Using fuzzy Indicators in customer experience analytics

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Abstract. The aims of this study is to propose a model for managing customer experience analytics focused on value generated in an online market, this study to explore touch points experience, measured with conventional indicators and fuzzy indicators, using to a structural equation model analysis and Mamdani inference method. The investigation has delved deeper into the nature of the value of the experience construct, the results revealed of the empirical study confirm regarding how the experience value is related with the key touch points of the customer/company relationship. Very few studies in the reviewed literature about the conceptualization on customer interactive experience focused on value generated in an online environment. This study becomes more relevant today, where, after the pandemic, the value of the online customer experience becomes more important.

Keywords: Fuzzy key performance indicator, customer experience, text mining, fuzzy set, mamdani model

1. Introduction

Customer experience (here onwards referred to as *CX*), has become a dominant marketing concept pivotal in marketing strategy [52, 62]; turning it into a competitive advantage for companies capable of delivering it [60]. The importance of *CX* is widely recognized in business by consultant groups and marketers [63], helping grow interest in academic research pertaining *customer experience* and *customer experience management* [61]. In lieu, various citations have been attributed to authors developing this area of study, such as: Novak, Hoffman and Yung [30]; Brakus et al. [53], Verhoef et al. [48], Brodie et al [54], Szymanski and Hise [55], Lemon and Verhoef [56], Berry, Carbone and Haeckel [3], Meyer and Schwager [25], Mollen and Wilson [57], Grewal, Levy and Kumarc [10]. In addition, Zha et al's [62] biometric study identifies *CX* as a vital link-related to value- in the economic relationship between customers, the company, and the market. Furthermore, the study also emphasizes the co-creation of *experience value* with the brand and customer experience.

This study proposes a model to manage *customer interactive experience* focused on value generated in an online environment, as well as to explore *touchpoints experience*; measured by conventional and fuzzy indicators that use a structural equation analysis model and the *Mamdani inference* method. Thus, the main goal is to determine the key performance indicators for the management of the interactive experience of the customer, through the analysis of fuzzy data in data mining. To clarify, "*classic data*" -in this study- refers to "*numerical*", whereas "*fuzzy data*" refers to all the information in "*linguistic*" format.

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Furthermore, the proposed conceptual model is based on [40, 59], which proposes the analysis of customer "*interactive experience*" for *customer experience management* (determined in a balance scorecard). Hence, to define the indicators of fuzzy management, text mining is applied to the *Mamdani inference* model.

In this regard, many authors agree on how *customer experience management* should include all the contact points between the customer and the company [7, 10, 14, 26, 40, 48]. In lieu, Meyer and Schwa- ger [26] consider *customer experience* as the internaland subjective answer of the people towards a director indirect contact with a company. They claim that direct contact normally occurs during a purchase, use and service, and is generally initiated by the customer. Additionally, Schmitt [40] -recognized for his contributions to *customer experience management*- proposes a model based on *Customer Experience Management* (*CEM*), which shows how to use the power of an experimental approach so as to be able to connect with the customer in each interaction or *Touch Points*. In this regard, Meyer and Schwager [26], consider that the *CEM* captures the subjective thoughts of customers regarding a specific brand at the company's interaction points with them; the "*Touch Points*".

To this end, Carbone and Haeckel [5] point out the need for new management principles, tools, and methodologies; with the goal of generating a new approach that should be the total sum of the experience -as the key proposal of value for customers-. Furthermore, management of signals produced by the customer's experience will be a source of competitive advantage, where a negative experience (or the absence of specific key clues) endangers the value of the entire experience [5].

Gathering this information, and transforming it into knowledge, is a great opportunity for organizations as customers are willing to provide it and exchange opinions. Hence, considering the aforementioned (and other factors), the handling of ideal methodologies for *customer experience management* is a priority for firms that consider the consumer to be at the top of the organizational pyramid [61].

Customer experience management is commonly defined as "*improving the value received by the customer by managing the experience that it has*" [5, 31, 33, 40, 48]. In addition, within customer experi-ence index proposals, the following have been found: [19, 34].

The precursors of the *key performance indicator* (KPI) were [16], which gather all the interrelated company strategies -transformed into goals and measured by management indicators- into one place [59]. Initially, the indicators were centred on a company's financial results, however, the fact that these results need to be supplemented with non-financial indicators -so as to create a comprehensive performance measurement system associated to the "*SMART Pyramid*" [23], the [15, 16], and the strategic maps [17]- has repeatedly proposed the use of indicators in different organizational functional areas.

According to previous research, the following relevant authors establish the following regarding the *key performance indicators*: [11] proposes a *process-based performance measurement framework* (*PPMF*); [12] proposes a fuzzy *KPY* in customer retention; [59] proposes *KPY* through fuzzy *customer experience* by free text; [28] defines how performance indicators in higher education applies to the assessment of doctoral/research degrees; [44] proposes a *KPY* by fuzzy linguistic variables to incentivize a pay system; and [58].

This article is divided into the following sections: Section 2 shows and explains a con- ceptual framework, the theoretical framework, and the methodology applied; Section 3 shows the results, which indicates the *Fuzzy Key Performance Indicators* (*FKPI*) for the *Customer Experience Management* model; and Section 4 describes the main conclusions and discussions of the document.

