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Accurately predicting the success of B2B e-commerce in small and medium enterprises

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Abstract

Since implementing B2B e-commerce in small and medium enterprises (SMEs) is a long-term commitment and such enterprises are more limited in terms of resources than large enterprises, the predicted value of successful implementation is extremely useful in deciding whether to initiate B2B e-commerce. This investigation establishes an analytical hierarchy framework to help SMEs predicting implementation success as well as identifying the actions necessary before implementing B2B e-commerce to increase e-commerce initiative feasibility. The consistent fuzzy preference relation is used to improve decision-making consistency and effectiveness. A case study involving six influences solicited from a Taiwanese steel company is used to illustrate the feasibility and effectiveness of the proposed approach. The analytical results show that the three most influential factors are management support, industry characteristics and government policies; meanwhile, the three least influential factors are organizational culture, IT integration and firm size.

Keywords: B2B e-commerce; Small and medium enterprises; Multi-criteria decision-making; Consistent fuzzy preference relation

1. Introduction

Rapidly developing communications technology and increasing internet penetration have contributed to the growth of electronic commerce (e-commerce) worldwide. The term "e-commerce" emerged only in recent years as businesses became aware of the potential role of the Internet as a powerful medium for conducting business. In the past decade, e-commerce has substantially affected the business world and is expected to increase in importance. E-commerce has prompted the rise of virtual business relationships including business-supplier, business-client, business-to-end consumer and strategic alliance (Speier, Harvey, & Palmer, 1998). Based on the parties involved in the business transaction, e-commerce can be classified as business-to-customer (B2C) or business-to-business (B2B).

The benefits of e-commerce are apparent not only for large firms but also for small and medium enterprises (SMEs) (Grandon & Pearson, 2004). However, some governments have noted the relatively slow uptake of electronic commerce in the SME sector (Barry & Milner, 2002; Darch & Lucas, 2002). Deciding whether to implement B2B is difficult in many organizations and particularly in SMEs. This vital decision may promote growth in an organization or lead to its downfall; consequently, all aspects of implementation must be considered before reaching a consensus within an organization.

Although cases of successful B2B e-commerce implementation have been widely reported, several noteworthy failures have also occurred worldwide. Implementing B2B e-commerce is time consuming, and the long-term impact on an organization may be unclear for some time. Since implementing B2B e-commerce in SMEs is a long-term commitment and is more limited in resources than large enterprises, the predicted value of successful implementation would be extremely useful when deciding whether to initiate B2B e-commerce. Therefore, the likelihood of

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successful implementation and an effective decision-making process can facilitate implementation of B2B e-commerce in SMEs. Additionally, although previous studies of e-commerce adoption have examined user acceptance, consumer behavior, e-commerce software, investment decision making factors in adopting e-commerce, selection of e-commerce sites by the consumer, the impact of innovation and pricing strategies (Aldin & Stahre, 2003; Basu & Muylle, 2002; Chun & Kim, 2005; Huang, Hung, & Yen, 2005; Li & Buhalis, 2006; Liao, To, & Shin, 2006; Lin & Jou, 2005; Liu, Marchewka, Lu, & Yu, 2005; Luarn & Lin, 2005; Poel & Buckinx, 2005; Salmeron & Hurtado, 2006; Sarkis & Talluri, 2004; Shin, 2004; Wu & Hisa, 2004; Wu & Wang, 2006), few studies have investigated the magnitude of all these factors on B2B e-commerce implementation in SMEs. Thus, elucidating the factors required for successful electronic commerce, particularly in the SME sector, is a worthwhile endeavor.

The focus on B2B e-commerce in SMEs has become an increasingly important topic for both researchers and SME managers. The proposed prediction model based on the reciprocal additive consistent fuzzy preference relation (Herrera-Viedma, Herrera, Chiclana, & Luque, 2004) in this study can help organizations identify key factors affecting B2B e-commerce implementation in SMEs and remedial action necessary to ensure successful implementation.

