

Journal of Industrial Strategic Management

Identifying and prioritizing the factors affecting the establishment of long-term relationships with LARG supply chain suppliers using the F.AHP technique (Medical equipment companies)

Mahsa Taheri Tafreshi ^{*a}, Anahita Salari ^b, Maryam Mosleh ^c

a Department of Industrial Management, Islamic Azad University, West Tehran Branch, Tehran, Iran.

b Department of Industrial Management, Islamic Azad University, West Tehran Branch, Tehran, Iran

c Department of Mathematics, Islamic Azad University, West Tehran Branch, Tehran, Iran.

CHRONICLE

Article history:

Received: 08/07/2020

Received in revised:

10/11/2020

Accepted: 10/01/2021

Keywords:

* Long-term

relationships

* LARG supply chain

* Lean chain

* Agile chain

* Resilient chain

* Green chain

Abstract

A desirable supply chain cannot be one-sided and not considering its various forms causes negative consequences and sometimes deviates from organizational purposes and considered goals in production; The output of this issue led to the formation of the general principle called larg supply chain management Accordingly, the present study was examined with the aim of identifying and prioritizing the factors affecting the establishment of long-term relationships with larg supply chain suppliers (lean, agile, resilient and green) with a fuzzy approach in medical equipment companies This study was applied in term of purpose and descriptive-survey studies in terms of research method in which, using theoretical and empirical foundations, each of the criteria has been determined in different dimensions of the larg supply chain. At first, using the fuzzy Delphi method, the main criteria and in accordance with the larg supply chain were determined. In the second step, these criteria were examined in supply chain companies using a one-sample t-test. In the next step, the determined criteria were prioritized using the opinions of Ψ experts and the fuzzy hierarchical technique In accordance with the findings of the present research, it was determined that the three main priorities in each of the dimensions of the larg supply chain are as follows: In a supply chain based on lean criteria: communication with suppliers, reduce the rate of defects, and reduce the production cycle time, respectively. In a supply chain based on agile criteria; speed in delivery reliability, reduction of product development cycle time, response speed, respectively. In a supply chain based on resilient criteria; ensuring supply conditions, flexible sourcing, fulfillment of material supply obligations. Finally in a supply chain based on green criteria; management commitment to green supply chain, sourcing, green purchase, green packaging as well as reduce the equipment energy consumption.

© All rights reserved

* Corresponding author.

Email address: mahsa_tafreshi@yahoo.com

۱. Introduction

Today, it is clear that one of the most important competitive advantages of companies can be in the supply chain of companies. In other words, the quality of a company's relationship with the supply chain can achieve features that ultimately improve the company's performance (Schewe et al, ۲۰۲۰). Companies that have more long-term relationships with their supply chain companies can create more desirable agility and optimization in many areas (Liu et al, ۲۰۲۰, Duffuaa, ۲۰۲۰). However, not having a desirable relationship with the supply chain can create several negative consequences for a company, which ultimately leads to the problem of reducing the market share and removing the company from the competition (Chen & Lu, ۲۰۲۰). One of the main challenges in achieving a desirable supply chain is that it is not clear what key and vital indicators each of these key dimensions have in comparison with other dimensions. To put it more clearly, the vacuum of studies in the field of comparing the indicators and criteria of larg supply chain has made it impossible to refer to a comprehensive pattern or model in which based on the comparison of key criteria to provide a generalizable and comprehensive model that in it, the priorities are specified (Zhang et al, ۲۰۱۹).

Obviously, each dimension of the larg supply chain has some key criteria that must be considered and compared separately to determine the most important criteria or indicators in each dimension of the larg supply chain (Schewe et al, ۲۰۲۰). Proper prioritization of each of the major areas of the larg supply chain provides the ability for companies to put their time, money and effort on key factors in this area. One of the important points to be noted is that in the current situation, companies cannot meet all the criteria and indicators in the four dimensions of the larg supply chain (Parast, ۲۰۲۰,

relationship with the supply chain can create several negative consequences for a company, which ultimately leads to the problem of reducing the market share and removing the company from the competition (Chen & Lu, ۲۰۲۰).

Companies that do not have a desirable relationship with their supply chain compared to companies that have this advantage, far less achievable financial performance and development goals are visible. For example, it can be said that the

put it more clearly, the vacuum of studies in the field of comparing the indicators and criteria of larg supply chain has made

Yang et al, ۲۰۱۹). Achieving a large set with several criteria such as a larg supply chain requires years of effort, and on the other hand, ignoring this area can easily remove companies from the market by successful companies in this field. However, achieving all the criteria in this field is impossible except in the long time, and this challenging issue has caused researchers to try to identify the most important criteria in this field so that they can take purposeful steps in this field and in the next steps to cover the criteria with lower prioritization in their designs (Schewe et al, ۲۰۲۰, Duffuaa, ۲۰۲۰, Chen & Lu, ۲۰۲۰).

