Using interpretive structural modeling and fuzzy analytical process to identify and prioritize the interactive barriers of e-commerce implementation

Changiz Valmohammadi [a,*], Shahrbanoo Dashti [b]

[a] South Tehran Branch – Islamic Azad University, Faculty of Management and Accounting, Department of Information Technology Management, Shariati Ave., Tehran, Iran
[b] South Tehran Branch – Islamic Azad University, Tehran, Iran

A B S T R A C T

The main purpose of this study is to present a novel and useful application of a specific analytical technique to indicate the interactions and calculate the ranking of the barriers of electronic commerce (EC) in the Iran Khodro industrial group, a leading Iranian automotive company, using the combination of two techniques: interpretive structural modeling (ISM) and the fuzzy analytical network process (FANP). Based on an in-depth review of the relevant literature and interviews with managers and experts from the company, thirteen barriers and challenges to the implementation of e-commerce were determined and categorized into four main factors: technical, organizational, individual, and environmental. In the following step, the ISM technique is applied to construct a structural graph and identify inherent interactions among these barriers. The FANP is then used to quantify the relationships and weigh the significance of these barriers. The results obtained from the proposed model reveal that a "lack of awareness regarding the benefits and nature of electronic commerce" is the most important barrier to the implementation of e-commerce. This type of modeling approach can be extremely valuable for companies that wish to focus their efforts and resources on removing the most important barriers and challenges toward the successful implementation of EC.

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1. Introduction

Electronic commerce can be considered the interaction between a company and other companies or customers [46]. E-commerce is the process of buying, selling, or exchanging products, services, and information via computer networks, including the internet [31,53]. However, e-commerce is not restricted to purchasing and selling products over the internet; it also includes all supporting activities during the business process. E-commerce can serve as a resource that improves the domestic economic and rapid globalization of production and the development of available technology [47]. Considering the highly complex nature of business, the intensely competitive environment, and the variability of customers [30], e-commerce is well accepted in the developed world and plays a vital role in economic development [35] that can lead to more effective marketing action, greater efficiency in processes, higher levels of customer satisfaction, and higher returns on investments [30]. Investment in the implementation of e-commerce within the organization can increase efficiency and reduce costs. Studies show that the adoption of e-commerce leads to 21–70% savings on the costs of various activities. Statistics published on the top 500 global companies indicate that 34% of these companies in 1995 and nearly 80% in 1996 used this method to promote their products. In 2006, the value of on-line transactions was estimated at 12.8 trillion dollars [23]. Iran, which has a population of more than 70 million and a GDP of approximately $270 billion, is the second largest economy in the Middle East. With relatively strong economic growth (approximately 4.8%) and a diverse number of industries, Iran offers great potential in e-commerce in the future [60]. Additionally, as Al-Somali et al. [2] note, e-commerce adoption in developing countries is more complex due to challenges such as insufficient regulatory environments and inadequate infrastructure; therefore, there is a particular need to study less developed countries.

According to the forecasts, the implementation of e-commerce in Iran will cost approximately 210 billion dollars during the third

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development plan period. Estimates show that these costs have strong economic justification and are being challenged due to e-commerce implementation [23]. The ever-increasing growth of e-commerce in developed countries means that business policies and strategies should be fundamentally reconsidered in developing countries [34]. Iran has been facing the various barriers and challenges in e-commerce implementation, given the newness of the e-commerce field in this country. For example, Valmohammadi [55] notes the barriers encountered by Iranian companies, including poor IT infrastructure and the low internet speed in Iran.

Numerous researchers have extensively studied and identified the challenges and barriers to the implementation of e-commerce (see Table 1). However, to the authors' best knowledge, the existing studies have not examined or analyzed the interactions between these barriers. Therefore, the current study aims to fill this gap in the literature by offering a comprehensive model involving the dimensions of barriers and their relationships in the EC domain. Due to the above discussion and the importance of successful EC implementation in Iran, the main purpose of this study is to present a comprehensive and novel model to analyze the interaction between barriers of electronic commerce and calculate the ranking of the barriers in the Iran Khodro industrial group, a leading Iranian automotive company, using the combination of two techniques: interpretive structural modeling (ISM) and the fuzzy analytical network process (FANP). Accordingly, we believe that it would be useful to investigate how individual barriers identified in the literature and prioritized by the experts would influence EC implementation.

In particular, this study can serve as guidelines for the senior management team of the survey organization and policy makers of Iran in general to enact the necessary measures to remove or at least reduce these inhibitors and provide a suitable environment for the successful implementation of EC in Iranian companies based on the importance and priority of the barriers and challenges identified in this study. More importantly, because the novel

method proposed in this study is applicable in other contexts, firms can use this method to solve problems in other areas.

The remainder of this paper is organized as follows: a literature review of the barriers to e-commerce implementation and the identification of the most important barriers are presented in Section 2; the methodology of the study, which covers the ISM and FANP techniques, is presented in Section 3; and Section 4 presents the results obtained from the application of this hybrid approach to decision making in the case study. Finally, Section 5 concludes and offers recommendations for future research studies.