2. Conceptual framework and development of hypotheses

2.1. Fuzzy key performance indicators

Management indicators are constructs designed for creating an organizational performance model adequate for a specific purpose. These are conceived through useful abstraction, based on the plausible assumption that the management of large organizations requires a reduction in complexity to avoid information overload [22]. Furthermore, the use of indicators by company management is motivated by two more assumptions: 1) establishing and pursuing goals are often seen as an essential pre-requisite of a rational action [38], 2) it is a widely shared belief that the results of a course of action, that affects reaching an organization's goals, needs to be measured to be able to make decisions and thus control

management [35]. It is important to note that the practice of management has adopted the use of performance indicators, as *performance measurement systems* appear to be present in most medium and large organizations [42].

Marketing performance area, unlike measurements derived from the physical world, aims to mainly measure latent constructs such as: customer satisfaction, employee loyalty, brand experiences and emotional connection, among others, which can be expressed in quantitative or qualitative data. Basically, the aim of performance indicators is to measure a certain aspect of organizational performance regarding a certain reference object. Hence, a performance indicator is based on the hypothesis that appropriately represents a specific aspect of the organization's performance [46].

Quantitative sources of information are generally used in the creation of these indicators [59], allowing a company to perform complex statistical analysis. In the case of this study, the investigation proposes the creation of indicators based on qualitative sources of information- "*fuzzy*" for these purposes- gathered from data in text format.

In this regard, there is limited work in the literature pertaining *fuzzy key performance indicator*s. The only ones found are: [20, 25, 27, 32, 43, 51, 59], where [28, 51, 59] are applied to the marketing area. Furthermore, the appropriate theoretical background for the formalization of data vagueness is the *fuzzy set* and *fuzzy logic theory* [25].

2.2. Fuzzy inference systems

Fuzzy Inference Systems (*FIS*) are methodologies that represent knowledge and inaccurate data, characterized by being very representative of human thought. *FIS* defines a non-linear correspondence between one or more input variables (input) and an output variable (output), hence providing a base from which to deliver information for decision-making processes [24]. Moreover, they are based on the theory of fuzzy subset given by [49]. The idea of these subsets is that "*given a referential set, subsets are built in such a way that the characteristic function of belonging* $\mu A(x)$ *can adopt its values not only in the 0,1 set, but in the [0,1] segment; in other words, 0.1 in the intermediate values as well, in such a way that a value will be assigned, said value getting closer to the unit the closer it gets to it, or that it complies with the established property or proposition*" [9]. The concept of a *fuzzy set* associated to a determined linguistic value, defined by a word, adjective, or linguistic label, is included in this definition. This method is widely used to handle imprecise and uncertain information obtained in real-world problems [50]. In essence, the theory's main contribution is to allow the study of ambiguity by better expressing human expression and "*natural language*" logical relationships.

Of the types of fuzzy inference systems, three stand out: *Mamdani Model*, *Model-Tang Takagi-Sugeno* (TSK) and *Model Tsukamoto*. This study applies the *Mamdani inference* model as it is a fuzzy inference method –also called *Linguistics*- widely used in the fuzzy methodologies.

2.3. Proposed model customer interactive experience

The proposed conceptual model is based on Schmitt [40], who claims that the interactive experience that includes all kinds of exchanges between the company and the customers -for the development of *customer experience management*- must be analyzed. These are formed by key or crucial *contact points*, also known as *moments of truth* [40].

Thus, the model analyzes the causality between the value of the experience in the customer-company relationship, and its effects on the key contact points of interaction with the customer. To this end, an online business model is analyzed to identify these points, whilst also developing an empirical study on the customers. The critical moments con- sidered are: Ticket Purchase Experience, Website Experience, Pre-Flight Experience, In-Flight Experience, Post-Flight Experience, and Customer Service Experience. These aforementioned experiences are reviewed and ratified by a group of experts.

The *Experience Value* construct is made up of the following global valorization of the interactive experience of the customers: the ticket purchase, the experience with the company website, the experience before, during, and after the flight, and the experience with customer service. The indicators considered are grouped according to the following crucial identified contact points: ticket purchase experience, website experience, preflight experience, inflight experience, post-flight experience, and customer service experience.

General experience with the purchasing pro- cess shows that the purchase experience is part of the interactions that customers experience with the brand/customer [7, 40, 48], considering it to be within the search – purchase – and post-consumption

processes. [18] indicates that the perceived purchase experience is more important in the total value than the price and quality, while [3] suggests that companies should synchronize all *contact points* that involve the purchase process to give its customers satisfying experiences. Hence, this study proposes the following hypothesis:

Hypothesis 1: The general experience of purchasing a ticket has a direct positive effect on the value of the interactive experience of the customer-company relationship.

General experience with company's website shows that experiences with company web pages are differentiating elements for companies and their competitors, hence able to create memorable experiences for their customers [13, 30]. In addition, user experiences regarding company websites are related to their subsequent actions [41]. And every time companies interact with their customers they contribute to the value of the customer's experience with the company [40]. In lieu, [37] points out that e-retailer channels can develop memorable experiences for their customers, giving them greater control and empowerment within the website pages. Whereas [18] indicates that consumers with positive online experiences will perceive that the purchased product is of better quality, unlike consumers who have negative online experiences (especially if those that are not familiar with the product). Hence, the second proposed hypothesis is:

Hypothesis 2: The general experience with the company website has a direct positive effect onthe value of the interactive experience of the customer/company relationship.

General experience before flights indicates that since pre-flight experiences are moments of interaction with the customer, they are part of the moments of truth as noted by [40]. These points of contact between the customer and the company contributes to the valorization of the general experience with the brand [10, 40]. Therefore, the third proposed hypothesis is:

Hypothesis 3: The general experience prior to the flight has a direct positive value on the value of the interactive experience of the customer/company relationship.

