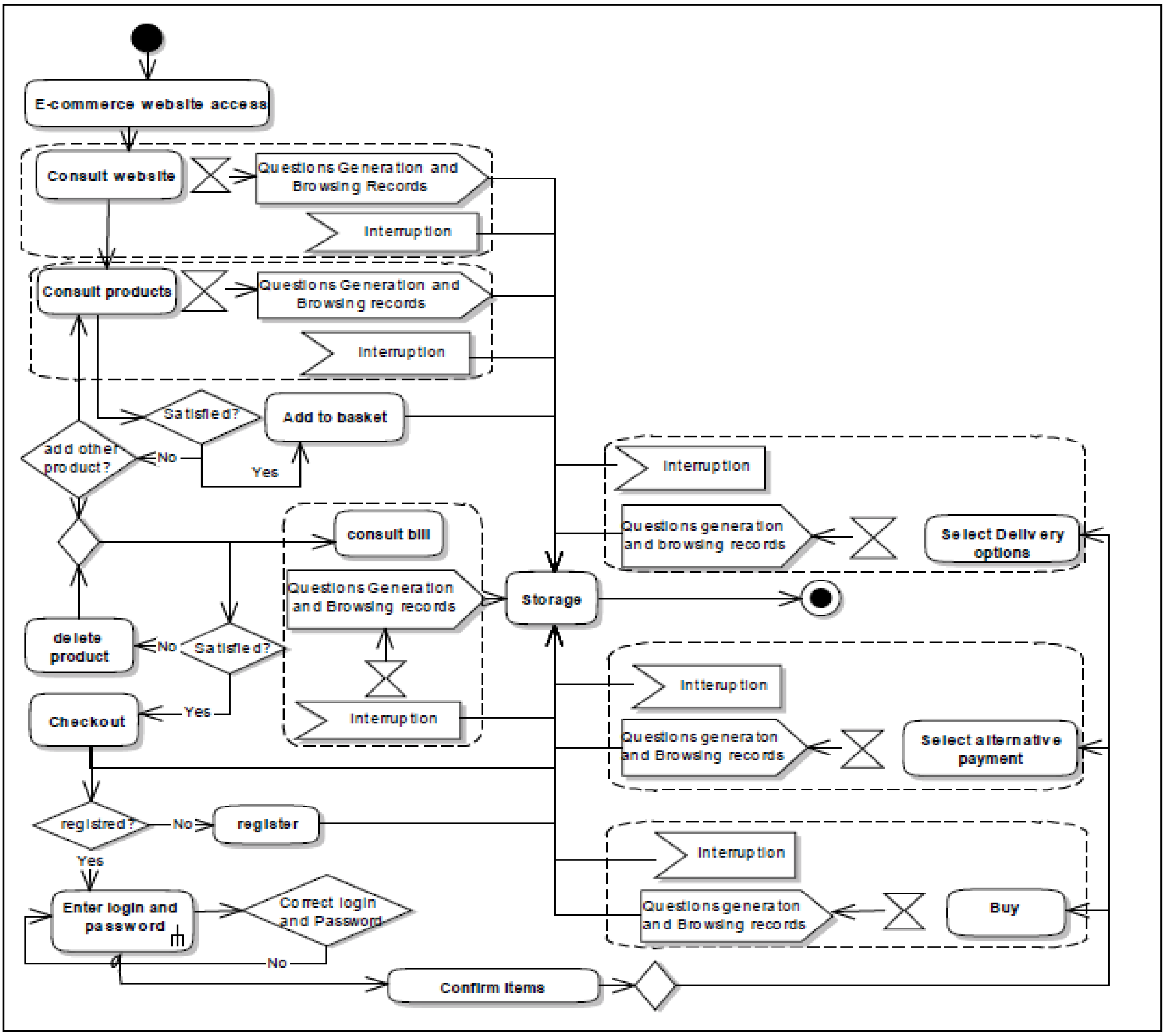

Figure 3. Object Activity Diagram of Data Flow

C. Fuzzy-Based Preprocessing

1) Considered Measures

Clicks: the interaction between the user and the web server; is measured by the click of mouse.
Visits: the number of times a user visits a specific web site. Every new session is counted as a new visit.
Exists: counted by site inactivity for more than a specific period.
Repeated visitor: the average number of times a user returns to a site over a specific time period.
Session: a sequence of internet activity made by one user during a period of time.
Page views: the view of any page by user
Page view per visit: average number of page views per visit.
Page views per session: average number of page views per session
Click per session: average number or clicks per session.

The timeout threshold $t'0$: time period before the current time without adding any product to the basket.
Time period tp: is the length of product consultation time.
Time period $t'p$: a time spent before purchase that must not be greater than the timeout a threshold $t''0$.

P_s is the set of consulted product(s) and $P_s - P'_s$ the consulted product(s) not added to basket. $P'_s - P''_s$ represents products added and then deleted from the online basket and the set of purchased product(s) is denoted by P''_s.

