

THE QUALITY OF E-SERVICE IN B2C WEBSITES: AN APPROXIMATION WITH FUZZY DECISION SUPPORT SYSTEMS

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Abstract - *The present paper proposes a model to evaluate B2C websites. It has been considered a set of dimensions that have influence in the evaluation according to the literature review and a study of reliability. Once validated the model, it makes use of fuzzy inference systems in order to eliminate the uncertainty associated with the decision-making process. As a result of this research, a model capable of designing a simple and intuitive knowledge base is obtained (experts and/or users) in the evaluation of B2C websites, thus obtaining a further optimization of the results obtained.*

Keywords: Fuzzy Inference Systems, E-service, Quality Service, B2C websites evaluation.

1 Introduction

The growth of online shopping activities has been particularly rapid, presenting business opportunities, opening up a vast new territory, which business enterprises are eager to explore and resulting in more consumers and companies choosing the Internet as means of purchase and sale (Shih et al. 2002).

Among the different types of E-commerce, Business to Customer (B2C) technology covers those websites and transactions through which organizations sell goods and services to customers directly over the Internet. Efficiency and cost effectiveness of this technology have already transformed the web into a global environment for business. Nevertheless, consumers find many difficulties in the online purchasing processes that have to do with searching and browsing websites, evaluating and comparing products or with the payment process among others. All these inconveniences affect the satisfaction of customers with the B2C websites (Kuo et al., 2011).

The present paper proposes an exhaustive analysis of the variable influence-teas in the design and evaluation of B2C web sites. Once validated the proposed model is a methodology based on the fuzzy set theory. This methodology allows to improve the interpretation of the base of knowledge induced in the system of decision, improving

this way the behaviour of the model opposite to other simpler systems.

2 Literature Review

E-service quality analysis methods are supported by questionnaires with Likert-type scale. These questionnaires are filled into by potential customers. Next, Table 1 summarises the most commonly used methods, according to the reviewed literature, to evaluate the quality of the online service.

Table 1: Relevant dimensions for evaluate the quality of e-service in B2C websites.

RELEVANT DIMENSIONS FOR EVALUATE THE QUALITY OF E-SERVICE IN B2C WEBSITES	
Design	Definition Web design is an activity that consists in planning, modelling and implementing websites
	Authors Rangathan y Ganapathy (2001), Alpar (2001), Melián y Padrón (2005), Brown y Jayakody (2008), Lin (2009), Oppenheim y Ward (2010), Stefani y Xenos (2011).
Information	Definition Information, in general terms, is defined as an organised set of processed data that form a message that improves the level of knowledge of the receptors of the message.
	Authors Chang y Sangjae (2002), DeLone y McLean (2003), Evanshitzki et al. (2004), Melián y Padrón (2005), Cao et al. (2006), Meziane y Nefti (2006), Nielsen (2006), Joia y Barbosa (2008), Bauernfeind et al. (2009), Lin (2009), Sun y Lin (2009), Oppenheim y Ward (2010).
Warranty	Definition Warranty usually refers to the action that a person or company performs so as to assert what has previously arranged. By offering a Warranty, it is intended to supply greater security to the fulfilling of an obligation or the payment of a debt, according to the arranged.
	Authors Santos (2003), Melián y Padrón (2005), Otim y Varum (2006).
Offer	Definition In general terms an offer is a proposal made to execute or fulfil a series of requirements.
	Authors Yang et al. (2000), Melián y Padrón (2005), Cao et al. (2006).
Personalisation	Definition Personalisation is the adaption of the products or services to the necessities of customers, in such a way that a customer feels exclusive, unique and different.
	Authors Melián y Padrón (2005), Koutsabasis et al (2008) Adjei y Clark (2009), Bauernfeind et al (2009), Oppenheim y Ward (2010).
Payment Security	Definition Payment Security is defined as a protection Warranty regarding made transactions and used means of payment during the process of purchase.
	Authors Madu y Madu (2002), Francis y White (2002), Otim y Varum (2006), Venkataiahgari et al. (2006), Oppenheim y Ward (2010).
Privacy	Definition Privacy in the service is defined as the protection given to the data provided by the customer regarding record, treatment and preservation of those data. In electronic commerce, privacy refers only to the customers' personal data.
	Authors Ranganathan y Ganapathy (2001), Zeithami et al. (2002), Oppenheim y Ward (2010), Stefani y Xenos (2011).
Trust	Definition Trust is defined as the expectations that are set on something or someone. Regarding electronic commerce, it refers to the hope that online customers have that the purchase made in a web portal will be performed according to their expectations.
	Authors Gefen (2000), Kaplan y Nieschwietz (2003), Oppenheim y Ward (2010), Hong y Cho (2011).

