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ORIGINAL RESEARCH ARTICLE

Identifying the Effective Factors of the Educational Model of Electronic Supply Chain Management at World-Class Home Appliance Industry with a Fuzzy Approach

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ABSTRACT

Purpose: This research aims to identify the effective factors of the educational model of electronic supply chain management in order to achieve a world-class home appliance industry with a fuzzy approach.

Methods: This research is carried out through library and survey method based on the basic purpose. The library and the fuzzy Delphi methods were used to identify the factors and screen the identified codes in MATLAB software.

Findings: Three rounds of Delphi were conducted. Based on the final results, 39 indicators were approved. Electronic procurement, customer relationship management, demand management, product development, logistics, electronics, quality and accuracy, information transactions, information up-to-date, transparency, information processing speed, security, software facilities, integration, stability, the cost compared to competitors, and expenses. Relative research and development, the percentage reduction in transfers, the satisfaction of supply chain members, percentage compatibility with goals, percentage supplier reduction, delivery time, order fulfillment time, distance traveled, percentage access to materials, relative ability to change production volume, size Order categories, electronic data exchange, Internet of Things, precautionary storage, strengthening the spirit of self-sacrifice among human resources, commitment, honesty, waiting time, customer service, flexibility, price, delivery speed, and responsiveness.

Conclusion: Due to the serious presence of foreign competitors in the home appliance market of Iran, the competitive position of domestic companies is in unfavorable conditions and it is necessary to design a suitable strategy for a flexible production.

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Introduction

Companies and organizations are facing many challenges in the turbulent era of changes and the current competitive environment (Farsijani and Allah Karampour, 2023). One of the challenges is the new manufacturing philosophies and technologies that supersede the old technologies, and the other challenge is the customers who demand new products and services in a short period of time. In order to deal with the challenges that come from this direction, organizations are required to take quick measures for their survival (Farsijani and Qayyomi Ghahrodi, 2013). The expansion of information technology in various structures of society in today's world has caused an increase in the speed of providing services by manufacturers as one of the important and fundamental factors and issues in customer retention and customer relationship management (Shekarian et al., 2022).

In research conducted among Asian countries, Asian countries namely China and India are growing faster among the world economies. China, Japan, and India account for more than 30% of the world's GDP. The share of Asian economies in the world's GDP exceeds that of the European Union and the United States. The growth rate of GDP in China and India is more than 70% compared to the growth rate of GDP in the world (Rafigh et al., 2022).

Hence, Asia has become a center of attraction for global trade. This indicates more capital inflow and capital formation in China and India, which has increased the scope of increasing the production of goods and services and narrowed the field of competition for other Asian countries (Scheller et al, 2021). This pervasive expansion throughout the business has, in fact, also fundamentally changed the way supply chains are designed, operated, and maintained (Johansson and Wang, 2012). Companies in these countries have become aware of the role that supply chain management plays in their market success, and many companies have realized that automation in supply chain management processes such as transportation, fulfillment, and warehouse management can be implemented in a short period of time reduce costs and increase efficiency (Sombultawee et al., 2022).

Regarding this serious competition in the home appliance industry among domestic and foreign companies, it is required to identify the effective factor in a successful model to educate leaders at the managing level. Therefore, we tend to identify the effective factors on the educational model of electronic supply chain management at world-class home appliance industry with a fuzzy approach.

Literature Review

Over the last few decades, through better coordination of activities, business reimbursements, and improved operational flexibilities, we have seen increasing integration and greater synchronicities in supply chains. Yong et al (2021), believe that, with the creation of an e-commerce context, the conditions for the emergence of electronic supply chains are more ready, but some companies still use both traditional and virtual supply chain flows. Among their reasons, we can mention the diversity in the complexity of both supply chain and e-commerce fields, which go back to diverse and interconnected issues such as the formation of new and untested business models (Shaharudin et al., 2023).

In recent years research conducted by the production group, they have come to the conclusion that e-scm technology has many advantages, including optimizing the data recording of goods, distribution of goods, and facilitating the audit of goods from upstream to downstream. The existential philosophy of this system is the product of the lack of integrity of the traditional supply chain used in this industry, under conditions of uncertainty. Yang et al (2019), based on their studies, state that e-commerce sales are expected to reach 219 trillion pounds in 2022, which is a growth of 13.5% compared to previous years since 2017. Also, they state that between 13 and 75% of the costs of traditional supply chains are due to coordination and logistics issues, which have been reduced to much smaller amounts in recent years (Wang et al, 2020).