For each user, perform the following:
a. Find the time difference between the website access and abandonment.

b. If this difference exceeds the threshold $t0$, assign a session ID Sv to the user.
c. If tp exceeds $t'0$, assign consultation sessions Sc to user who consults product(s) without any placement to online basket.
d. Assign the session basket Sb to the user who adds items to his online shopping cart, but exits without completing the purchase.
e. Sessions of purchase Sp have an end when user pays consulted product(s).

2) *Preliminaries*

Let A be a fuzzy variable and X the range of its values. Fuzzy sets are characterized by a membership function, which is also called the degree or grade of membership. One suggestion is to ask the experts to assign a real number from the interval [0, 1] for each relationship and then calculate the average. However, it is difficult for the experts to assign a real number in order to express their beliefs with regard to the strength of relationships. This is the reason why partially ordered linguistic variables such as "weak", "medium", etc.
The membership function defined as: $f_v: X \to [0,1]$, this function maps X into real numbers defined in the interval [0,1]. Subsets present expression to evaluate e-commerce websites fuzzy criteria using five basic linguistic terms, as "very weak", "weak", "medium", "strong", and "very strong".

3) *Fuzzy Inference*

The proposed fuzzy-based framework searches membership functions suitable to mining click stream data for E-CRM strategy implementation.
The proposed framework first collects customer's navigational data to automatically derive the resulting membership functions by computing possible values of click stream data according to the possible online customer actions, initializing membership threshold until a good set of membership functions has been obtained and transforming each set of membership functions into linguistic representation on the universe of E-CRM features.

Values of the inferior and superior limits of the triangle base is based on formulas mentioned thereafter to depict the domain of mapping for the membership function (MF) for five linguistic terms: VW(Very Weak), W (Weak), M (Medium), S (Strong) and VS (Very Strong). (See Figure 5).

Here an algorithm used to generate triangular membership function on numerical data. Assume the fuzzy attribute has numerical value x. Each linguistic term T_i has a triangular membership function, m_i represents scale values of the X axis:

$$(x) = \begin{cases} 1 & if\ x \le m_1 \\ \dfrac{(m_2 - x)}{(m_2 - m_1)} & if\ m_1 < x < m_2 \\ 0 & if\ x \ge m_2 \end{cases}$$

$$U_{T_i}(x) = \begin{cases} 0 & \text{if } x \ge m_{i+1} \\ \dfrac{(m_{i+1} - x)}{(m_{i+1} - m_i)} & \text{if } m_i < x < m_{i+1}\ ,\quad 1 < i < k \\ \dfrac{(x - m_{i-1})}{(m_i - m_{i-1})} & \text{if } m_{i-1} < x < m_i \\ 0 & \text{if } x \le m_{i-1} \end{cases}$$

$$U_{T_k}(x) = \begin{cases} 1 & if\ x \ge m_k \\ \dfrac{(x - m_{k-1})}{(m_k - m_{k-1})} & if\ m_{k-1} < x < m_k \\ 0 & if\ x \le m_{k-1} \end{cases}$$

x refers to numeric value of usability V_U, content adequacy V_{CA} and reliability V_R

The Fuzzy values of usabilityV_U, content adequacy V_{CA} and reliability V_R are based on e-customer behavior during navigation session S=$S_v \cup S_c \cup S_p \cup S_b$ respectively, are visit session, consultation, basket and purchase session. More details in our previous work [22].

Equation (1) refers to the value of the website's usability V_U is based on values of (ts), $\psi(s)$and Φ(s))which depend on the time of website's consultation and product discovering.

$$V_U = \frac{1}{card(S)} \sum_{s \in S} (\varphi(t_s)\, \psi(s) + \Phi(s)) \qquad (1)$$

$$\varphi\ (t_s) = \begin{cases} 1 & if\ t_s < t_0 \\ 0 & else \end{cases}$$

$$\psi(s) = \begin{cases} 1 & if\ s \in S - S_v \\ 0 & if\ \ s \in S_v \end{cases}$$

$$\Phi(s) = \begin{cases} -1 & if\ \ s \in S_v \\ 0 & if\ \ s \in S - S_v \end{cases}$$

IF card(S)= 1 and $\sum_{s \in S}(\varphi(t_s)\, \psi(s)$+$\Phi$(s))=1 THEN Usability is Very Strong.
IF card(S)=1 and $\sum_{s \in S}(\varphi(t_s)\, \psi(s)$ +Φ(s))= -1 THEN Usability is Very Weak

For the equation (2), φ′(tp) ,ψ′(p)and Φ'(p) are related to the consultation time of product and product added to the basket to calculate value of website's content adequacy V_{CA}.

$$V_{CA} = \frac{1}{card(S_c)} \sum_{s \in S_c} \left(\frac{1}{card(P_s)} \sum_{p \in P_s} \varphi'(t_p)\, \psi'(p) + \Phi'(p) \right) \qquad (2)$$

$$\varphi'(t_p) = \begin{cases} 1 & if\ t_p < t'_0 \\ 0 & else \end{cases}$$

$$\psi'(p) = \begin{cases} 1 & if\ p \in P'_s \\ 0 & if\ \ p \in P_s - P'_s \end{cases}$$

$$\Phi'(p) = \begin{cases} 0 & if\ p \in P'_s \\ -1 & if\ p\ \in P_s - P'_s \end{cases}$$