3 Proposed Model

The model that is proposed to evaluate B2C platforms stems from a Delphi Study and through in-depth interviews performed in Spain by experts on Market Online. The study of the most relevant variables describes in part 2 has been the starting point. Additionally, a pre-test has been made to know the feeling of the customers.

To make the B2C evaluation system more easily understandable, it has been structured into three subsystems. Every subsystem's output dependent variable is function of a maximum of three input variables. Figure 1 depicts this structure.

A partial evaluation will be obtained from every subsystem. Later, the partial results obtained are combined, thus achieving the final evaluation of the B2C websites.

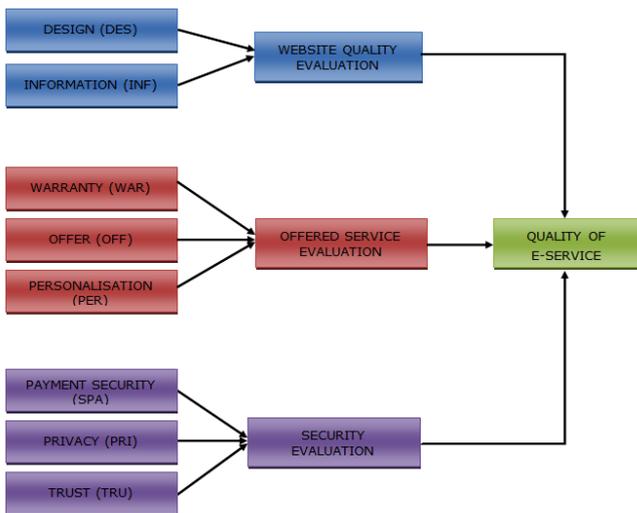


Figure 1: Model to evaluate the quality of e-service in B2C websites.

The information has been gathered by means of personal surveys filled in by Internet regular purchasers. The scales to evaluate websites underwent a pre-test performed by 405 regular Internet customers aiming to put to the test the proper comprehension of the questions and add, remove or modify the composition of the final questionnaire. The target universe has been defined as the set of individuals that are older than 18, that are regular buyers on the Internet and that live in Spain. The sampling error was $\pm 2,42\%$ with a trust level of 95%.

To determine the use of the B2C websites evaluation model, it has been evaluated the one-dimensionality and reliability and validity of the scales of measure. During the first phase of validation, the variables that have been studied

with all the items present in the questionnaire have been considered. This exploratory analysis made apparent the necessity of removing some of the items to optimise the composition of the scales. To that end, it has been used the statistical suite SPSS v.19. As a result of this pre-test, it has been performed an exploratory factor analysis of principal components with Varimax rotation and a reliability analysis by means of Cronbach's alpha. Table 5 shows the results obtained in this study.

Table 2: Results obtained through Exploratory Analysis and Cronbach's α .

	DES	INF	WAR	OFF	PER	PAY	PRI	TRU
Explicative Information Percent	59,3	68,4	65,7	54,4	52,5	65,1	90,6	82,1
Cronbach's α	0,80	0,90	0,90	0,80	0,60	0,80	0,90	0,79

Cronbach's alpha coefficient is an indicator used to determine the reliability of the scales. As seen in the previous table, all proposed variables exceed the threshold value 0,6 recommended in exploratory studies (Hair et al. 1999). Besides, in all cases, the proposed variables show a cumulative percentage of variance upper 50%. This is why the results obtained in this pre-test allow the validity of the proposed model to be confirmed.

4 Methodology

The methodology used to in this research is based on fuzzy decision support systems. These are based on the theory of fuzzy sets developed by Zadeh (1965), which allows you to incorporate the term of uncertainty associated with the decision-making process which is better approximate to the reality (Martin y Sanz, 2005).

In fuzzy inference systems, variables, linguistic, allow to process both qualitative and quantitative information since they take as values labels associated to concepts of common language. This contrasts with the traditional numeric variables whose values are numbers (Ponce, 2011).

In our case, to assess the quality of perceived e-service - by users or experts- presents a high level of subjectivity. For this reason, the use of linguistic labels will allow a better adaptation of the assessment criteria given in the evaluation of B2C websites. It will also be tested the design of a fuzzy system in the field of B2C e-commerce, and specifically in the evaluation of websites, allowing a better interpretation of the basis of knowledge inserted in the decision systems, thus improving the results to the output of the proposed model.

4.1 Fuzzy Decision Support Systems (FDSS)

In this case, for use to a fuzzy decision support system will be utilised aided by the application Matlab fuzzy logic toolbox ® version 2.0. (Mamdani and Gaines, 1981).