Literature Review

In a world full of ever-increasing changes in the field of science and information, both theoretically and practically, the role of a training and knowledgeable person; It is a very vital factor for the continuity of the organization's life as well as adapting to the various changes in the internal and external environment of the organization (Wright et al., 2017). What causes the superiority of a community over other human communities is only due to the cultivation, maintenance, development and evolution of humans and individuals available to each community; Because the material, financial and facility resources are all man-made (Sidjavadin and Farahi, 2013). But in some human societies, the place of man is still not well understood, and even acknowledging this fact, it is still observed that the role of this basic element has been downplayed by the planners, and in some areas, the necessary has been prioritized over the necessary. (Chen et al., 2012). Moreover, dealing with the management of other resources is more important than the management of human resources, and the need to carefully examine the position and importance of this organizational pillar has been overshadowed (Naz et al., 2016). As a result, training and educating can be a key factor of human resource management practices when establishing goals for organizational levels (Donate et al., 2016). When a company has a correct human resource management strategy, human resource management moves towards a high efficiency system (Norwan et al., 2022)

For this research, human resource management in voluntary organizations can be considered a set of activities, initiatives and strategies that companies use to improve their performance (Gupta et al., 2020). By relying on innovation, organizations seek to increase productivity and improve their economic situation, and innovation is a complex activity that uses new knowledge, and part of this new knowledge comes from external factors and part of it is through human resource activity within the organization. It is achieved (Della Torre, 2019). In some researches, they have come to the conclusion that applying human resource management is a necessary factor for innovation and sustainable competition (Chen et al., 2020)

Researchers argue that organizations that align their human resource management practices with their specific strategy (Garcia-Morales et al., 2007) will be more successful in creating sustainable competitive advantage (Otoo, 2019). All employees have weaknesses in some of their job skills. The training program allows the employees to strengthen the skills in which they are weak. Development programs raise the level of all employees so that all employees acquire the same level of skill. This problem strengthens the skills of people who need others to do their basic work (Zack et al., 2009; Singh et al., 2021). An employee who has received the necessary training performs much better in his job. He is more aware of safe practices and proper procedures for performing basic tasks. Training also helps to increase the self-confidence of employees because they get a better understanding of the industry they work in and their job responsibilities. This self-confidence even doubles their performance and they can think of new ideas to improve their performance (Li et al., 2019). Ongoing training can make your employees a leader in the development and improvement of performance in your industry. Competent employees who are aware of the ever-changing standards of their respective industries can help your company maintain its leadership position in its respective industry and remain a fierce competitor (Zhu & Warner, 2019)

There are organizations that are not excellent in developing new and fundamental methods and are also not that strong in exploiting existing resources, but they benefit from the advantages and functions of human resources that promote stability and rapid socialization of new members. (Su et al., 2018). Examples of these practices include internal recruitment, formal training, behavior assessment, limited job definition, and clear career paths (Zhang et al., 2022). Considering the nature of human resources and innovation, human resource management practices can have a significant effect on increasing the company's intellectual capital and innovation ability (Al-Hakin et al., 2013). Also, in line with the studies that have

been conducted, to improve the state of innovation, managers should use traditional human resource management practices to advance the organization's goals and create a competitive advantage in voluntary organizations. Secco et al. (2022) showed the importance of the capability program for human resource development. Malik et al. (2022) introduced empowerment as one of the important dimensions of human resource management

Training provides a basic opportunity for the development of knowledge of all employees, but training and development positions seem expensive for many employers. Also, the presence of employees in training courses leads to spending the employees' work time and it may seem that it will delay the completion of projects. But despite the apparent potential disadvantages, training and development provides benefits to both the organization and the

employees that make the investment of time and money a worthwhile investment. The studies conducted show that human resource training has not been done in voluntary organizations and this research aims to fill this research gap.

In another research conducted by Sabrina et al. (2019), in the field of the clothing industry, they consider electronic supply chain management to be the product of electronic transportation, electronic distribution, organizational resource planning, and warehouse management system. High speed, low cost, communication, and interactions between suppliers and customers are key factors to improve management, all of which are realized under the shadow of electronic supply chain management (Wu et al, 2020). Hao et al (2022), consider the first condition for the realization of world-class products to be the flow of materials and information, and the partnership and communication between the company and its suppliers, and they believe that strengthening the supply chain will lead to the development of world-class production. According to domestic researchers, the philosophy of world-class production and world-class organizations is associated with strategic planning challenges, and new methods and technologies are growing every day.