IF $\sum_{p \in P_s} \varphi'(t_p)\, \psi'(p) + \Phi'(p)$= 0 THEN Content Adequacy is Medium

Value of reliability V_R depends in the equation (3) on values of φ"(tp) ,ψ"(p) and Φ"(p) based on the time spent before purchase, deleted and purchased products, security and delivery process.

$$V_R = \frac{1}{card(S_b)} \sum_{s \in S_b} \left(\frac{1}{card(P'_s)} \sum_{p \in P'_s} \varphi"(t_p)\, \psi"(p) + \Phi"(p) \right) \quad (3)$$

IF card S_b =1 and $\frac{1}{card(P'_s)} \sum_{p \in P'_s} \varphi"(t_p)\, \psi"(p) + \Phi"(p)$= 1/4 THEN Reliability is Strong.

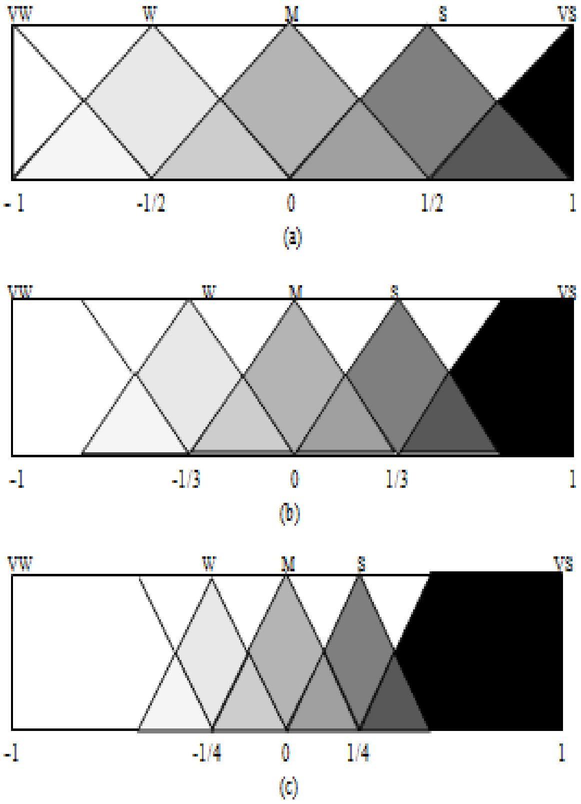

Figure 5. MF of (a) Usability (b) Content Adequacy and (c) Reliability

Values of the inferior and superior limits of the triangle base is based on formulas mentioned above to depict the domain of mapping for the membership function (MF) for five linguistic terms: VW(Very Weak), W (Weak), M (Medium), S (Strong) and VS (Very Strong) as mentioned in Figure5.

D. Customer Comments Data Usage

On electronic commerce platforms, people can read even comments to the reviews from other customers who brought or receive a product in the past and knew the quality of the product. A customer's review often contains information related to product itself and consumer preferences toward the online service.

Thus, retrieving information from helpful reviews has become an important issue. In this paper, we rank the reviews based on a set of linguistic terms and use them to calculate and assign customer's rating.

IV. Proposed Fuzzy Weighting Model

A wide variety of e-CRM attributes requires that customer satisfaction measurement is a multivariate evaluation problem which depends on alternatives assessed on the basis of attributes [23].

Let $(C_i)_{i=1,\ldots 5}$ the consumer's satisfaction level, which are represented by five classes: "very satisfied" (C_1) , "satisfied" (C_2) , "moderately satisfied" (C_3) , "somewhat satisfied"(C_4), and "not satisfied"(C_5).

$(A_j)_{j=1,\ldots p}$ denotes the finite set of p e-CRM criteria that may influence consumer's satisfaction as shown in figure1. $V_{q,j}^i$ represents the possible value of criterion A_j given by clients of category C_i. We denote by $(C_j^i)_{j=1,\ldots p}$ the prototype of the attribute $(A_j)_{j=1,\ldots p}$for category or class C_i.

The weight α_j^i denotes the relevant indicator or the importance of attribute A_j to determine the class C_i.

In the prototype algorithm, one prototype is built for each class from the input vectors with three types: numeric, nominal and fuzzy ones. The class of a new input is then predicted as the class of the prototype which is closest to this input.