In view of the above and in accordance with the theoretical and empirical foundations in general, we can point out the gaps and vacuums of the study as follows, which clarifies the need for such research:

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

- Lack of proper prioritization of indicators and criteria in the larg supply chain makes it impossible to have desirable planning and designing in practice. This problem significantly wastes capital and time for companies. At the same time, the loss of opportunities and capital in such a competitive environment causes irreparable losses for companies. This highlights the need for research to prioritize key factors in this chain (larg supply chain).
- Achieving all the criteria in any of the dimensions of the larg supply
- (and at a higher level fuzzy Delphi) to determine the criteria based on the case study. One of the important companies that is especially related to community health are medical equipment companies, which are classified in the category of companies with larg supply chains, in which compliance with many criteria is very important. These can be particularly important in both being agility and being green of this chain, as they are directly related to community health.
- One of the most important points in the field of larg supply chain is the study vacuum to determine the set of important indicators and criteria for each of the dimensions of this chain. Although in many studies the larg supply chain is mentioned and its dimensions are enumerated, but there are limited studies that have determined the four indicators and criteria of this chain based on a chain is not possible except for companies with high organizational maturity. On the other hand, one of the main points in this regard is that not all the indicators or criteria mentioned in the studies for the four dimensions of the larg supply chain are necessarily generalizable for all companies. The conditions of companies and their supply chains are not together so that the separate patterns presented in them can be considered generalizable to other companies. This explains the need to use techniques such as Delphi comprehensive study of theoretical and empirical foundations. In other words, the need for research is clearly observed that has separately determined each of the criteria in the four dimensions of the larg supply chain. This can be understood by examining the few studies available in this field, which have generally mentioned only a limited number of criteria as key criteria in the dimensions of the larg supply chain.
- Another point that has been overlooked in previous studies is the impossibility of generalizable priorities in the larg supply chain in other companies for medical equipment companies. In other words, the main components with a focus on medical equipment companies should be observed step by step; in the first place, what are the main criteria and indicators for each dimension of the larg supply chain, especially for this type of

companies, which the use of fuzzy Delphi techniques are helpful in this regard, in the second place, what are the priorities of these criteria, which have been determined according to medical equipment companies, separately for each of its dimensions?

Considering the mentioned cases and considering the vacuums and gaps of studies that clarify the necessity of this research, in this research, the factors affecting the establishment of long-term relationships with larg supply chain suppliers were identified and prioritized. With this in mind, in the present study, two main questions are proposed as follows: What are the effective criteria for establishing long-term relationships with larg supply chain suppliers (lean, agile, resilient and green)? How to prioritize the factors identified in the larg supply chain (lean, agile, resilient and green)?

The continuation of this article is as follows: In the second part of this article, based on theoretical and empirical foundations, the criteria in each of the four dimensions of the larg supply chain have been determined. In the third part of this article, the research methodology is discussed and then in the fourth part, the findings obtained from the prioritization of these criteria are mentioned. Finally, in the final section, conclusions and topics related to each area are discussed.

۲. Review of the research literature

This section consists of two parts. In the first part, using theoretical foundations, a brief definition is provided in relation to each of the specialized keywords in this article. In the second part, the classification of each of the criteria is discussed according to different researchers in each of the dimensions of the supply chain.

۲.۱. Theoretical concepts and definitions LARG supply chain

Larg supply chain refers to putting lean, agile, resilient and green approaches together to create a supply chain approach that combines all the benefits and encompasses all sides. In this regard, larg supply chain as an integrated approach from different perspectives is as follows: features, organizational system, human and technology factors, information systems and performance measurement (Maroun et al, ۲۰۱۸).

Lean supply chain

Lean supply chain practices involve a set of organizations that are directly related to the upstream and downstream streams of products, services, finance, and information that work together to reduce costs and waste with an efficient and effective pull system for meet the needs of specific customer. Lean supply chain management includes various elements that are integrated for the efficiency and effectiveness of the organization. Both elements must be present for any lean company in the modern context. Competitive companies need to

understand and measure the amount of each value-added element in the supply chain. Lean supply chain components include: lean suppliers, lean procurement, lean manufacturing, lean warehousing, lean transportation, lean customers, lean production and conversion practices (Ndirangu & Gachuri, ۲۰۱۸).