Iranian companies can achieve success in the global market when they design their supply chains in an efficient and world-class way. This important thing will not be achieved unless this design is done in the social and economic background of the world of e-commerce.

According to the review of articles and clear and hidden differences of opinion in the opinions and results of researchers and considering the importance and role of industry in the process of economic development and globalization of the economy, it is necessary for domestic industries to take measures to adapt to the existing global conditions. This importance will not be achieved unless, due to the complexity in supply chain networks and in order to effectively manage these complexities, companies always consider new technologies as a potential factor in improving the performance of their supply chain. By using these technologies and through information circulation, companies seek to gain competitive advantages and improve performance in their supply chain management (Rahimi et al, 2019).

Household appliance production industries are not excluded from this. An important issue that is part of the necessity of this research is the wide importance of the supply chain management of these industries in the web space and world-class e-commerce, which has not been the focus of academic research as it should be. For example, some of the important dimensions of these industries are 1: The very high volume of global trade, which after energy carriers, is the largest volume of international trade related to the equipment of this sector of production. 2: The low level of pollution and energy consumption in such a way that most of the sub-sectors of these industries are in the field of green industries (Nezhadroshan et al, 2020).

3: The ability to create soft power that can turn Iran into a technology pole at the regional and global level in the home appliance manufacturing industry. 4: The ability to empower other industries of the country in terms of the extensive relationship that these industries have with other sectors such as transportation, communication and information technology, electricity industry, industrial equipment, and machinery, etc. (Li et al., 2019) . With an overview of this industry, it can be seen that despite the global progress, Iran is not in a good

competitive situation and is at a low level in terms of the ability to compete with other competing countries. Currently, due to sanctions, foreign brands have been removed from the domestic market and there is a good opportunity to invest and recreate domestic industries with quality and global standards, and supply chain management can also be part of this strategy (Keshavarz-Ghorbani et al, 2021).

Most of the research conducted on electronic supply chain management has been formed at the tactical, operational, and logistical levels, and there has been a lack of an all-around view at the strategic level in order to realize a world-class structure in the context of the supply chain. Therefore, this research responds to the necessity of this need by identifying the factors affecting the educational model of electronic supply chain management in order to achieve world-class, the study gap in the academic space, and also providing a solution based on scientific knowledge.

Method

This research is fundamental in terms of its purpose and in terms of library and survey method. The library method was used to identify the factors, and the fuzzy Delphi method was used to screen the identified codes. A total of 47 indicators have been identified for the design of the electronic supply chain model to achieve world class in the home appliance industry. The Delphi method has been used to screen and identify the final indicators. Delphi analysis is based on the opinion of 15 experts. 15 people were selected based on the snowball technique. In this study, triangular fuzzy numbers have been used to fuzzify the experts' point of view. The opinion of experts about the importance of each index has been compiled with a 7-degree fuzzy spectrum.

Table 1. *The spectrum of seven fuzzy degrees for valuing indicators*

Linguistic variable	Fuzzy value	Triangular fuzzy equivalent
very unimportant	$\tilde{1}$	(0, 0, 0.1)
Very unimportant to unimportant	$\tilde{2}$	(0, 0.1, 0.3)
unimportant	$\tilde{3}$	(0.1, 0.3, 0.5)
Unimportant to medium importance	$\tilde{4}$	(0.3, 0.5, 0.75)
medium	$\tilde{5}$	(0.5, 0.75, 0.9)
Medium to important	$\tilde{6}$	(0.75, 0.9, 1)
Important	$\tilde{7}$	(0.9, 1, 1)

In this research, M. FILE command is used in MATLAB software for fuzzy Delphi:

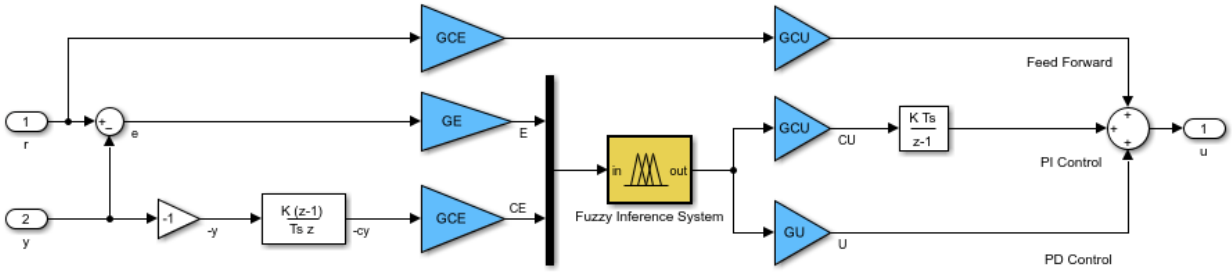

Figure 1. *Fuzzy Delphi process in MATLAB software*

Findings

The opinion of 15 experts about each indicator is shown in Table 2:

Table 2. *Fuzzification of the opinion of the expert panel for each of the research indicators*

R1	E01	E02	E03	E04	...	E15
C01	(0.3,0.5,0.75)	(0.3,0.5,0.75)	(0.3,0.5,0.75)	(0.3,0.5,0.75)	...	(0.9,1,1)

C02	(0.9,1,1)	(0.9,1,1)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.75,0.9,1)
C03	(0.75,0.9,1)	(0.9,1,1)	(0.9,1,1)	(0.75,0.9,1)	...	(0.75,0.9,1)
C04	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.5,0.75,0.9)	...	(0.5,0.75,0.9)
C05	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.9,1,1)	(0.75,0.9,1)	...	(0.5,0.75,0.9)
C06	(0.5,0.75,0.9)	(0.9,1,1)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.75,0.9,1)
C07	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.9,1,1)	(0.5,0.75,0.9)	...	(0.75,0.9,1)
C08	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.9,1,1)	(0.75,0.9,1)	...	(0.9,1,1)
C09	(0.75,0.9,1)	(0.75,0.9,1)	(0.9,1,1)	(0.9,1,1)	...	(0.9,1,1)
C10	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)	(0.5,0.75,0.9)	...	(0.5,0.75,0.9)
C11	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.75,0.9,1)	(0.9,1,1)	...	(0.5,0.75,0.9)
C12	(0.5,0.75,0.9)	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)	...	(0.9,1,1)
C13	(0,0,0.1)	(0,0,0.1)	(0.9,1,1)	(0.5,0.75,0.9)	...	(0,0,0.1)
C14	(0.75,0.9,1)	(0.1,0.3,0.5)	(0.75,0.9,1)	(0.3,0.5,0.75)	...	(0.5,0.75,0.9)
C15	(0.9,1,1)	(0.9,1,1)	(0.75,0.9,1)	(0.5,0.75,0.9)	...	(0.9,1,1)
C16	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.9,1,1)
C17	(0,0,0.1)	(0.75,0.9,1)	(0,0.1,0.3)	(0,0,0.1)	...	(0,0,0.1)
C18	(0,0,0.1)	(0.5,0.75,0.9)	(0,0,0.1)	(0,0,0.1)	...	(0,0.1,0.3)
C19	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.75,0.9,1)
C20	(0,0,0.1)	(0.3,0.5,0.75)	(0.75,0.9,1)	(0.1,0.3,0.5)	...	(0.1,0.3,0.5)
C21	(0.75,0.9,1)	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	...	(0.9,1,1)
C22	(0.9,1,1)	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.9,1,1)	...	(0.5,0.75,0.9)
C23	(0.9,1,1)	(0.75,0.9,1)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.9,1,1)
C24	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	(0.75,0.9,1)	...	(0.9,1,1)
C25	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.9,1,1)	(0.5,0.75,0.9)	...	(0.9,1,1)
C26	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.9,1,1)	...	(0.75,0.9,1)
C27	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	(0.9,1,1)	...	(0.75,0.9,1)
C28	(0.75,0.9,1)	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	...	(0.75,0.9,1)
C29	(0.5,0.75,0.9)	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	...	(0.75,0.9,1)
C30	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.9,1,1)	(0.9,1,1)	...	(0.75,0.9,1)
C31	(0.9,1,1)	(0.5,0.75,0.9)	(0.9,1,1)	(0.5,0.75,0.9)	...	(0.9,1,1)
C32	(0.5,0.75,0.9)	(0.9,1,1)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.9,1,1)
C33	(0.9,1,1)	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.75,0.9,1)
C34	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	...	(0.9,1,1)
C35	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.75,0.9,1)
C36	(0.75,0.9,1)	(0.75,0.9,1)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.1,0.3,0.5)
C37	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.9,1,1)	(0.9,1,1)	...	(0.9,1,1)
C38	(0,0.1,0.3)	(0,0,0.1)	(0.1,0.3,0.5)	(0.9,1,1)	...	(0.3,0.5,0.75)
C39	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.9,1,1)
C40	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	...	(0.75,0.9,1)
C41	(0.75,0.9,1)	(0.75,0.9,1)	(0.75,0.9,1)	(0.9,1,1)	...	(0.75,0.9,1)
C42	(0.75,0.9,1)	(0.75,0.9,1)	(0.75,0.9,1)	(0.75,0.9,1)	...	(0.5,0.75,0.9)
C43	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)	(0.9,1,1)	...	(0.75,0.9,1)
C44	(0.5,0.75,0.9)	(0.9,1,1)	(0.75,0.9,1)	(0.5,0.75,0.9)	...	(0.5,0.75,0.9)
C45	(0.5,0.75,0.9)	(0.75,0.9,1)	(0.9,1,1)	(0.75,0.9,1)	...	(0.5,0.75,0.9)
C46	(0.9,1,1)	(0.75,0.9,1)	(0.9,1,1)	(0.9,1,1)	...	(0.5,0.75,0.9)
C47	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.5,0.75,0.9)	(0.75,0.9,1)	...	(0.9,1,1)

