

# A fuzzy model of customer satisfaction index in e-commerce

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## Abstract

Customer satisfaction index (CSI) is an important concept for evaluating the quality of service in e-commerce. It permits to evaluate the validity of an e-commerce operation from the point of view of consumers. In this paper, we present a model of CSI in e-commerce using fuzzy techniques and provide a method for calculating CSI, expressed in a five levels quantity table.

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## 1. Introduction

Since Oliver [17] put forward a cognitive model for characterizing antecedents and consequences of satisfaction in 1980, customer satisfaction and customer satisfaction index (CSI) have been widely developed in both theory and applications [3,5,7,9,13,14,16,18,19], especially in the fields of marketing, education, medical treatment, guesthouse management. In 1989, the first model of CSI was built by Swedish researchers [12]. The American customer satisfaction index (ASCI) was set up in 1994 [1]. Another well-known CSI was built by 11 countries of European Union in 1999 [15,22]. In practice, these CSI play a very important role in the improvement of enterprises' performance [6,11].

Also, e-commerce through Internet has become an important transaction model in international trade [2,20]. In this situation, more attention has been paid to the problem of e-commerce customer satisfaction [8,21]. For example, the fourth quarter 2004 e-commerce aggregate customer satisfaction score of USA is 78.61 [4]. However, most of existing CSI are rather similar between them. Each of them generally includes 4–7 indices and uses numerical scores in related computing. In fact, in many cases, it is very difficult to assign exact numerical scores to an index. Moreover, these proposed indices of CSI are not completely accepted by general public. In this background, we present in this paper a new model for evaluating customer satisfaction in e-commerce and a new method for calculating the e-commerce customer satisfaction index (ECSI) using fuzzy techniques.

In the quality system certification of ISO9000 of 2000 edition, the term *customer satisfactory degree* has been used frequently. ECSI is used for measuring this concept in e-commerce by evaluating the criteria of customers' cognition and expectation, customers' loyalty behavior and grumble behavior. As there exists uncertain information in the evaluation of customer satisfaction, this paper uses fuzzy logic to calculate ECSI. The basic ideas for evaluating customer satisfaction and calculating ECSI are given as follows. First, customers compare their cognition with the

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perception in e-commerce. The result of comparison is denoted as  $ECSI_1$ . Second, customers express their loyal behavior and grumble behavior in e-commerce. It is denoted as  $ECSI_2$ . Third,  $ECSI$  is obtained by aggregating  $ECSI_1$  and  $ECSI_2$  using a specific fuzzy composition operator.

Since Zadeh built fuzzy set theory in 1965 [23], a lot of fuzzy logic based applications have been successfully put forward in many fields [10]. As there exist uncertainty and imprecision in the nature and human perception, fuzzy logic can be considered as a powerful and practical tool for solving human related problems, such as classification, evaluation and decision support in the fields of industry, economy, society, safety and management.

The organization of this paper is as follows: Section 2 describes the concept of  $ECSI$  using the ideas of system analysis and system control. The model of  $ECSI$  and its basic formalization are given in this section. More details on the description and computing of the related indices are proposed in Section 3. It includes two parts, i.e. the description of the input (denotes as  $ECSI_1$ ) and the output (denotes as  $ECSI_2$ ) of the model of  $ECSI$  as well as the fuzzy logic based method for computing synergistic values of different indices. Section 4 introduces the main steps for measuring  $ECSI$ . In Section 5, one application of evaluation with  $ECSI$  is given in order to validate the effectiveness of our method. A conclusion is provided in Section 6 to show the significance of our method.

## 2. Model of ECSI

$ECSI$  can be considered as a system with input and output variables. The input variables concern the comparison between customer’s expectation and cognition in e-commerce while the output part generates two variables, i.e. customers’ loyalty behavior and grumble behavior. In general, it is easier to obtain the result from the output than from the input of  $ECSI$ . The model of  $ECSI$  is shown in Fig. 1.

In Fig. 1,  $U, V, S$  and  $T$  denote the sets of linguistic variables related to expectation index, cognition index, loyal behavior index and grumble index of customers in e-commerce respectively.  $\Delta$  represents a vector of adjustment values for improving the quality of  $ECSI$  by taking into account the difference between  $ECSI_1$  and  $ECSI_2$ . If  $ECSI_1 = ECSI_2$ , then  $\Delta = 0$ . More details on the formalization of these concepts are given below.

### 2.1. Index of expectation and cognition of quality of customers in e-commerce

Formally,  $ECSI_1$  is defined by

$$ECSI_1 = R \left( \frac{V}{U} \right) \tag{1}$$

In (1), the relation between  $V$  and  $U$  is bijective, and  $R(V/U)$  expresses the result of comparison between  $V$  and  $U$ .  $ECSI_1$  is one  $r$ -dimensional vector of membership degrees related to  $r$  predefined linguistic evaluation terms describing customer satisfaction levels. Each membership degree varies between 0 and 1.

### 2.2. Index of customers’ behavior in e-commerce

The index of customers’ behavior in e-commerce  $ECSI_2$  is formally expressed by

$$ECSI_2 = (w_S \quad w_T) \circ \begin{pmatrix} S \\ T \end{pmatrix} \tag{2}$$

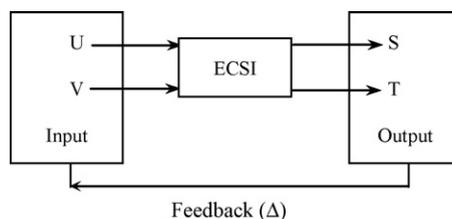


Fig. 1. A model of ECSI.

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