A. Numeric Criteria

The prototype C_j^i of numeric criterion A_j is the average of its values given by all the n members of class C_i (6)

$$C_j^i = {\sum_{q=1} V_{q,j}^i}\Big/_{n} \quad (6)$$

The weight α_j^i (7) of numeric criterion A_j is the standard deviation of its values given by all members of class C_i compared with the average:

$$\alpha_j^i = {}^{1}\Big/_{1+\sum_{q=1}^{n} \left|V_{q,j}^i - C_j^i\right|} \in [0,1] \quad (7)$$

B. Nominal Criteria

For the class C_i, the prototype C_j^i of nominal criterion A_j is the value that has a high frequency among all possible values $\left(V_{q,j}^i\right)_{q=1,\ldots m}$ of this criterion. m: number of possible values for nominal attribute A_j. The relevance indicator of nominal criterion A_j is calculated by: $\alpha_j^i = f(C_j^i) \in [0,1]$.

C. Fuzzy Criteria

The dissimilarity $d(V_1, V_2)$ between any two values V_1 and V_2 for the fuzzy attribute A_j can be computed by:

$$d(V_1, V_2) = \left(\sum_{i=1}^{5} (V_{1i} - V_{2i})^{2}\right)^{1/2} \quad (8)$$

The proposed formula to calculate the dissimilarity is a Euclidean distance where $V_{1i}$and V_{2i}represent the vector of belonging to fuzzy objects $\{a_1, \ldots a_{i,} \ldots, a_5\}$ which are represented by functions mapping the fuzzy attribute scale (See Figure 5) $V_1 = v_{11}, v_{12}, \ldots v_{15}$.

The similarity $s(V_1, V_2)$ between any two values V_1 and V_2 for the fuzzy attribute A_j can be computed by:

$$s(V_1, V_2) = \frac{1}{1+d(V_1,V_2)} \qquad (9)$$

The prototype C^i_j of fuzzy criterion A_j is the most typical value of A_j which is very similar to values of members of the class C_i and very different from members of other classes. We use functions of similarity and dissimilarity to calculate the typicality of different values of a fuzzy criterion A_j for the class C_i.

Let $(V_{k,j})_{k=1,\dots 5}$ be the value of the criterion which may be represented by five fuzzy sets called "very weak" , "weak" , "medium" , "strong" , and "very strong". $V^i_{q,j}$ be the possible value of criterion A_j given by member of the category C_i.

$D^i_{k,j} = \frac{1}{n'}\sum_{q=1}^{n} d\left(V_{k,j}, V^r_{q,j}\right)$ is the overall dissimilarity of $V_{k,j}$ against to all values of A_j given by n' members of class C_r different from C_i which is obtained by the sum of partial dissimilarities $d\left(V_{k,j}, V^r_{q,j}\right)$ (8).

$S^i_{k,j} = \frac{1}{n}\sum_{q=1}^{n} s\left(V_{k,j}, V^i_{q,j}\right)$ is the overall similarity of $V_{k,j}$ against to all values of A_j given by n members of the class C_i which is obtained by the sum of partial similarities $s\left(V_{k,j}, V^i_{q,j}\right)$ (9).

The typicality of $V^i_{k,j}$ is defined by $T^i_{k,j} = \left(S^i_{k,j} + D^i_{k,j}\right)/2$. The prototype C^i_j of the fuzzy criterion A_j is the value that has the maximum typicality: $C^i_j = V_{q,j}$ where $T^i_{q,j} = \max_{k=1,\dots 5}\left(T^i_{k,j}\right)$.

The relevance indicator of the criterion A_j is the average of the differences between the maximum typicality for category C_i and the typicality of other possible values for this criterion: $\alpha^i_j = \frac{\sum_{k=1,k\neq q}^{5}\left(T^i_{q,j} - T^i_{k,j}\right)}{4} \in [0,1]$.

On one hand, these weights help to identify central individuals in a group. On the other hand, they can be used in various applications such as classification by prototypes. The principle is to deduce a system of weights associated with various criteria of an e-commerce website within each class of satisfaction customers.

V. Prototype Classification for E-customer Satisfaction Survey

The block diagram mentioned in Figure 6 provides a better understanding of the process of prototype classification in data stream scenario, particularly focusing on the mathematical foundations of classifying customers taking into account weights of continuous, categorical and fuzzy criteria.