In the next step, the opinion of the experts should be gathered. Various methods have been proposed to aggregate the opinions of n respondents. In fact, these aggregation methods are experimental methods presented by different researchers. For example, a conventional method for aggregating a set of triangular fuzzy numbers is considered to be the minimum l, the geometric mean m, and the maximum u.

$$F_{AGR} = \left(min\{\mathrm{l}\}, \prod\{m\}, max\{u\}\right)$$

There are several methods for defuzzification. In most cases, the following simple method is used for de-fuzzification:

$$x_m^1 = \frac{L + M + U}{3}$$

The fuzzy average and the de-fuzzified output of the values related to the indicators are shown in Table 3. The de-fuzzified value greater than 0.7 is acceptable, and any index with a score lower than 0.7 is rejected.

Table 3. *The results of the screening of educational indicators of the electronic supply chain (first round of the Delphi technique)*

Electronic supply chain indicators	Definite value	Fuzzy average	The result of round 1
Replenishment	0.539	(0.39,0.54,0.687)	Rejection
Electronic	0.856	(0.717,0.883,0.967)	Accepted

procurement			
Customer relationship management	0.828	(0.673,0.857,0.953)	Accepted
demand management	0.822	(0.663,0.85,0.953)	Accepted
Product development	0.872	(0.743,0.9,0.973)	Accepted
Electronic logistics	0.834	(0.677,0.857,0.967)	Accepted
Quality and precision	0.817	(0.657,0.847,0.947)	Accepted
Information transactions	0.872	(0.743,0.9,0.973)	Accepted
Up-to-date information	0.894	(0.78,0.923,0.98)	Accepted
transparency	0.850	(0.713,0.883,0.953)	Accepted
Information processing speed	0.850	(0.707,0.877,0.967)	Accepted
security	0.883	(0.76,0.91,0.98)	Accepted
Sharing level	0.319	(0.213,0.307,0.437)	Rejection
Basic economic technology	0.611	(0.453,0.62,0.76)	Rejection
Software features	0.872	(0.743,0.9,0.973)	Accepted
integrity	0.895	(0.777,0.92,0.987)	Accepted
the trust	0.369	(0.25,0.357,0.5)	Rejection
being open	0.356	(0.253,0.347,0.467)	Rejection
integrity	0.839	(0.69,0.867,0.96)	Accepted
Ability	0.463	(0.307,0.46,0.623)	rejection
Stability	0.906	(0.797,0.933,0.987)	Accepted
Cost compared to competitors	0.856	(0.717,0.883,0.967)	Accepted
Relative costs of research and development	0.872	(0.743,0.9,0.973)	Accepted
Percentage reduction in transfers	0.861	(0.727,0.89,0.967)	Accepted
Satisfaction of supply chain members	0.844	(0.7,0.873,0.96)	Accepted
The percentage of compatibility with the goals	0.866	(0.733,0.893,0.973)	Accepted
Percentage reduction of the supplier	0.867	(0.737,0.897,0.967)	Accepted
Delivery time	0.844	(0.7,0.873,0.96)	Accepted
Order time	0.861	(0.727,0.89,0.967)	Accepted
the covered distance	0.889	(0.77,0.917,0.98)	Accepted
Percentage of access to materials	0.833	(0.683,0.863,0.953)	Accepted
Relative ability to change production volume	0.878	(0.753,0.907,0.973)	Accepted
Batch size of orders	0.856	(0.717,0.883,0.967)	Accepted
Electronic data exchange	0.811	(0.647,0.84,0.947)	Accepted
Internet of Things	0.867	(0.73,0.89,0.98)	Accepted
Setting up the synchronous system	0.724	(0.59,0.74,0.843)	Accepted
Safety stock	0.856	(0.72,0.887,0.96)	Accepted
Hard work and hard work	0.400	(0.257,0.393,0.55)	Accepted
Strengthening the spirit of selflessness among human resources	0.828	(0.673,0.857,0.953)	Accepted
obligation	0.828	(0.673,0.857,0.953)	Accepted
Honesty	0.845	(0.697,0.87,0.967)	Accepted