General experience during flights shows that general valorization of the in-flight experience -which represents the service contracted by the customer- is part of the interaction points with the customer. Hence, the experience with a service, and its valorization, can be completely subjective. Thus, its valorization will be done once consumers have lived through the service and have compared it to reality [36]. In addition, the value also resides in consumer experience [39]; the literature classifies it as a functional value and an experiential value [18]. This presents the fourth hypothesis:

Hypothesis 4: General experience during a flight has a direct effect on the value of the interactive experience of the customer/company relationship.

General experience after the flight shows that the moments of interaction with the customer, after they have lived through the contracted experience, is still within the scope of the company's global service. The management of customer interactions includes the post-sales service [21], and authors identify the guiding interaction components' effects on the performance measures at an aggregate value for the customer. Henceforth, the fifth hypothesis is:

Hypothesis 5: The general experience after the flight has a direct positive effect on the value of the interactive experience of the customer/company relationship.

General experience with customer service shows that most studies indicate that e-consumers need some kind of human interaction [1]. It can be inferred that customers feel more at ease when they know they have the possibility of asking questions directly to a person, implying an increase in the value of the customer/company relationship experience. Additionally, considering [18], the service needs of an online store are different than those of a physi-cal store, making customer expectations differentin both scenarios. Therefore, good customer service contributes to greater value of the global customer experience with the online company, making the sixth hypothesis:

Hypothesis 6: The general experience with customer service has a direct positive effect on the value of the interactive customer/company relationship.

The measure of degree in which the value of the interactive experience of customer-company relationship is explained by the global perceived value of customers in each key company contact point. Interaction with customers can improve, or worsen, the experience of these same customers through brand experience [40]. The design of this interaction is important and must follow a global implementation model, where it's content and form must be based on

customer input [40]. The second stage of the model is that all contact points are crucial.

Taking this into consideration, past experiences build the global valorization of the customer experience, thus affecting the creation of expectations regarding the purchasing process [2], which will affect the final evaluation of the customer-company interaction. This leads to the following hypotheses:

Hypothesis 7a: The experience value has direct positive control on customer experience at the moment of purchasing the ticket.

Hypothesis 7b: The experience value has direct positive control on the customer's experience with the company website.

Hypothesis 7c: The experience value has a direct positive effect on the experience of the customer before flying.

Hypothesis 7d: The experience value has a direct positive effect on the experience of the customer during the flight.

Hypothesis 7e: The experience value has a direct positive effect on the experience of the customer after the flight.

Hypothesis 7f: The experience value has a direct positive effect on the experience of the consumer with customer service.

Figure 1 outlines the conceptual model. After reviewing the literature, the proposal proposes the creation of the *fuzzy key performance indicator* (*FKPI*) to evaluate customer perspective in a balance scorecard. In the airline's case, the customer experience process is shown in Fig. 2.

3. Methodology

Previous studies [40, 59] have based their customer experience research on fuzzy logic methods, due to the vagueness of the data obtained from the customers. Consequently, this study uses qualitative and quantitative analysis. The initial stage starts by applying multiple linear regression analysis and *structural equation model* (*SEM*). This is followed by using a fuzzy logic analysis method known as the fuzzy inference model [70]. Analysis is based on the conceptual framework proposed by Schmitt [40] and Nicolas [59].

The project uses sampling type probabilistic and simple random sample, returning a valid sample

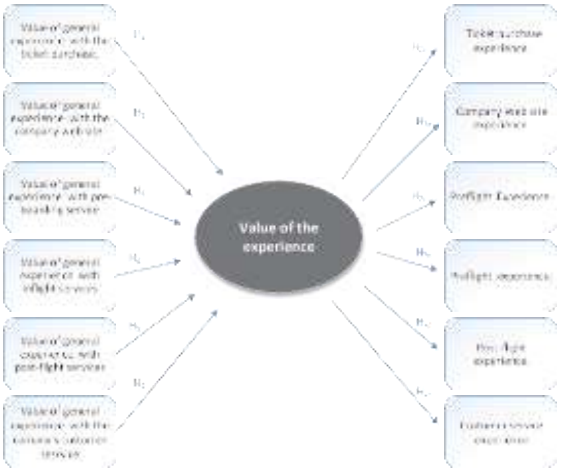

Fig. 1. Conceptual Model: Value of the experience. Source Self-elaborated.

of 960 surveyed individuals for the analysis. The selected data universe is made up of active customers in an online market. The margin of error is of +/-3.16% (this margin of error is calculated with a probability of it not surpassing 95%, and for the most unfavorable case; in other words, of maximum indetermination (P = Q=50%), for an infinite universe (N > 100,000)). Geographical selected area: Spain. The final sample is composed of the following: 49.8% women, 50.2% men. Of these, 57% were be-tween the ages of 25-44, 68.9% live in Spain, 61.5% have college level educations, and 58.6% are de-pendent workers.

This cross-sectional study uses an online style structured questionnaire as an information gathering tool. To measure value of the experience and de customer experience the study used fixed text, the semantic endecadaria scale, this scale adapts to eleven linguistic expressions, which are subjective and uncertain, with a sensible level of assumption α of truth in the interval [0; 1], which is defined as a grouping of graduated responses; using fuzzy inference model [59].