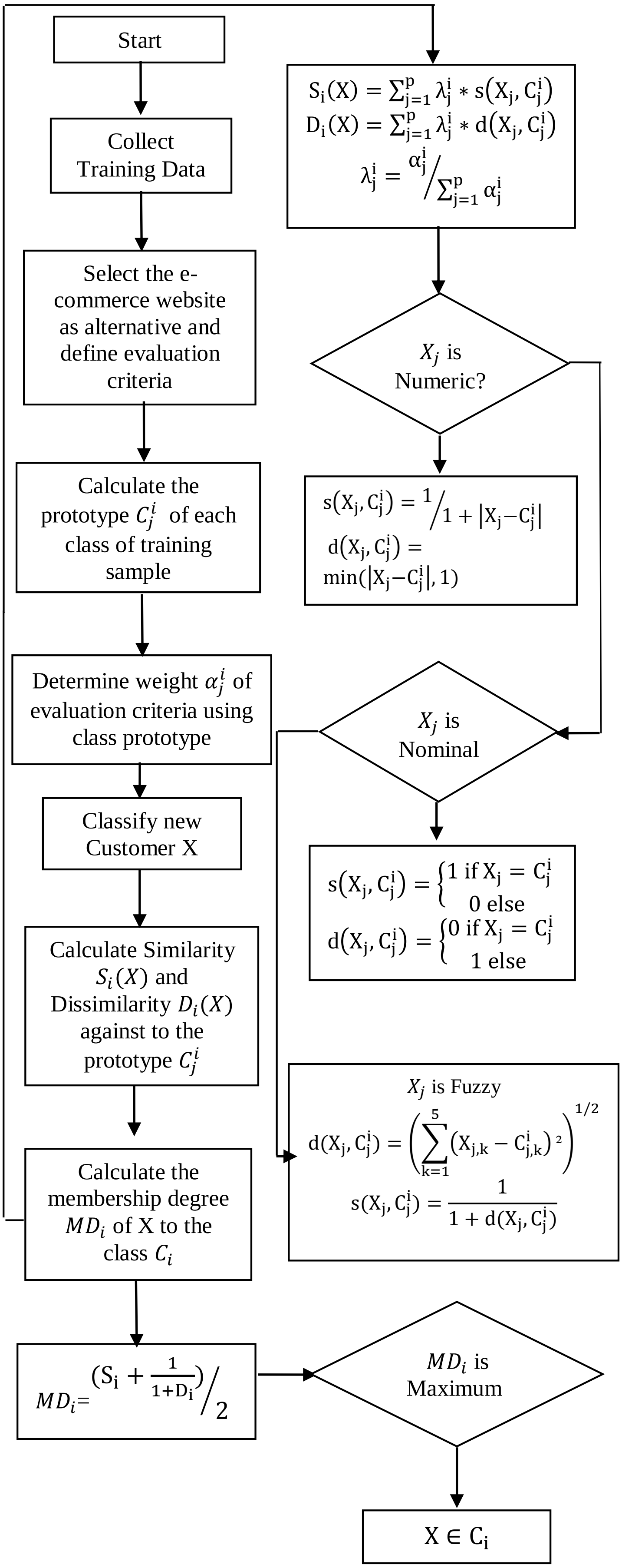

Figure 6. Block Diagram of the Proposed MCDM Method for E-Customer Satisfaction Survey

VI. Findings

A. *Case Study*

We choose reviews and click stream data from TMALL as the data source. TMALL is an important business unit of Alibaba Group which is known as the top one B2C platform in China. The user’s behavior of browsing TMALL reflects their preference of items. This data set contains 25432915908 records of user-item interactions. Features of each row are listed as below:

Item	Definition
User_id	A string as "u9774184", denoting an unique user
Item_id	An integer in[1, 8133507], denoting an unique item
Action	Type of behavior, a string like "click", "collect", "cart", "alipay", represents for ' click' , ' add to favorite' , ' add to cart' and ' purchase' , respectively
Vtime	Timestamp of user’s behavior

Table 1. User-Item Interaction.

Review data is available for partial "user-item" pairs, which contains the review and rating on the item/merchant/logistic. This data set contains 241919749 rows, corresponding to 241919749 reviews:

Item	Definition
User_id	A string as "u9774184", denoting an unique user
Item_id	An integer in[1, 8133507], denoting an unique item
Feedback	A string containing multiple key words, separated by ' ' There words are extracted from the raw title by an NLP system
Rate_Pic_url	An URL linked to corresponding image online
Gmt_create	Timestamp of the review, A string as "yyyy-mm-dd hh:mm:ss"

Table 2. Online Customer Reviews.

Item Id	Item Id	User Action	VTime	Action
u41	i161	Click	30/09/2014 15:19:00	★★★★
	i534	Alipay	03/09/2014 15:46:01	★
u57	i135	Cart	26/09/2014 20:32:01	★★
u1641	i109	Alipay	02/09/2014 11:50:52	★
				★★

Table 3. Tmall Data Sampling.

Data	User-Id	Class	Usability					Content Adequacy					Reliability					Order Fulfillment	Delivery Time
			VS	S	M	W	V W	VS	S	M	W	VW	VS	S	M	W	VW		
Training	u41	C1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	Available-To-Promise	3
	u13	C1	1	0	0	0	0	0	0.5	0.5	0	0	1	0	0	0	0	Available-To-Promise	5
	u48	C2	0	0.5	0.5	0	0	0	1	0	0	0	0	0	1	0	0	Available-To-Promise	4
	u1675	C4	0	0	0	0.7	0.3	0	1	0	0	0	0	0	0.6	0.4	0	Not Available-To-Promise	12
	u24	C3	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	Not Available-To-Promise	10
	u394	C5	0	0	0	0.8	0.2	0	0	0.5	0.5	0	0	0	0	0	1	Not Available-To-Promise	20
	u32	C2	0.6	0.4	0	0	0	0	0	1	0	0	0	1	0	0	0	Available-To-Promise	6
Test	u4	C1	1	0	0	0	0	0	0	1	0	0	0.8	0.2	0	0	0	Available-To-Promise	3
	u1136	C3	0	1	0	0	0	0	0	0.5	0.5	0	0	0	0	1	0	Not Available-To-Promise	14
	u31	C2	0	1	0	0	0	0	0.6	0.4	0	0	0	0	1	0	0	Not Available-To-Promise	10