waiting time	0.883	(0.76,0.91,0.98)	Accepted
customer service	0.867	(0.737,0.897,0.967)	Accepted
flexibility	0.828	(0.673,0.857,0.953)	Accepted
Price	0.839	(0.69,0.867,0.96)	Accepted
Delivery speed	0.894	(0.78,0.923,0.98)	Accepted
responsiveness	0.850	(0.707,0.877,0.967)	Accepted

Based on the results of replenishment indicators, sharing level, basic economic technology, trust, openness, ability, setting up a synchronous system, overwork and hard work were eliminated. Other indicators were used for the second round analysis.

Round two fuzzy Delphi method

Fuzzy Delphi analysis continued for the remaining indicators in the second round. At this stage, 39 indicators were evaluated based on the opinion of experts. The results of fuzzy Delphi in the second round are reported in Table 4:

Table 4. *Fuzzy average and fuzzy screening of electronic supply chain educational indicators (round two)*

Electronic supply chain indicators	The result of round 2	Definite value	Fuzzy average
Electronic procurement	accepted	0.853	(0.723,0.88,0.957)
Customer relationship management	accepted	0.839	(0.69,0.867,0.96)
demand management	accepted	0.833	(0.68,0.86,0.96)
Product development	accepted	0.833	(0.683,0.863,0.953)
Electronic logistics	accepted	0.811	(0.643,0.837,0.953)
Quality and precision	accepted	0.856	(0.717,0.883,0.967)
Information transactions	accepted	0.850	(0.707,0.877,0.967)
Up-to-date information	accepted	0.872	(0.747,0.903,0.967)
transparency	accepted	0.883	(0.76,0.91,0.98)
Information processing speed	accepted	0.853	(0.72,0.877,0.963)
security	accepted	0.861	(0.727,0.89,0.967)
Software features	accepted	0.762	(0.583,0.783,0.92)
integrity	accepted	0.814	(0.66,0.84,0.943)
integrity	accepted	0.845	(0.697,0.87,0.967)
Stability	accepted	0.839	(0.69,0.867,0.96)
Cost compared to competitors	accepted	0.823	(0.68,0.843,0.947)
Relative costs of research and development	accepted	0.831	(0.683,0.853,0.957)
Percentage reduction in transfers	accepted	0.872	(0.74,0.897,0.98)
Satisfaction of supply chain members	accepted	0.837	(0.693,0.86,0.957)
The percentage of compatibility with the goals	accepted	0.744	(0.543,0.777,0.913)
Percentage reduction of the supplier	accepted	0.866	(0.733,0.893,0.973)
Delivery time	accepted	0.859	(0.733,0.887,0.957)
Order time	accepted	0.845	(0.697,0.87,0.967)
the covered distance	accepted	0.892	(0.787,0.92,0.97)
Percentage of access to materials	accepted	0.853	(0.72,0.877,0.963)
Relative ability to change	accepted	0.866	(0.733,0.893,0.973)

production volume			
Batch size of orders	accepted	0.826	(0.677,0.85,0.95)
Electronic data exchange	accepted	0.850	(0.707,0.877,0.967)
Internet of Things	accepted	0.872	(0.743,0.9,0.973)
Safety stock	accepted	0.831	(0.687,0.857,0.95)
Strengthening the spirit of selflessness among human resources	accepted	0.878	(0.753,0.907,0.973)
obligation	accepted	0.779	(0.61,0.8,0.927)
Honesty	accepted	0.822	(0.66,0.847,0.96)
waiting time	accepted	0.817	(0.657,0.847,0.947)
customer service	accepted	0.872	(0.74,0.897,0.98)
flexibility	accepted	0.861	(0.723,0.887,0.973)
Price	accepted	0.850	(0.707,0.877,0.967)
Delivery speed	accepted	0.872	(0.743,0.9,0.973)
responsiveness	accepted	0.785	(0.62,0.807,0.927)

In the second round, no questions were asked, which is a sign for the end of the Delphi rounds.

