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Ranking the strategic actions of Iran mobile cellular telecommunication using two models of fuzzy QFD

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ABSTRACT

Mobile cellular telecommunication success in target markets first requires ranking the customer's expectations and then prioritizing the engineering characteristics (ECs) to meet the expectations. In this paper, two prioritization models based on quality function deployment (QFD) are developed to rank the strategic actions (SAs), or the ECs of Iran mobile cellular telecommunication. QFD is a widely used customer-driven tool for which the success of its applications may be the result of some of its benefits, such as greater customer focus. It uses a matrix called House of Quality (HOQ) to translate Customer Attributes (CAs) into ECs. However, due to the high degree of subjectivity in constructing the HOQ, the application of fuzzy logic provides an efficient tool to handle the subjective assessments. On the other hand, taking into consideration the gap between the current state and the positive ideal state for each CA, TOPSIS is used to rank CAs in a first model. In addition, in a second model, using the analytic hierarchy process (AHP), more criteria are taken into consideration in ranking CAs. Also, a fuzzy utility factor, B_j, is used to rank SAs in both models. Both presented models have the ability to capture the vagueness of human thinking style, and let customer oriented organizations, such as MCI, derive benefits from the voice of the customer (VOC) in a more expressive way.

1. Introduction

Telecommunication is a profitable industry which develops societies in cultural, economic, and social aspects. However, any extension in its deployment should consider the circumstances of the society which is taking advantage of this industry. Therefore a multilateral study is required for telecom development in order to gain a proper ranking. Although Mobile Communication of Iran (MCI) has been so successful in giving cell-phone SIM-cards to the customers (quantitatively) in recent years, complaint reports indicate that the quality of cell-phone line service presentation could not satisfy cell-phone users in many aspects. Furthermore, elevation of customers' expectations of MCI has led them to go beyond only playing the role of a convinced consumer and show their desires in being involved in quality promotion. Therefore, using a customer-driven tool would be so beneficial for MCI to capture its customers' points of view and raise their satisfaction level. Quality function deployment (QFD) is a customer-driven tool widely used in product planning to achieve a higher level of customer satisfaction (Zhang, 2009). It uses a matrix called House of Quality (HOQ) to translate Customer Attributes (CAs) into engineering characteristics (ECs). Constructing the HOQ, which includes determining the importance weights of CAs, the correlation matrix among ECs and the relationship matrix between CAs and ECs are important factors in the application of

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QFD. However, considering the typical vagueness of functional relationships between CAs and ECs, and the correlation among ECs, it is difficult to identify them (Bevilacqua & Ciarapica, 2006); therefore, HOQ in QFD states linguistic and vague ideas (Liu, 2009). Fuzzy logic can help QFD change customer's vague language into fuzzy numbers, and let the customer oriented organization, such as MCI, take advantage of the voice of customer (VOC) in a more expressive way and rank the organizations' ECs in order to increase customer satisfaction. So, MCI can benefit from fuzzy QFD to consider cell-phone users' expectations and key CAs, and then to prioritize the ECs.

In this paper two prioritization models are proposed in order to rank MCI strategic actions (SAs). Using fuzzy logic, different parts of HOQ such as the relationship matrix between customer's expectations (shown by WHATs or CAs in this paper) and the ECs of MCI (shown by HOW or SA) were changed from linguistic-vague forms into fuzzy numbers. In both models, first the priority weights of CAs were calculated by fuzzy-TOPSIS deployment in Model I and by AHP in Model II. Then, SAs were ranked through application of fuzzy QFD, which is the second part of both models. Additionally, the way HOQ applied with multi-objectives and four new fuzzy parameters, added to HOQ, is demonstrated. In Model I, satisfying each customer's need is supposed as a goal for MCI. Achieving all these goals is not feasible simultaneously because of company's resource limitations, technical problems, and some conflictions therein. The stages of satisfying each of the customers' needs include a wide spectrum. This spectrum can be promoted from the negative ideal state (the worst state) to positive ideal one (the best state). TOPSIS considers three states for each customer's need: positive ideal, negative ideal and the current state. Taking into consideration the gap between current and positive ideal state of each need, TOPSIS can rank the customer's expectations.

The remainder of the paper is organized as follows. In Section 2, a literature review of QFD, fuzzy, TOPSIS and AHP methodology with some instances of their joint implications is presented. In Sections 3 and 4, the phases of Model I and II are detailed, and in Section 5 the proposed models are discussed. Finally, Section 6 contains the concluding remarks and suggestions for MCI budget allocation.

2. Background: Models I and II: fuzzy QFD–TOPSIS and fuzzy QFD–AHP

2.1. Quality function deployment

Nowadays QFD is widely used in prosperous companies all around the world as useful tool in strategic decision makings (Akao, 1990). QFD originated in Japan in 1972 (see Akao, 1990), and focusing on the customers, it has been a successful tool to help companies systematically translate CAs to appropriate product features (Liu, 2009). It is a widely used customer-driven design and manufacturing tool in which the success of its applications may be the result of some of its benefits, such as higher customer satisfaction, greater customer focus, shorter lead time, and knowledge preservation. It ensures that customers' needs drive the product design and production processes. So the main idea of the implementation of this efficient tool is to consider customers' expectations in different steps of formation of a product or a service. Customer language is different from production language, so this tool can be very beneficial in today's market, which is mainly based on customer orientation (Chan & Wue, 2005). QFD was originally implemented and developed at the Kobe Shipyards of Mitsubishi Heavy Industries. Early users of QFD include Toyota, Ford Motor Company, AT&T, IBM, Philips, and Xerox (Choen, 1995; Revelle & Moran, 1998). It was observed that Toyota was able to reduce pre-production costs by 60% from 1977 to 1984 and to decrease the time required for its development by one-third through the use of QFD (Hauser & Clausing, 1988).

Two main QFD approaches to production development emerge from a literature analysis (Akao, 1990; Choen, 1995; Fung, Popplewell, & Xie, 1998), namely the "matrix of matrices" and the "four-phase model". In the models proposed here, the focus is on a four-phase approach, the steps having been completely described by Hauser and Clausing (1988). In the four-phase model, QFD is broken down into four inter-linked phases to fully deploy the customer's needs phase by phase. In QFD, the important outputs of each phase (HOWs) generated from the phase's inputs (WHATs), are converted into the inputs of the next phase (new WHATs). Most QFD studies focus mainly on the first phase, called the House of Quality (HOQ) (Bottani & Rizzi, 2006; Chen & Weng, 2003). HOQ is of strategic importance, since it is in this phase that the customers' needs are identified and then, incorporating the company's competitive priorities to be converted into appropriate technical measures to fulfill the needs (Chen & Weng, 2003). So HOQ links the "voice of the customer" to the "voice of the technician" through which process and production plans can be developed in the other phases of QFD. The crucial and essential activity in the application of QFD is to construct the HOQ accurately, which includes determining the important weights of CAs, the relationship matrix between CAs and ECs, and the correlation matrix among ECs. This paper has concentrated on the HOQ of the four-phase model. For the HOQ modeling approach, see Chan and Wue (2005), Bottani and Rizzi (2006), Fung, Tang, Tu, and Chen (2003) and Vairaktarakis (1999).

Four advantages of QFD application are

- Creation of a transaction between CAs and ECs, of course within the boundary of the company's abilities;
- *Quality promotion*: To get assured that customer's needs have been considered in the process of designing the product or the service;
- Prevention of ignoring critical control points;
- Reduction of time to market of the product or service (Bottani & Rizzi, 2006; Carnevalli & Miguel, 2008).