Analysis of the conceptual model is seen in Fig. 1, "Value of the experience". The first stage regards the validation of the pro-posed model by contrast- ing the existing relationship between the explanatory variables: value of the general experience with the purchasing process, value of the general experience with the website, value of the general experience before the flight, during the flight, after the flight, and with customer service, and the explained variable of experience value. By also employing multiple

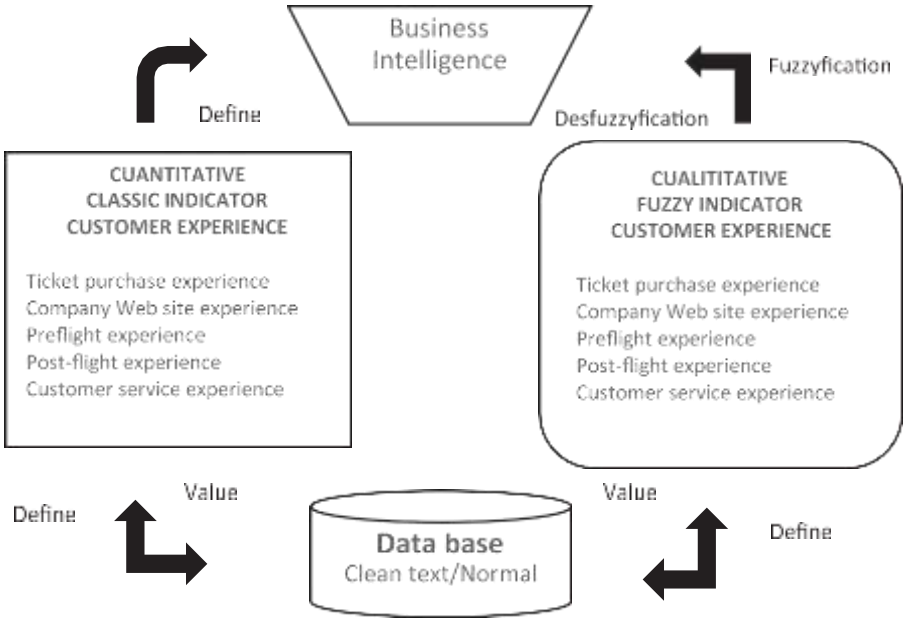

Fig. 2. Proposal for Analyzing Customer experience data. Source: Self-elaborated.

linear regression analysis, the relationship between the dimensions are compared to measure the implications of the value of experience on the experiences of customers in each of the key points of contact between client-company; this stage applies a structural equation model (SEM).

Considering the aforementioned, the investigation uses causal-predictive analysis with exploratory characteristics. For this, one-dimensionality, reliability, and validity factors were analyzed prior to the main document analysis; providing internal valid evidence in the design of the measurement scales, whilst dealing with the conditions necessary so that the investigation results correspond to reality and are not merely the effect of the investigative process. In addition, the external validity focuses on problems related to the generalization of results and other groups, situations, and markets [7] (see Table 6). To analyze this validity, the scales are adapted from several theoretical research proposals such as [13, 18, 29, 30, 37, 40, 41].

A group of three experts help define the model and verify the validity of the scales to be able to evaluate each scale's item.

The decision is to use a measuring scale from values 0-10, where 0: Terrible Experience, and 10: Excellent Experience. Justification for the use of a 0-10 scale stems from the greater understanding in the target population on the values attributed to these numbers (10, meaning excellence, 0 meaning terrible). This allows the data to have a mid-point (5).

The second stage is the creation and measurement of diffuse model of customer experience: employing indicators of results and discussion, to see Fig. 13. At this stage of the analysis it is applied in Fuzzy Inference Systems (FIS) [24] methods explained in section 2, with the aim of making inference with fixed text. With these results it is built a model for managing customer experience analytics focused on value generated in an online market, responding to the research objective.

4. Results and discussion

4.1. Validating the proposed global model

4.1.1. Multivariate general linear model (GLM) validation

Table 1 presents the correlation matrix. As shown, all correlations are positive and at about 0.3, indicating that there is a correlation between the measured constructs. All are significant.

The model shows a good fit, where the R-squared (0.553) is almost equal to the adjusted R (0.555), indicating that all variables provided are used in the estimation of the model. The Durbin-Watson (2.103) statistic is greater than 2, showing that the model used

Table 1
Correlations matrix

		VE	EB	EW	EA	EV	ED	EC
Pearson correlation	VE	1,000	,620	,510	,627	,606	,632	,370
	EB	,620	1,000	,645	,570	,518	,527	,331
	EW	,510	,645	1,000	,549	,533	,567	,284
	EA	,627	,570	,549	1,000	,659	,704	,407
	EV	,606	,518	,533	,659	1,000	,675	,341
	ED	,632	,527	,567	,704	,675	1,000	,363
	EC	,370	,331	,284	,407	,341	,363	1,000
Sig. (1-tailed)	VE	.	,000	,000	,000	,000	,000	,000
	EB	,000	.	,000	,000	,000	,000	,000
	EW	,000	,000	.	,000	,000	,000	,000
	EA	,000	,000	,000	.	,000	,000	,000
	EV	,000	,000	,000	,000	.	,000	,000
	ED	,000	,000	,000	,000	,000	.	,000
	EC	,000	,000	,000	,000	,000	,000	

Source: Prepared by the authors.

is appropriate to measure the dependent variable. The F test (0.000) indicates that the model is significant with *** 99% confidence.

The analysis shows that the Beta coefficient variables all have a positive value in the estimation of VE, except for the EWG variable which has a slightly negative Beta and is associated with being a non-significant variable in the model. The rest of the variables, along with the constant, returns significant values, with appropriate estimates of the dependent variable. See Table 2.

4.1.2. Exploratory and confirmatory factor analysis

Based on the individual analysis of the factors described as parts of the model, it can be stated that each construct is made by its corresponding items; being, based on the statistical adequacy and suitability of factor analysis, as well as the reliability of each construct, the possibility of confirming the previous proposed model is feasible. These are regarded as constructs -Shopping Experience Tickets (EB) and Experience Serv. Customer (EC)- which require individual confirmation in the confirmatory factor analysis (CFA), given the anomalies in the AFE at the individual level, Table 3.