So as to make the inference, it is required a knowledge base built up from an expert's know-how, able to explain the operation of the system by means of a set of linguistic rules made up with the input and output variables (other options would allow to constitute the base of rules from reasoning systems based on cases). So, in the first place, it is necessary to define the range and form of the labels in which the dominions of the system variables are partitioned in order to define the variables in a fuzzy way. Mamdani type fuzzy decision systems, supported by all the aforementioned, allow to make inferences through a process that consists of five stages (Chen & Klein, 1997): fuzzyfication, application of logical operators in every rule's antecedent, implication to every rule's consequent, aggregation of all rules' consequents and defuzzyfication of the final aggregate.

Additionally, it will be established the adequate sequence of fuzzy subsystems that are part of the model and the evaluation knowledge will be aggregated as conditional rules for each qualification subsystem (in such a way that allows to intuitively assign linguistic labels to all the variables (Martinez-López et al., 2009)). Figure 2 represents the labels used in input and output variables.

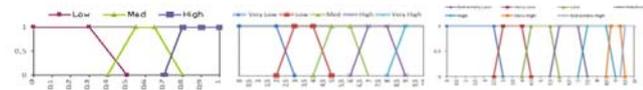


Figure 2: Labels of input and output variables.

Later, the four rule-bases that are to be used are defined for each evaluation subsystem by using the expert's knowledge: Web Quality, Offered Service, Service Security and Final Evaluation (See Table 7).

Table 3: Bases of rules for each partial and final subsystem.

WEB QUALITY		DESIGN			OFFERED SERVICE		PERSONALISATION						SERVICE SECURITY		TRUST									
		L	M	H			L	M	L	M	L	M	H	L	M	L	M	L	M	H				
INFORMATION	L	VL	L	M	OFFER	M	L	L	M	M	M	M	H	SERVICE	M	VL	VL	L	M	M	M	M	H	VH
	H	L	M	VH	H	L	M	M	M	M	M	M	H	PRIVACY	H	VL	M	M	M	M	M	M	H	VH
					WARRANTY								PAYMENT SECURITY											
					L		M						H											

FINAL EVALUATION	OFFERED SERVICE	WEB QUALITY																			
		VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH	VL	L	M	H	VH
VL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
L	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
M	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
H	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
VH	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
		VL		L		M		H		VH											
								SERVICE SECURITY													
								L						M							

Labels: EL – Extremely low; VL – Very low; L – Low; M – Medium; H – High; VH – Very High; EH – Extremely High

For instance, the shaded cell in the table related to security expresses the rule: If the score of security is medium

and privacy is low and confidence is high, then the final evaluation of the security is medium.

Once a fuzzy subsystem has been designed, the evaluation of a website can be inferred from it as a function of the crisp values given to the input variables. What is more, it is easy and intuitive to analyse the congruence of the obtained evaluations by using the inference maps supplied by each model's subsystem. In these maps, the scores of the input variables are represented by the height of the surface in each point. For, example, the Figure 3 shows the evaluation of the offered service as a function of two input variables (Offer and Personalisation), while keeping constant the other input variable which is not shown in the graphic (Warranty).

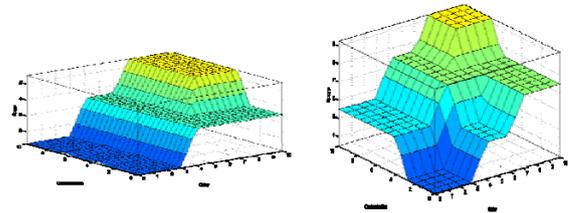


Figure 3: Map of solutions of the Offered Service subsystem with low warranty (left graphic) and high warranty (right graphic).

The analysis of the influence of those input variables on the Offered Service evaluation shows that in case the customer perceives that the offered products have a short warranty period, the final evaluation is penalised so that the maximum values are around 5.5. On the opposite, if the variable [Warranty] has medium or high values, the evaluation of the offered service can reach values over 9 points (if the scores of the rest of the variables are regarded as high).

Therefore, establishing a warranty system in agreement with customers' necessities and wishes may grant competitive advantages to the company over those that do not establish a warranty policy.

5 Conclusions

In these paper carried out an analysis of the main variables used in the evaluation of websites in the textile sector. It has conducted a comprehensive literature review, along with a Delphi method and a pre-test. Once considered the appropriateness of the different variables have been a market study to regular users in the search/purchase of items of fashion through the Internet, thus the validation of the proposed model.

Once the proposed model has been validated, it has analyzed the uncertainty associated with the processes of evaluation of this type of websites. As a result, a model, based on fuzzy inference systems, has been able to improve the interpretation of the induced in decision system, knowledge base thus improving behaviour compared to other simpler systems.

As future lines of research is intended to merge with neural network fuzzy inference systems in order to achieve a base of knowledge as dynamic as possible.

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