2. Literature review of barriers to EC implementation

Many studies have been performed on the challenges and barriers facing e-commerce in developed countries. For instance, in 2000, Commerce Net identified ten major barriers to e-commerce implementation in the USA, including security, reliability and risk, lack of trained staff, lack of business models, cultural issues, lack of public infrastructure for organizations, fraud, slow internet speed, and legal issues. Ihlstrom et al. [17] classified barriers to e-commerce implementation as internal or external barriers to the organization. Internal factors include the lack of organizational knowledge and awareness of e-commerce and organizational resource limitations. External factors mainly include technical concerns, external stakeholders, and support and maintenance. A study by Rao et al. [38] presented a multi-stage development model for e-commerce and investigated the facility factors and barriers within each of these stages. This multi-stage model illustrates the gradual evolution of e-commerce in different development stages. In addition, the model helps companies by providing a road map for their improvement. Javalgi and Ramsey [19] investigated the factors that affect the growth of e-commerce. As we know, e-commerce is one of the most widely used internet applications, and its growth strongly depends on Information and Communication Technology (ICT) and social, cultural, commercial,

Table 1
An overview of the barriers and challenges to e-commerce implementation.

No	E-Commerce barriers	References
1	High cost of EC implementation	Rao et al. [38]; Lawrence and Tar [26]; Darch and Lucas [7]; Kaynak et al. [22]; MacGregor and Vrazalic [32]; Aljifri et al. [1]; Ihlstrom and Nilsson [16]; Heung [14], Hawking et al. [13], Thulani et al. [53]; Kuzic et al. [25].
2	Organizational resistance to change	Ihlstrom et al. [17]; Rao et al. [38]; Lawrence and Tar [26]; MacGregor and Vrazalic [32]; Gunasekaran et al. [10]; Thulani et al. [53].
3	Complexity of EC implementation	Ihlstrom et al. [17]; Kuzic et al. [25]; MacGregor and Vrazalic [32]; Thulani et al. [53].
4	Lack of technical infrastructure	Darch and Lucas [7]; Rao et al. [38]; Javalgi and Ramsey [19]; Lawrence and Tar [26]; Kaynak et al. [22]; Aljifri et al. [1]; Ihlstrom and Nilsson [16]; Heung [14], Liao et al. [29]; Kshetri [24]; Moodley [36].
5	Lack of availability of specialists	Ihlstrom et al. [17]; Javalgi and Ramsey [19]; Darch and Lucas [7]; Kuzic et al. [25]; Kaynak et al. [22]; Aljifri et al. [1]; Heung [14]; Mohanna et al. [35]; Liao et al. [29]; Thulani et al. [53].
6	Lack of awareness regarding the benefits and nature of e-commerce	Ihlstrom and Nilsson [16]; Ihlstrom et al. [17]; Darch and Lucas [7]; Lawrence and Tar [26]; MacGregor and Vrazalic [32]; Stockdale and Standing [49]; Heung [14], Kshetri [24], Mohanna et al. [35]; Thulani et al. [53]; Moodley [36].
7	Lack of suitability of EC for products/services	Ihlstrom et al. [17]; Rao et al. [38]; MacGregor and Vrazalic [32]; Stockdale et al. (2004), Heung [14]; Thulani et al. [53].
8	Lack of technical skills/IT knowledge by personnel	Ihlstrom et al. [17]; Darch and Lucas [7]; Heung [14]; Lawrence and Tar [26]; MacGregor and Vrazalic [32]; Aljifri et al. [1]; Kshetri [24]; Thulani et al. [53]; Kuzic et al. [25].
9	Governmental policy, legal issues/standards	Rao et al. [38]; Javalgi and Ramsey [19]; Kuzic et al. [25]; Kaynak et al. [22]; MacGregor and Vrazalic [32]; Aljifri et al. [1]; Ihlstrom and Nilsson [16]; Stockdale and Standing [49]; Hawking et al. [13]; Mohanna et al. [35]; Lawrence and Tar [26].
10	Security concerns/lack of trust	Rao et al. [38]; Darch and Lucas [7]; Lawrence and Tar [26]; Kaynak et al. [22]; MacGregor and Vrazalic [32]; Aljifri et al. [1]; Heung [14]; Hawking et al. [13]; Liao et al. [29]; Mohanna et al. [35]; Thulani et al. [53]; Kuzic et al. [25].
11	Lack of financial resources	Ihlstrom et al. [17]; Lawrence and Tar [26]; Stockdale and Standing [49]; Heung [14]; Gunasekaran et al. [10]; Kshetri [24]; Moodley [36]; Thulani et al. [53].
12	Lack of top management support	Lawrence and Tar [26]; Rao et al. [38]; Heung [14]; Hawking et al. [13]; Liao et al. [29]; Kshetri [24]; Thulani et al. [53].
13	Lack of trust in suppliers of technology	Hajkarimi et al. [11]; MacGregor and Vrazalic [32]; Hawking et al. [13]; Kuzic et al. [25].