Table 4. Descriptive Example of Used Training Data

Customers who don't describe their feedback were chosen as testing set as mentioned in Table 5

Item Id	Item Id	User Action	VTime
u39	i146	Click	03/09/2014 21:01
	i53	Cart	29/09/2014 11:17
	i366	Alipay	04/09/2014 19:23
u3286	i152	Collect	27/09/2014 0:28
u2984	i41	Cart	24/09/2014 21:36

Table 5. Tmall Testing Data

Data in Table 4 present the processed original data (Table 3) used as training data to learn the model and to adjust weights. Test dataset is used for assessing model performance on future data. However, in many applications only two sets are created, training and test. Table 4 describes used training and test data where class is deduced from online reviews which are filtered by 5 starts referring to customer satisfaction rate. C1: Very Satisfied, C2: Satisfied, C3: Moderately Satisfied, C4: Moderately Satisfied, C5: Not Satisfied. For each class of each customer, restrictions can be placed on E-CRM features values to define their possible changes based on e-customer behavior during navigation sessions. These features will be classified into 5 linguistic terms. e.g. (0.0/VW Very Weak + 0.0/W Weak + 0.5M /Medium + 0.5/S Strong + 0/VS Very Strong).

B. Results and comparison

For the purpose of the current study a performance assessment model for e-commerce is proposed including criteria, indicator weights, and evaluation method. The model designs prototype to understand customer satisfaction trends. For this process, the related attributes weights are identified to assist in understanding customer needs.

Class	Usability	Content Adequacy	Reliability	Order Fulfillment	Delivery Time
C1	VS 1.042	VS 0.901	VS 1.180	Available-To-Promise	4
C2	M 0.968	M 0.886	S 0.905	Available-To-Promise	5
C3	W 0.965	M 0.986	M 1.003	Not Available-To-Promise	10
C4	W 0.820	S 0.869	M 0.742	Not Available-To-Promise	12
C5	W 0.865	W 1.033	VW 1.190	Not Available-To-Promise	20

Table 6. Class Satisfaction Prototype Based on Typicality as a Relevance Index Using Training Dataset.

Table 6 depict the prototype showing the profile of online customer and display pertinent information from the customer point of view like e-CRM factors interestedly encourage participation of customer as frequent buyer.
Attribute of "Order Fulfillment" and "Reliability" have the high rank among the effective factors, it is recommended that accessibility of customer knowledge information about order status should be made possible for the entire staff, a positive view should be created on change of customer relation.
The usability and delivery time factors are rated second. The feature "Content adequacy" is identified as the factor with least priority of effect.

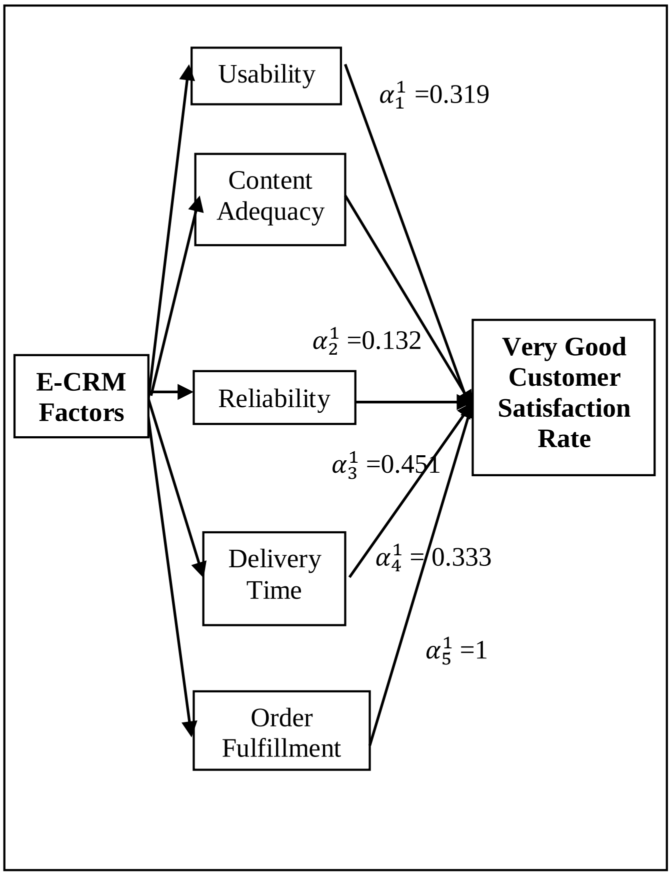

Figure 7. ECRM Attributes Weights Based on Prototypes Calculated in Table 6

Results show that the proposed model gives label correctly predicted respecting the three types of features, e.g; the customer u4 is affected to the class C1 (Very satisfied) with a maximum membership degree equals to 0.752.