Agile supply chain

Organizational supply chain agility enables the firm to create a more competitive position and thus enables it to respond more quickly and effectively to market changes and other uncertainties. In addition, firms with agile supply chain processes are more sensitive to the market, have more ability to synchronize supply and demand, and are able to achieve shorter time cycles. Given that agility in the supply chain of the organization directly affects the production of innovative products and their delivery to customers, it can be concluded that supply chain agility is a critical factor that affects overall competitiveness (Abdoli Bidhandi & Valmohammadi, ۲۰۱۷).

Green supply chain

The green supply chain includes increasing the desirability of resources, energy and reducing the environmental effects produced by some products. Strategic and transparent integration and achievement of social, environmental

and economic goals of the organization in the systematic coordination of key inter-organizational business processes are important indicators to improving the long-term economic performance of individual companies and their supply chain in the green supply chain (Jamali et al, ۲۰۱۷).

Resilient supply chain

Supply chains become more vulnerable as supply networks become longer and leaner. Resistance is often interpreted as resilience. The process of resistance and toughness is expected to be accompanied by reasonable compatibility results with one or more changes in outputs. Resilience is the ability to return to its original state or even better after turbulence. The efficiency balance versus redundancy is usually examined to identify areas in which capacity and inventory are used effectively to create resilience. Resilient supply chain is the ability of the supply chain to react to unexpected events and maintain the continuity of network operations at the desired level (Rajesh, ۲۰۱۷).

۲. ۲. Theoretical concepts and definitions

In a general conclusion based on theoretical and empirical principles, the main factors in the large supply chain (lean, agile, resilient and green) can be presented in accordance with Table ۱ as follows:

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

Table ۱: Larg supply chain measurement and prioritization factors (lean, agile, resilient and green)

Lean supply chain measurement factors (L)		
(Carvalho, & Cruz Machado, ۲۰۱۳) (Cabral et al, ۲۰۱۲) (Wu, ۲۰۰۹) (Sarraf et al, ۲۰۱۳) (Sangari et al, ۲۰۱۵).	timely production	L _۱
	use of multi-skilled workforce	L _۲
	mass production	L _۳
	standardization of work processes	L _۴
	reduce the production and startup cycle time	L _۵
	reduce the rate of defects	L _۶
	registration on demand	L _۷
	use of total productive maintenance (tpm)	L _۸
	relationship with customer	L _۹
	logistics outsourcing for transportation	L _{۱۰}
	use of total quality management (tqm)	L _{۱۱}
	decrease delay times	L _{۱۲}
	communication with suppliers	L _{۱۳}
Agile supply chain measurement factors (A)		
(Hugos, ۲۰۱۸) (Esfahbodi et al, ۲۰۱۶) (Ngai et al, ۲۰۱۴)	Response speed	A _۱
	Use of information technology	A _۲
	Speed in decision making	A _۳
	Produced in large and small categories	A _۴
	decrease delay times	A _۵
	Change in the number of orders according to customer needs	A _۶
	Reduce the product development cycle time	A _۷
	Produced in large categories	A _۸
	Reduce the production and start-up cycle time	A _۹
	Improve customer relationships	A _{۱۰}
Speed in delivery reliability	A _{۱۱}	
Resilient supply chain measurement factors (R)		
(Heidari et al, ۲۰۱۷) (Hugos, ۲۰۱۸) (Mensah et al, ۲۰۱۵) (Kristianto et al, ۲۰۱۴)	Fulfillment of material supply obligations	R _۱
	Ensure supply conditions	R _۲
	Demand-based management	R _۳
	Supply chain risk management culture	R _۴
	Flexibility in transportation	R _۵
	Flexible sourcing	R _۶
	Ability to use additional capacity without using in critical situations	R _۷
	Save inventory and strategic capacity surplus	R _۸
	Production in small sizes (minimum category)	R _۹
	Use of expert workforce	R _{۱۰}
	decrease delay times	R _{۱۱}
	Collaboration culture to reduce risk	R _{۱۲}
	Green supply chain measurement factors (G)	
(Stadtler, ۲۰۱۵) (Muduli et al, ۲۰۱۳) (Heidari et al, ۲۰۱۷)	ISO ۱۴۰۰۱ certification of suppliers	G _۱
	Conduct meetings to solve environmental problems	G _۲
	Green sourcing, purchasing and procurement, green distribution and sale	G _۳
	Energy efficiency practices for lighting and heating	G _۴
	Use of reusable and recycled materials and pallets	G _۵
	Proper use of natural resources (such as mines)	G _۶
	Management commitment to green supply chain management processes	G _۷
	Join to local recycling organization	G _۸
	Total Quality Environmental Management (TQEM)	G _۹
	waste reduction	G _{۱۰}
	Reducing energy consumption	G _{۱۱}
	Vehicle route planning to reduce environmental impacts	G _{۱۲}
	Use of filters and methods to control the discharge and release of pollutants	G _{۱۳}