Table 2
Coefficients

		Unstandardized		Standardized		
Model		coe ficients B	Std. Error	coefficients Beta	t	Sig.
1	(Constant)	0,409	0,234		1,749	0,081
	EBG	0,323	0,032	0,308	10,13	0
	EWG	–0,019	0,038	–0,016	–0,508	0,612
	EAG	0,159	0,034	0,16	4,68	0
	EVG	0,198	0,036	0,177	5,542	0
	EDG	0,243	0,037	0,222	6,517	0
	ECG	0,064	0,023	0,067	2,788	0,005

a. Dependent Variable: VE. Source: Self-elaborated.

Table 4 concludes that the variance explained by standardized R is high (greater than 0.5) in almost all constructs except SB4, SB5, SW6, SW7; which have values below 0.4. To assess the overall fit of the model, the research considers and discusses: Setting absolute index, Incremental Adjustment Index, and Index Adjustment Parsimony. In this case, the model shows a relatively good fit given the exploratory nature of the research -all fit under the minimum accepted- and incremental and parsimony indices are within acceptable ranges. SB4, SB5, SW6, SW7 items have problems in R standardized factor loadings, thus the investigation suggests deleting the respective constructs.

4.2. Fuzzy indicators – fixed text

After defining the management of interactive customer experience model, the study proceeds with defining the fuzzy management indicators; using indicators defined by fixed text and understood as a group of graduated responses. The methodology used in this stage is the [24] fuzzy inference method (see Fig. 3).

Table 3
Main statistical exploratory factor analysis

Construct	Number of items	Chi-square	Sig.	Correlation	KMO	N° of factors	Alfa Cronbach
EB	3	444,463	0	(+)	0,532	1	0,587
EW	7	2003,683	0	(+)	0,853	1	0,927
EA	3	790,362	0	(+)	0,668	1	0,796
EV	5	1798,337	0	(+)	0,8	1	0,837
ED	3	1143,805	0	(+)	0,705	1	0,856
EC	4	982,289	0	(+)	0,756	1	0,927

Source: Self-elaboration. Note: Extraction method: Analysis of main components. Rotation Method: Varimax standardization with Kaiser.

Table 4
Statistics for Value of experience and its components

Variable	Items	Standardized R	R square
Value of experience	EB	0,5	0,25
	EW	0,71	0,51
	EA	0,97	0,93
	EV	0,81	0,65
	ED	0,96	0,91
	EC	0,23	0,05
Items	EB1	0.89	0,8
	EB3	0,57	0,38
	EB4	0,34	0,11
	EB5	0,34	0,15
	EW1	0,88	0,77
	EW2	0,89	0,78
	EW3	0,74	0,55
	EW4	0,81	0,65
	EW5	0,76	0,58
	EW6	–0,06	0
	EW7	–0,07	0,01
	EA4	0,67	0,45
	EA7	0,84	0,7
	EA8	0,8	0,65
	EV1	0,72	0,53
	EV2	0,61	0,37
	EV3	0,88	0,77
	EV4	0,85	0,72
	EV5	0,62	0,39
	ED1	0,83	0,69
	ED2	0,89	0,8
	ED3	0,77	0,6
	EC1	0,74	0,55
	EC2	0,84	0,71
	EC3	0,97	0,94
	EC4	0,95	0,89
Goodness of fit	Adjustment measures	Criteria	Result AFC
Absolute fit indices	Chi Squared	>0,05	3456,296
		Sig.	0,000
	RMSEA	0,05 a 0,08	0,208
Fit indices incremental	NFI/TLI	Greater or equal to 0,9	0,716/0,716
	IFI/CFI	Greater or equal to 0,9	0,733/0,732
Parsimony Index	PNFI	Between0y1	0,601

Inference with the [24] shows it to be a fuzzy inference method (also known as Linguistic), which has a wider range of use than other fuzzy methodologies. The authors base themselves on [50]'s research regarding fuzzy algorithms for complex systems and decision-making processes. Application in the study is done through MATLAB version 7.1.

Hence, to complete the proposal, the process of analysis fuzzy indicators created from fixed text information as a group of graduated responses, is undertaken. In this sense, a [24] type unified intelligent system is applied. Generally, it is the most utilized system due to its efficiency and ability to model data for evaluation of Customer-Company Experience Value.

To solve the problem, a methodological sequence that covers the selection of indicators for each (customer) experience is passed through the design of the general architecture of the system to the fuzzy model, with the help of Fuzzy Logic Toolbox by Mat- lab software. Thus, the centroid in the de fuzzification method is used. Figure 3 shows all key performance indicators over customer experience.

4.2.1. The design of the fuzzy controller is the following: Ticket purchase example

All significant operating ranges are established for the design of the fuzzy controllers, which were the result of an acquisition of securities, from the minimum to the maximum, to both inputs to outputs.