We give a broader comparison in tabular from the existing MCDM methods for ECRM implementation and the proposed method under fuzziness (Table 7).
Comparison results show that the e-commerce is not an area frequently researched by using fuzzy sets with categorical and numeric data as evaluation criteria. Existing approaches realize customer's attitudes towards the preferred online service characteristics without prior knowledge about the E-CRM criteria weights in the customer's viewpoint. Our proposed approach can evaluate E-CRM system by capturing the precise and uncertainty of vague and imprecise information based on customer click stream data record.

Ranking Different Dimensions Of Implementing E-CRM				
Analysis Method	**Problem Definition**	**Considered Criteria**	**Measures of Goodness of split**	**Decision Rules and Class Assignment**
Decision Tree	Customer profiling	Continuous data	Usage of Golden-section search (GSS)	Identifying a group of customers who have the same preferences and predict the set of customers with highest probability to accept the offer based on their personal characteristics
		Numeric and categorical criteria	Entropy Information Metric (TEIM)	
		Continuous valued (real and integer)	K-ary partition discretization	
		Fuzzy criteria	Combined fuzzy C-means and ID3, Order-Neuro- Fuzzy Decision Tree, or multilabel fuzzy decision tree	
Analysis Method	**Problem Definition**	**Considered Criteria**	**Weighting Attributes**	**Aggregation of Preferences and Class Assignment**
Data Envelopment Analysis (DEA)	Measuring e-commerce efficiency	Inputs, outputs should reflect an analyst's or manager's interests	Weights are determined using linear programming to maximize the ration of outputs to inputs	
Grey Analysis Method (GRA) Or VIKOR Method	Improve e-store business	build an influential network relationship map(INRM) of quantitative criteria	Weightsbased on face-to-face questionnaire administered to 10 frequent shoppers who are e-store experts	A gray relational coefficient is built to know which alternative should be improved to come close to the aspiration level.
TOPSIS Or PROMETHEE Or ELECTRE	Ranking B2C E-commerce Website	Subjective or vague data must be considered during the process	AHP, LINMAP, ANP methods are performed according to the decision-makers preference	The preferences of decision- makers are indentified using Saaty scale.
Quality Evaluation Method (QEM)	Website quality evaluation	Measurable criteria: Aesthetic, Ease of use, multimedia, rich content, reputation	Weights depend mostly on expert's judgments using website quality metrics (QCF score)	Assessment of partial and total quantitative quality preferences regarding the experts standpoints.
PROPOSED APPROACH	Customer Satisfaction and Strategic analysis of electronic service quality	Use numeric, nominal and fuzzy evaluation criteria. Possible to add different types of other evaluation criteria	Assign weights of evaluation criteria based on customer's opinions. Weights must denote the importance of the criterion to determine different e-customer's satisfaction levels	Aggregation preferences based on normalization weights of numeric, nominal and fuzzy evaluation criteria according to each customer satisfaction level.

Table 7. Comparative Study of MCDM methods and the Proposed Model.

VII. Conclusion and Implications

The results of this study give several implications for online service providers and marketing managers with regard to how to plan and market services that will be considered valuable by customers. Furthermore, the present study considered as important grounds for implementing e-CRM performance in assessing service providers to achieve sustainable customer satisfaction based on customer navigational data. Concerning the factors that influencing E-CRM performance. The present research suggests five factors as important determinants of E-CRM performance. A MCDM method has been proposed to carry out factors weights in accordance with customer satisfaction level.

Further study can expand the proposed method with other more objective criteria analysis methods to increase its accuracy and robustness by expanding the framework across industries and integrating more important factor that may influence E-CRM performance.

References

[1] Zaim H., Ramdani M., Haddi A. (2020) Decision Tree and MCDA Under Fuzziness to Support E-Customer Satisfaction Survey. In: Madureira A., Abraham A., Gandhi N., Silva C., Antunes M. (eds) Proceedings of the Tenth International Conference on Soft Computing and Pattern Recognition (SoCPaR 2018). SoCPaR 2018. Advances in Intelligent Systems and Computing, vol 942. Springer, Cham

[2] Wong Ke Er, "A Study on Relationship Between Customer Relationship Management (CRM) and Customer Satisfaction on Taobao Website in Johor Bahru". In Journal of Arts & Social Sciences Vol 3, Issue 2, 1-14 (2020).

[3] H. H. M. Rashwan, A. L. M. Mansi, H. E. Hassan "The impact of the E- CRM (expected security and convenience of website design) on E- loyalty field study on commercial banks". In Journal of Business and Retail Management Research (JBRMR), Vol. 14 Issue 1, 2019.

[4] H. Al-Dmour, R. S. Algharabat, R. Khawaja, R.H. Al-Dmour. "Investigating the impact of ECRM success factors on business performance". In *Pacific Journal of Marketing and Logistics*, 2019.