Round three fuzzy Delphi method

Although no new indicators were removed or added in the second round, one more round was continued to ensure more certainty. At this stage, 39 indicators were evaluated based on the opinion of experts. The results of fuzzy Delphi in the third round are reported in Table 5:

Table 5. *Fuzzy average and fuzzy screening of electronic supply chain educational indicators (round three)*

Electronic supply chain indicators	Fuzzy average	Definite value	The result of round 3
Electronic procurement	(0.717,0.883,0.967)	0.856	Accepted
Customer relationship management	(0.733,0.893,0.973)	0.866	Accepted
demand management	(0.7,0.873,0.96)	0.844	Accepted
Product development	(0.683,0.863,0.953)	0.833	Accepted
Electronic logistics	(0.733,0.893,0.973)	0.866	Accepted
Quality and precision	(0.707,0.877,0.967)	0.850	Accepted
Information transactions	(0.647,0.84,0.947)	0.811	Accepted
Up-to-date information	(0.633,0.83,0.953)	0.805	Accepted
transparency	(0.677,0.86,0.947)	0.828	Accepted
Information processing speed	(0.75,0.903,0.98)	0.878	Accepted
security	(0.763,0.913,0.973)	0.883	Accepted
Software features	(0.667,0.853,0.947)	0.822	Accepted
integrity	(0.807,0.94,0.987)	0.911	Accepted
integrity	(0.763,0.913,0.973)	0.883	Accepted
Stability	(0.733,0.893,0.973)	0.866	Accepted
Cost compared to competitors	(0.657,0.847,0.947)	0.817	Accepted
Relative costs of research and development	(0.683,0.863,0.953)	0.833	Accepted
Percentage reduction in transfers	(0.807,0.94,0.987)	0.911	Accepted
Satisfaction of supply chain members	(0.69,0.867,0.96)	0.839	Accepted
The percentage of compatibility with the goals	(0.657,0.847,0.947)	0.817	Accepted
Percentage reduction of the supplier	(0.84,0.96,1)	0.933	Accepted
Delivery time	(0.707,0.877,0.967)	0.850	Accepted
Order time	(0.727,0.89,0.967)	0.861	Accepted
the covered distance	(0.69,0.867,0.96)	0.839	Accepted

Percentage of access to materials	(0.69,0.867,0.96)	0.839	Accepted
Relative ability to change production volume	(0.727,0.89,0.967)	0.861	Accepted
Batch size of orders	(0.71,0.88,0.96)	0.850	Accepted
Electronic data exchange	(0.717,0.883,0.967)	0.856	Accepted
Internet of Things	(0.717,0.883,0.967)	0.856	Accepted
Safety stock	(0.7,0.873,0.96)	0.844	Accepted
Strengthening the spirit of selflessness among human resources	(0.707,0.877,0.967)	0.850	Accepted
obligation	(0.72,0.883,0.98)	0.861	Accepted
Honesty	(0.7,0.873,0.96)	0.844	Accepted
waiting time	(0.67,0.853,0.96)	0.828	Accepted
customer service	(0.727,0.89,0.967)	0.861	Accepted
flexibility	(0.647,0.84,0.947)	0.811	Accepted
Price	(0.693,0.87,0.953)	0.839	Accepted
Delivery speed	(0.743,0.9,0.973)	0.872	Accepted
responsiveness	(0.66,0.847,0.96)	0.822	Accepted

The end of the Delphi technique rounds

In the second and third rounds, no questions were asked, which is a sign for the end of the Delphi rounds. In general, one approach to the end of Delphi is to compare the average scores of two consecutive rounds. If the difference between the two stages is smaller than the very low threshold (0.2), then the polling process is stopped .