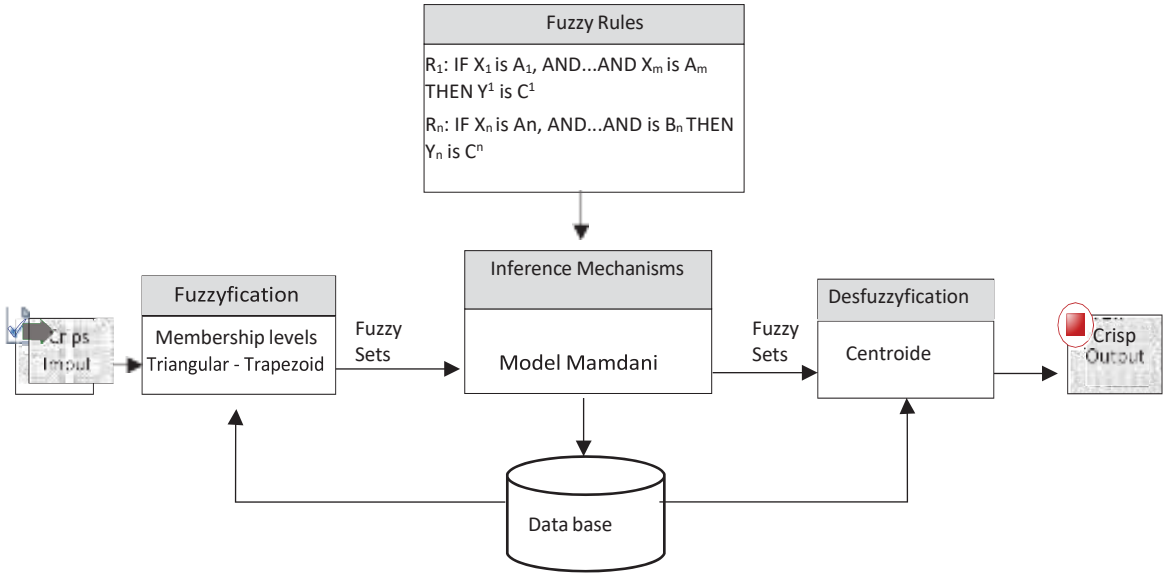

Fig. 3. Mamdani fuzzy inference system. Source: Self-elaborated based in Mamdani fuzzy inference system.

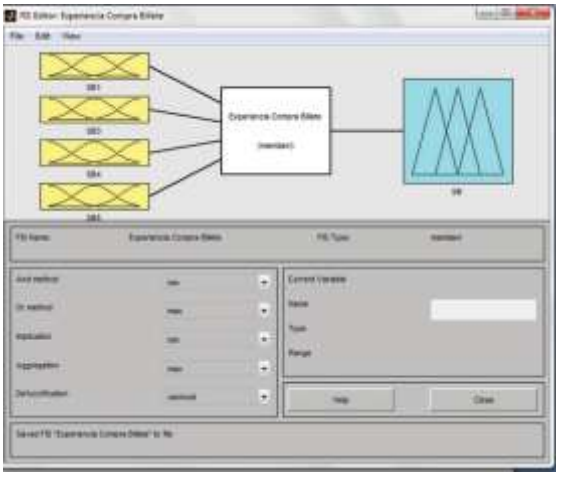

Fig. 4. Interface Editor.

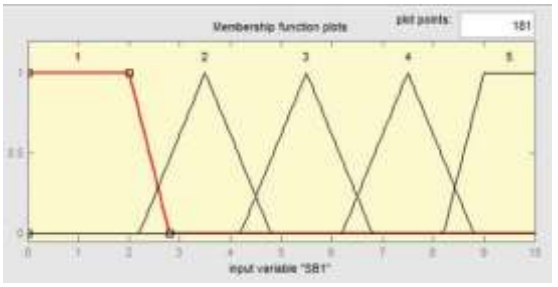

Fig. 5. Fuzzification de “SB1”.

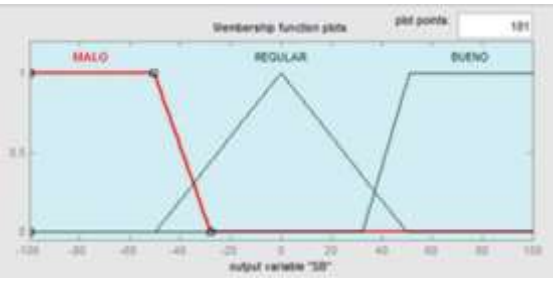

Fig. 6. Fuzzification de “SB”.

Table 5 shows the obtained maximum and minimum operating ranges.

As suggested by a group of experts, input data labels of the Fuzzy System ranges from 0-10, according to Linguistic labels. In the case of “*Very poor*”, the range is between 0-2, and so forth in as indicated in the table. Following normal procedure of the fuzzy inference Mamdani model, the following steps are performed (see Fig. 4).

Fuzzification of the membership functions

Fuzzification is carried out considering the membership functions of the extremities as trapezoidal functions. The purpose is so the tolerances are considered in the case of descending or ascending intervals which exceed the limits. The process for the rest was is through triangular functions, see Figs. 5, 6.

The triangular function is of belonging: “*trimf*”. This function is nothing more than a collection of