[5] Archanakumari, V. Selvan, "An Approach to Study the Effect of E-crm on Customer Satisfaction of Digital Marketing". In UGC Care Listed Journal, Vol-40 Issue-48 March 2020.

[6] I. Gamayanto, H. Christian. "The Development of Innovative CRM E-Commerce: The Case of Blibli.Com". In *Binus Business Review*, pp 29-38, 2018.

[7] E. Ardyan, G. Sugiyarti, "The influence of e-CRM capability and co-information sharing activity on product competitiveness and marketing performance of small and medium-sized enterprises". In *Int. J. Electronic Customer Relationship Management*, 2018.

[8] Chuanga, S., Lin, H. 2017. Performance implications of information-value offering in e-service systems: Examining the resource-based perspective and innovation strategy. The Journal of Strategic Information Systems. Volume 26, Issue 1, March 2017, Pages 22-38.

[9] Sun, T., Watanabe, W. C. 2017. The Study of Critical Success Factors of Cross-Border E-Commerce Freight Forwarder from China to Thailand. 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Singapore, 2017, pp. 1848-1852

[10] Kourtesopoulou, A., Kehagias, J., Papaioannou, A. 2018. Evaluation of E-Service Quality in the Hotel Sector: A Systematic Literature Review. Springer Proceedings in Business and Economics.

[11] Fanga, J., Lia, J.,.Prybutok, V. R. 2018. Posting-related attributes driving differential engagement behaviors in online travel communities. Telematics and Informatics Volume 35, Issue 5, August 2018, Pages 1263-1276 Telematics and Informatics.

[12] Rouyendegh, B.D., Topuz, K., Dag, A., Oztekin A. An AHP-IFT Integrated Model for Performance Evaluation of E-Commerce Web Sites. Inf Syst Front 21, 1345–1355 (2019). https://doi.org/10.1007/s10796-018-9825-z

[13] Heidary Dahooie, J., Vanaki, A.S., Daneshmoghadam, S., Kazimieras E. A Framework to Overcome Hesitancy of Decision-Makers in E-Government Web Site Evaluation. Int. J. Fuzzy Syst. 22, 583–603 (2020). https://doi.org/10.1007/s40815-019-00790-z

[14] Özkan, B., Özceylan, E., Kabak, M., Dağdeviren M. Evaluating the websites of academic departments through SEO criteria: a hesitant fuzzy linguistic MCDM approach. Artif Intell Rev 53, 875–905 (2020). https://doi.org/10.1007/s10462-019-09681-z

[15] Li, R.; Sun, T. Assessing Factors for Designing a Successful B2C E-Commerce Website Using Fuzzy AHP and TOPSIS-Grey Methodology. Symmetry 2020, 12, 363.

[16] Negi, Neerja and Satish Chandra. "A Hybrid User-Centric Approach for Efficient Web Service Selection." IJIRR 10.2 (2020): 1-20. Web. 23 Apr. 2020. doi:10.4018/IJIRR.2020040101

[17] Sharma K., Dubey S.K. (2020) Ranking of E-Commerce Sites in India Using Decision-Making Approach. In: Sharma D., Balas V., Son L., Sharma R., Cengiz K. (eds) Micro-Electronics and Telecommunication Engineering. Lecture Notes in Networks and Systems, vol 106. Springer, Singapore

[18] B.D. Rouyendegh, K. Topuz, A. Dag, A. Oztekin. "An AHP-IFT Integrated Model for Performance Evaluationof E-Commerce Web Sites". In the Journal of Information Systems Frontiers, 2018.

[19] Kahraman, S. C. Onar. B. Oztaysi. "B2C Marketplace Prioritization Using Hesitant Fuzzy Linguistic AHP". In the International Journal of Fuzzy Syst, pp 2202–2215 2018.

[20] G. Sisodia, K. Sharma, S. Gupta. Intuitionistic Fuzzy Weighted Sum and Product Method for Electronic Service Quality Selection Problem. In International Journal of Modern Education and Computer Science, pp 33-4, 2018.

[21] ZAIM, Houda and Ramdani, Mohammed and Haddi, Adil, A Model of E-Commerce Self-Assessment System Based on E-Customer Behavior (May 15, 2018). Smart Application and Data Analysis for Smart Cities (SADASC'18). Available at SSRN: https://ssrn.com/abstract=3179244

[22] H. Zaim, M. Ramdani, A.Haddi. 2018. SIG Proceedings Paper in word Format. In Proceedings of ACM SITA conference, Rabat, Morocco, October 2018 (SITA'18), 6 pages. DOI: 10.1145/3289402.3289528

[23] H. Zaim, M. Ramdani and A. Haddi, "Multi-criteria analysis approach based on consumer satisfaction to rank B2C E-commerce websites," 2016 11th International Conference on Intelligent Systems: Theories and Applications (SITA), Mohammedia, 2016, pp. 1-6. doi: 10.1109/SITA.2016.7772260