Table 6. *The distance between the final value of round two and round three*

Difference	The result of round 3	The result of round 2	Electronic supply chain indicators	Result
0.003	0.856	0.853	Electronic procurement	Agreement
0.027	0.866	0.839	Customer relationship management	Agreement
0.011	0.844	0.833	demand management	Agreement
0	0.833	0.833	Product development	Agreement
0.055	0.866	0.811	Electronic logistics	Agreement
0.006	0.850	0.856	Quality and precision	Agreement
0.039	0.811	0.850	Information transactions	Agreement
0.067	0.805	0.872	Up-to-date information	Agreement
0.055	0.828	0.883	transparency	Agreement
0.025	0.878	0.853	Information processing speed	Agreement
0.022	0.883	0.861	security	Agreement
0.06	0.822	0.762	Software features	Agreement
0.097	0.911	0.814	integrity	Agreement
0.038	0.883	0.845	integrity	Agreement
0.027	0.866	0.839	Stability	Agreement
0.006	0.817	0.823	Cost compared to competitors	Agreement
0.002	0.833	0.831	Relative costs of research and development	Agreement
0.039	0.911	0.872	Percentage reduction in transfers	Agreement
0.002	0.839	0.837	Satisfaction of supply chain members	Agreement
0.073	0.817	0.744	The percentage of compatibility with the goals	Agreement
0.067	0.933	0.866	Percentage reduction of the supplier	Agreement
0.009	0.850	0.859	Delivery time	Agreement
0.016	0.861	0.845	Order time	Agreement
0.053	0.839	0.892	the covered distance	Agreement

0.014	0.839	0.853	Percentage of access to materials	Agreement
0.005	0.861	0.866	Relative ability to change production volume	Agreement
0.024	0.850	0.826	Batch size of orders	Agreement
0.006	0.856	0.850	Electronic data exchange	Agreement
0.016	0.856	0.872	Internet of Things	Agreement
0.013	0.844	0.831	Safety stock	Agreement
0.028	0.850	0.878	Strengthening the spirit of selflessness among human resources	Agreement
0.082	0.861	0.779	obligation	Agreement
0.022	0.844	0.822	Honesty	Agreement
0.011	0.828	0.817	waiting time	Agreement
0.011	0.861	0.872	customer service	Agreement
0.05	0.811	0.861	flexibility	Agreement
0.011	0.839	0.850	Price	Agreement
0	0.872	0.872	Delivery speed	Agreement
0.037	0.822	0.785	responsiveness	Agreement

Based on the results listed in Table 6, it was determined that in all cases the difference is less than 0.2, so the Delphi rounds can be completed.

Discussion

The current research is argumentative and based on the analysis of the information obtained from the qualitative part of the research, its combination, and integration with the literature of the research has been done. The results of this research showed that, despite the implementation of a wide range of studies related to the electronic supply chain management model in the past and present, the electronic supply chain management model can be examined more carefully and thoughtfully in order to achieve the world-class home appliance industry.

This research was conducted with an integrated approach, in the first step by reviewing the subject literature and using past studies and identifying a number of new and effective factors in the electronic supply chain management model to achieve a world-class home appliance industry, the beginning and the initial conceptual model. The model was obtained and completed by deductive (quantitative) approach and then inductively (qualitative) approach. In the following, research questions and related answers are analyzed. At first, 47 criteria were identified. Based on the final results, 39 indicators were approved. Electronic procurement, customer relationship management, demand management, product development, logistics, electronics, quality and accuracy, information transactions, information up-to-date, transparency, information processing speed, security, software facilities, integration, stability, cost compared to competitors, expenses. Relative research and development, percentage reduction in transfers, satisfaction of supply chain members, percentage compatibility with goals, percentage supplier reduction, delivery time, order fulfillment time, distance traveled, percentage access to materials, relative ability to change production volume, size Order categories, electronic data exchange, Internet of Things, precautionary storage, strengthening the spirit of self-sacrifice among human resources, commitment, honesty, waiting time, customer service, flexibility, price, delivery speed and responsiveness. The results obtained by research (Shekarian et al., 2022; Yong et al., 2021; Nezhadroshan et al., 2020). It has been aligned.

Conclusion

From the past until now, the home appliance industry has been considered as one of the essential needs of every household, so now, according to experts, the home appliance industry

is considered the second most employment-generating industry in the country. However, checking the status of factories producing household appliances and the extent of internal manufacturing or assembly of these products is the weak point of this industry; Because now the share of imported raw materials and parts in the production of domestic household appliances is very high. On the other hand, it seems that despite the progress achieved in the production of these products, domestic producers are still far from the world's technology in the production of these products. Due to the serious presence of foreign competitors in the home appliance market of Iran, the competitive position of domestic companies is in unfavorable conditions, and it is necessary to design a suitable strategy for a flexible production system in the domestic markets with a scientific and accurate view.

According to the study and investigations carried out by the researcher and considering the conditions and needs, the following suggestions are presented for future researchers:

1. In this research, a questionnaire was used to collect data. It is suggested that future researchers conduct this research by using the tools of interview, observation, and reference to archives.

2. It is suggested to conduct a similar research in other industries and compare its results with the current research.

3. It is suggested to conduct research with the title of presenting the data model of the electronic supply chain foundation in a world-class.

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