۳. Research methodology

The present study is classified in the category of applied research in terms of purpose, so that it is possible to use the results to determine and explain the factors affecting the establishment of long-term relationships with large supply chain suppliers. Also, the present study is a survey in terms of data collection (with regard to the distribution of questionnaires). So that through the distribution of questionnaires among medical equipment companies to measure and prioritize each of the dimensions of the large supply chain (according to the view of experts) and finally the research model was tested based on them. It is worth mentioning that this study is exploratory in terms of nature and research method. So that, through an in-depth study, the theoretical and experimental foundations are examined in this field (for this purpose, the grounded theory method is used in which accurate identification of indicators is performed) and finally, the main factors were explained in order to achieve a large supply chain.

The statistical population of this study consisted of experts (managers and deputies) in medical equipment companies. For this purpose, ۱۰ expert opinions were received from these companies. It is worth mentioning that for this purpose, managers were selected who have high working years, management experience in the supply chain and management education. In the use of t-test, a sample of the statistical population

of this study was ۶۰ cases (managers, deputies and experienced experts in each of the medical equipment companies), two of whom were not available at the time of the study, so the total statistical population consisted of ۶۳ experts who, considering the ۵% error level, ۵۴ samples selected. Using the questionnaire tool, data were collected by distributing them among experts, ie managers of top medical equipment companies. In order to rank each of the desired criteria, fuzzy hierarchical analysis process is used. Also, to determine the status of each criterion in the sample supply chain companies, data were distributed and analyzed based on a one-sample t-test.

۴. Results

Determining the final criteria based on the fuzzy Delphi method

This method uses a series of sequential questionnaires in two or more rounds in order to reach a consensus; In the first stage, the respondents determine the views, and the main topics; In this section, in order to benefit from the experiences and views of previous experts, theoretical foundations are examined, in other words, all the criteria that have been considered as possible important factors are evaluated by experts, and finally the criteria for receiving expert comments are presented to them, the basic criteria that have been used to extract them from the theoretical foundations were presented in the previous section in Table ۱. In this section, in accordance with the opinions of ۱۰ experts who participated in the

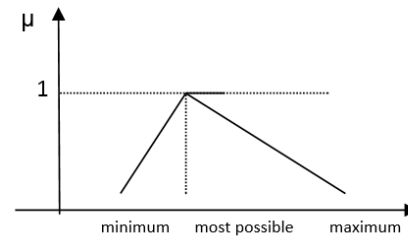
present study, the initial model was unanimously approved and experts did not consider another indicator for this model (end of the first stage of Delphi/it is worth mentioning that in this stage, all the indicators were examined so that in the next steps, based on accurate scoring, it can be determined exactly which one should remain and which one should be eliminated).

In the evaluation phase (second and third rounds), initial answers were obtained from the experts in the second phase and provided to the members and they were asked to evaluate their initial answers. In the fuzzy Delphi method, the estimates provided by experts are expressed in the form of definite numbers, while the use of definite numbers for predictions or decisions takes it away from the real world. Experts, on the other hand, use their mental competencies and abilities to make decisions, and this shows that the uncertainty that governs these conditions is a possibility, not a likely. The possibility of uncertainty is compatible with fuzzy sets, so it is better to make decisions in the real world using fuzzy sets (using fuzzy numbers), in this way, we will obtain the necessary information in the form of natural language from experts and analyze it, and for this purpose, the fuzzy Delphi method was used.

The steps will be as follows:

- ۱- Experts will be asked to present their estimate (according to triangular fuzzy numbers) in the form of the minimum value, the

most possible (bottom and top) and the maximum value.



$$(A_1^{(i)}, B_1^{(i)}, C_1^{(i)}), i = 1, \dots, n$$

In this regard, i represents the i expert and the number λ indicates the first step in the estimation process (presentation of opinion)[†].

- ۲- The answers of n experts (λ^0 experts from medical equipment companies) form a group whose average is calculated:

$$(A_1^m, B_1^m, C_1^m)$$

And for each expert, the amount of difference from the average category is calculated as follows:

$$(A_1^m - A_1^{(i)}, B_1^m - B_1^{(i)}, C_1^m - C_1^{(i)})$$

This difference can be positive, negative or empty. This information was then sent to selected experts for new feedback.