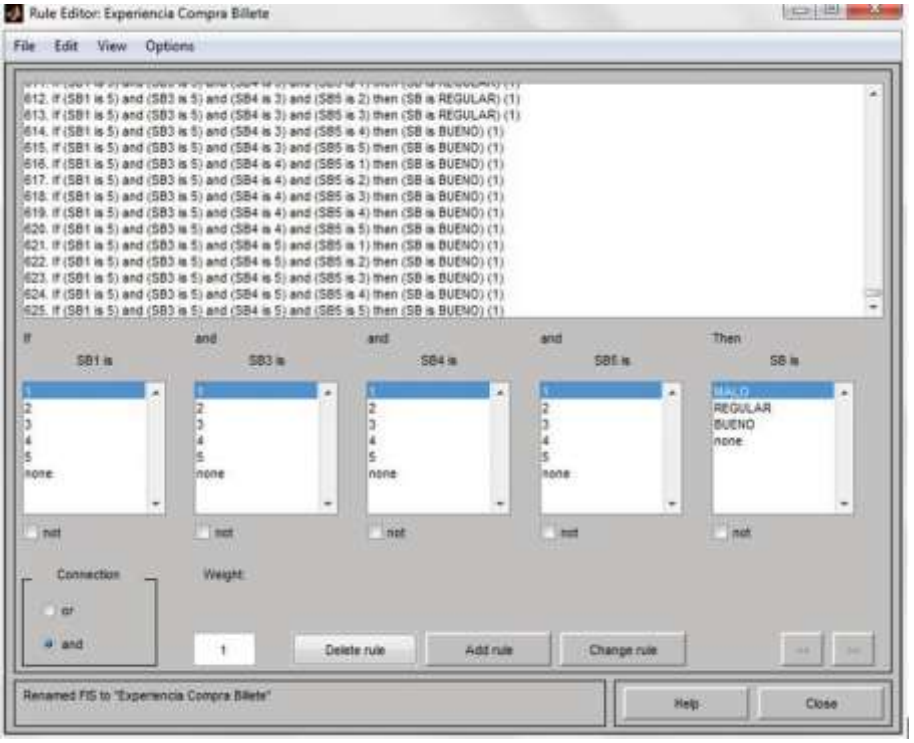

Fig. 7. Memberships for each entry and exit Ticker purchase.

three points that form a triangle. The trapezoidal function is of belonging "*trapmf*", which has a flat upper part and is a truncated triangle curve. These straight-line functions of belonging have simplicity.

Fuzzy inference mechanism

Fuzzy exit – the task of the inference system is to take the levels of belonging -based on the set of rules- to generate an exit from the fuzzy system. In this case, it is necessary to group the entry data into five groups, according to each corresponding label, so as to have a reasonable number of fuzzy rules. The set of rules is the manner that the fuzzy system has of storing the linguistic knowledge that allows it to solve the problem for which it was designed. As previously pointed out, the fuzzy inference method used is [29], and its rules are of the IF – THEN kind. As observed, a rule from the set of rules or knowledge base has two parts: the antecedent and the conclusion.

Fuzzy Rules: To create these types of rules it is necessary to make a table in order to observe all necessary possibilities (for better control). For an efficient fuzzy control of the airline experience, logic is important to solve different problems. Focusing on the number of memberships for each input and output, 625 possibilities are obtained as shown in Figs. 7 and 8.

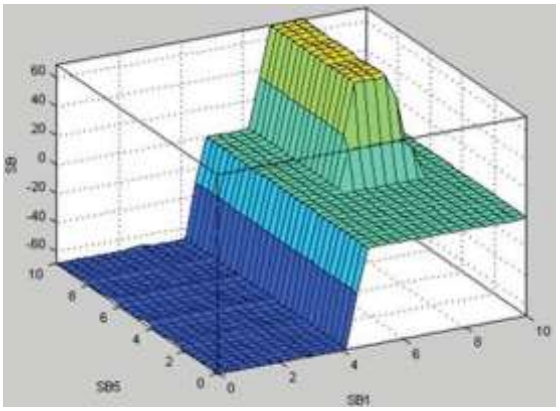

Fig. 8. Function response compared to SB function SB1 and SB5.

Defuzzyfication: To transform the fuzzy exit into a discreet value, the investigation uses the "Centroid" Center of Gravity analysis method. Three labels are used to group the exit data: "*Bad*" for the 1-2 range, "*Regular*" for the value 3, and "*Good*" for the 4-5 range. These labels are represented by a percentage indicator that corresponds to the [-100%, 100%]. Therefore, depending on the logic, an exit value that

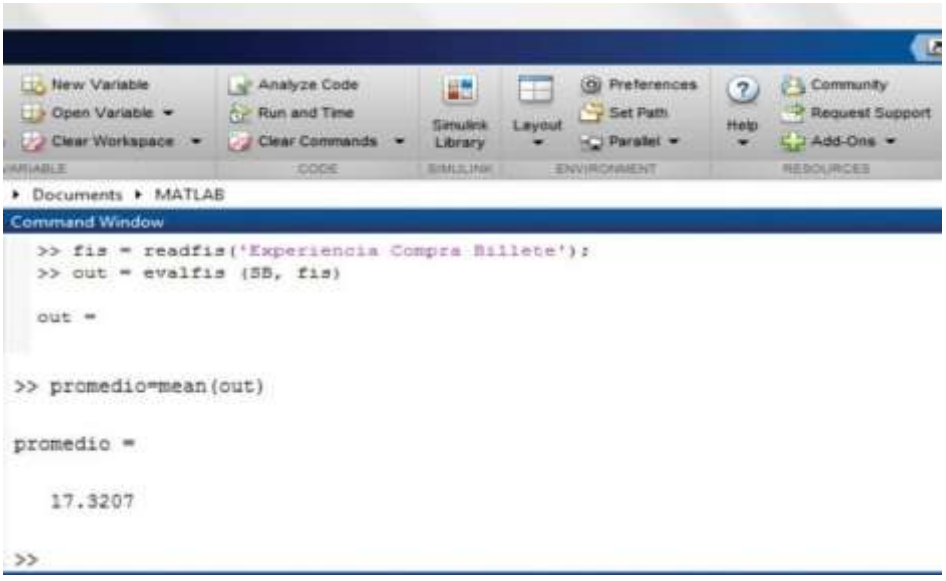

Fig. 9. Fuzzy key performance indicator to Ticker purchase example.