The rest of this paper is organized as follows. The following section discusses the reciprocal additive consistent fuzzy preference relation. Section 3 then presents an analytical hierarchy framework based on additive reciprocity transitivity for predicting B2B e-commerce implementation in SMEs. Next, Section 4 introduces an empirical case study of B2B e-commerce implementation in Taiwan SMEs. Finally, a discussion and conclusions are presented in Section 5.

2. Reciprocal additive consistent fuzzy preference relation

Many factors determine the success of B2B e-commerce implementation in SMEs. Essential considerations include not only financial issues but also organizational culture, government policies, industry characteristics and many others (Chou, Lee, & Chung, 2004; Grandon & Pearson, 2004; Kaefer & Bendoly, 2004; Lee & Li, 2006; Mauldin, Nicolaou, & Kovar, 2006; Taylor, Mcwilliam, England, & Akomode, 2005; Teo & Ranganathan, 2004; Thatcher, Foster, & Zhu, 2006; Wu & Wang, 2005). In SMEs, B2B e-commerce systems must be implemented with care. Factors requiring consideration include the internal, external, qualitative and quantitative attributes of the enterprise. The numerous considerations suggest an analytical hierarchy is required to properly address the issue (Kerzner, 1989). A well-known approach for effectively addressing this problem is the Analytic Hierarchy Process (AHP) proposed by Saaty (1980). The AHP methodology separates a complex decision issue into elemental problems to establish a hierarchical model. When the decision problem is hierarchically divided into smaller constituent parts, the relative importance of elements are compared pairwise at each level to establish a set of priorities. Although AHP is widely employed in diverse fields (Choi & Hartley, 1996; Ngai, 2003; Wei, Chien, & Wang, 2005), inconsistency increases as hierarchies of criteria or alternatives increase (Wang & Chen, 2005b). To address this dilemma, Herrera-Viedma et al. (2004) presented a set of consistent fuzzy preference relations to facilitate the effectiveness and accuracy of decision-making. Each of these preference relations requires completion of all $\frac{n(n-1)}{2}$ judgments to produce a preference matrix containing n elements. To reduce judgment time, this study employs the reciprocal additive consistent fuzzy preference relation proposed by Herrera-Viedma et al. (2004) as the basis for predicting the success of B2B e-commerce implementation in SMEs because it only requires $n-1$ judgments from a set of n elements.

Herrera et al. proposed consistent fuzzy preference relations in accordance with two preference relations, namely multiplicative preference relation and fuzzy preference relation (Wang & Chen, 2005a, 2005b; Wang & Chen, 2007). This study is based on the methodology of consistent fuzzy preference relations, which is presented below:

(1) Multiplicative preference relation. Experts express preferences regarding a set of alternatives since X can be denoted by a preference relation matrix $A \subset X \times X$, $A = (a_{ij})$, $a_{ij} \in [\frac{1}{9}, 9]$, where a_{ij} denotes the ratio of the preference degree of alternative x_i over x_j. As $a_{ij} = 1$ indicates no difference between x_i and x_j, $a_{ij} = 9$ indicates that x_i is highly preferable to x_j. A is assumed to be a multiplicative reciprocal, that is

$$a_{ij} \cdot a_{ji} = 1 \tag{1}$$

(2) Fuzzy preference relation. Experts express preferences over a set of alternatives where X is denoted by a positive preference relation matrix $P \subset X \times X$ with membership function: μ_p: $X \times X \to [0, 1]$, where $\mu_p(x_i, x_j) = p_{ij}$ indicates the ratio of the preference intensity of alternative x_i to that of x_j. Moreover, if $p_{ij} = \frac{1}{2}$ implies indifference between x_i and x_j (x_i–x_j), $p_{ij} = 1$ indicates that x_i is absolutely preferred to x_j, $p_{ij} = 0$ indicates x_j is absolutely preferred to x_i, and $p_{ij} > \frac{1}{2}$ indicates that x_i is preferred to x_j ($x_i > x_j$). Meanwhile, P is assumed to be an additive reciprocal, given by

$$p_{ij} + p_{ji} = 1 \tag{2}$$

Proposition 1. *Reciprocal additive fuzzy preference relation*

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \quad \forall i, j, k \tag{3}$$

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \quad \forall i < j < k \tag{4}$$