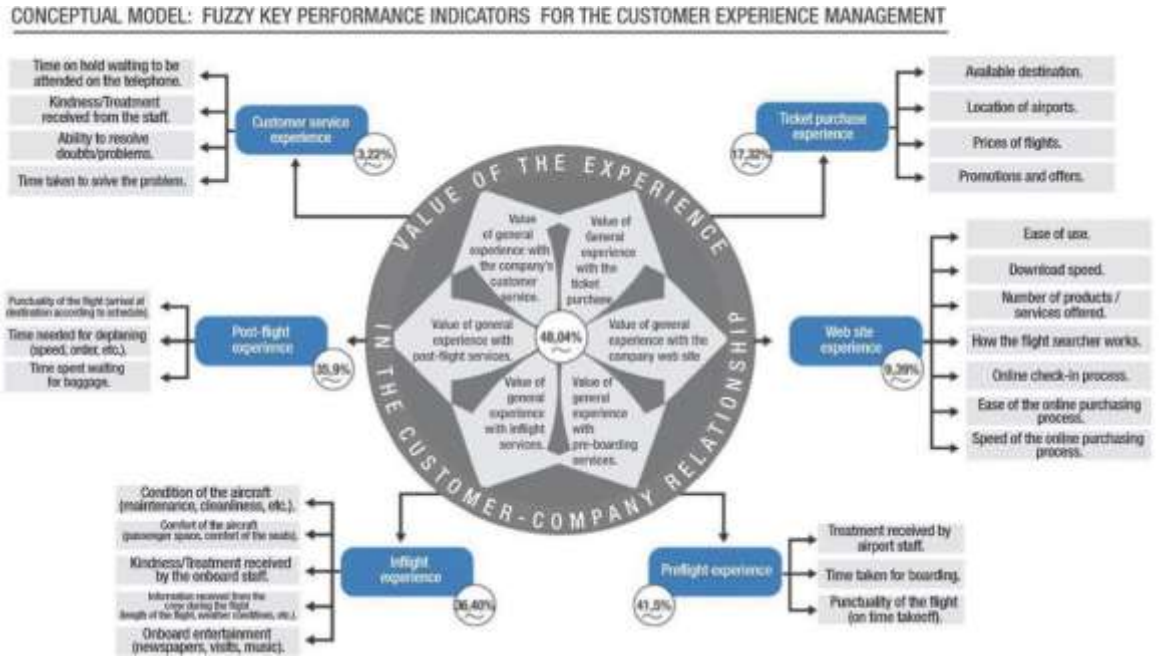

Fig. 10. Conceptual Model with Fuzzy Key Performance Indicators.

is a percentage of the indicator according to each experience is obtained.

Using *Matlab*, the input data (Excel SB) is loaded. Once stored in an array called "*SB*", loading the fuzzy controller (called "*Experience Purchase Ticket*"), and using "*evalfis*", the input data is loaded to the fuzzy controller and the output "*out*" is obtained with indicators of which the average is obtained using the "*mean*", see Fig. 9.

Consequently, the interactive customer experience model ends up being made up of classic and fuzzy indicators (see Fig. 10). In the case of fixed text,

six indicators are expressed, representing the fuzzy evaluation of each of the contact points. The most positive experience is before the flight, followed by the in-flight experience.

The final results, which allowed to add tothe explanatory model of fuzzy indicators forthe Management of interactive experience with customer-company relationship is seen in Fig. 10.

Results show that the application of the *theory of fuzzy sets*, supported in the modeling tool with Mamdani Inference System, is appropriate to define Interactive Experience Management indicators of the customer-company relationship. Fig. 10 shows the model for the customer experience with measured fuzzy indicators.

5. Conclusions

The aim of this investigation is to propose a model for managing customer experience analytics focused on value generated in an online market. The sec- ond aim of this study is to investigate the set out to fuzzy key performance indicators to assessment the customer experience.

The results of the study contributes empirical evidence that allows us to indicate that it is possible to define an explicative theoretical model for key performance indicators for the management of the experience of the customer, through classic and fuzzy data.

The investigation has also delved deeper into the nature of the value of the experience construct, analysing how sources of general experience value influence in its construction, resulting in evidence regarding how the experience value is formed with the key contact points of the customer/company relationship.

The results obtained, therefore, also allow us to indicate that after listening to and analysing the voice of the customer, it's possible to create management indicators that form the customer's perspective in an Integral Control Panel.

Lastly, the investigation contributes to, and increases, the literature regarding the experience value and the analyses based on fuzzy logic. Thus, methodologies for the management of uncertainty in the marketing areas of organizations are contributed. Its relevance is in the delivery of a proposal for the analysis of linguistic data transformed into management indicators.

Fuzzy indicators have been applied in other areas, such as [4] propose a Multidimensional and Fuzzy Indicator in the education area. For agricultural analysis [45], engineering [46, 49]. In social sciences, [47] analyze the level of customer retention with to put diffuse indicators; [9] proposes Multidimensional Fuzzy Indicator in Quality of work (QoW) analysis.

The business implications are related to development of business strategies that take into consideration the relationship of the contact points with the customer and the experience value.

All business aimed at customers should anchor their performance management policies on the creation of fuzzy management indicators that consider the models of natural communication present in human beings, avoiding Boolean groupings. Future studies consider new fuzzy key performance indicators about brand experience.

One of the limitations that this study presents is its application to a specific company, rather than focusing on an industry, or business activities of a determined sector. Also, the fact that in these business models the person that flies is not always the per- son that pays, and vice versa, should be considered. Therefore, this investigation evaluated the experience in a moment "X" of the company. Lastly, it is limited to a cross-sectional study, whereas a longitudinal section study would be a different contribution.

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