- ۳- At this stage, each expert presents a new point of view based on the information obtained from the previous step, and thus, at his/her discretion, corrects his/her previous opinion.

$$(A_2^{(i)}, B_2^{(i)}, C_2^{(i)}), i = 1, \dots, n$$

The result of this process will result in a single number, which is obtained based on receiving the average of the opinions of experts, if the lowest value received, ie value A , has a numerical

[†] This process will continue up to λ steps in the forthcoming review.

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

value higher than α , the desired criterion will be selected as an acceptable and important criterion in the Delphi method. In summary,

according to the comments received from the Delphi method, the final factors that have been examined in this study are as follows (Table 5):

Table 5: Final factors in the supply chain for medical equipment companies

Dimensions	Factors	Final factors in the field of lean supply chain
Lean supply chain factors	L ₁	Timely production
	L ₂	Standardization of work processes
	L ₃	Reduce the production and start-up cycle time
	L ₄	Reduce the rate of defects
	L ₅	Registration on demand
	L ₆	relationship with customer
	L ₇	Use of Total Quality Management (TQM)
	L ₈	Communication with suppliers
Dimensions	Number	Final factors in the field of agile supply chain
Agile Supply Chain Measurement Factors (A)	A ₁	Response speed
	A ₂	Use of information technology
	A ₃	Speed in decision making
	A ₄	Change in the number of orders according to customer needs
	A ₅	Reduce the product development cycle time
	A ₆	Improve relationships with customers
	A ₇	Speed in delivery reliability
Dimensions	Number	Final factors in the field of resilient supply chain
Resilient supply chain measurement factors (R)	R ₁	Fulfillment of material supply obligations
	R ₂	Ensure supply conditions
	R ₃	Demand-based management
	R ₄	Flexible sourcing
	R ₅	Ability to use additional capacity without using in critical situations
	R ₆	Production in small sizes (minimum category)
	R ₇	Use of expert workforce
	R ₈	Collaboration culture to reduce risk
Dimensions	Number	Final factors in the field of green supply chain
Green supply chain measurement factors (G)	G ₁	ISO 14001 certification of suppliers
	G ₂	Conducting meetings related to forecasting and solving environmental problems
	G ₃	Green sourcing, green procurement, green packaging, green distribution and sales
	G ₄	Use of reusable and recycled materials and pallets
	G ₅	Management Commitment to green supply chain management processes
	G ₆	Total Quality Environmental Management (TQEM)
	G ₇	Reducing energy consumption

One sample t-test results

After determining the main factors in the previous stage, this section examines the current situation of medical equipment companies in which of the indicators and factors specified in the previous section, are they problematic or they should be

considered. The output of this section specifies which indicators and factors should be carefully considered. It is noteworthy that the Smirnov-Kolmogorov test was used to determine the normality of data distribution. Findings in this section showed that in all the studied factors, the

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

value of the significance level of the test was greater than the standard value of 0.05 ($p > 0.05$), accordingly, in the inferential analysis section, a one-sample test was used. In this section, the results of a one sample t-test are presented in Table ۳:

Table ۳: Results of t-test in each of the identified factors

	statistic t	Degrees of freedom	Significance level	Difference from the mean
Timely production	۰/۰۲۹	۵۳	./...	./۷۲۲
Standardization of work processes	۸/۳۷۱	۵۳	./...	۱/۰۳۷
Reduce the production and start-up cycle time	۷/۰۸۹	۵۳	./...	۱/۰۷۴
Reduce the rate of defects	۷/۴۸۶	۵۳	./...	۱/۰۱۹
Registration on demand	۰/۹۷۵	۵۳	./...	./۸۸۹
relationship with customer	۰/۹۳۳	۵۳	./...	./۹۲۶
Use of Total Quality Management (TQM)	۰/۴۰۹	۵۳	./...	./۹۰۷
Communication with suppliers	۴/۸۷۹	۵۳	./...	./۸۳۳
Lean supply chain factors	۸/۳۸۳	۵۳	./...	./۹۳۰
Response speed	۲/۹۵۶	۵۳	./۰۰۵	./۰۹۳
Use of information technology	۲/۲۶۶	۵۳	./۰۲۸	./۴۶۳
Speed in decision making	۳/۰۵۱	۵۳	./۰۰۴	./۴۰۷
Change in the number of orders according to customer needs	۱/۸۸۴	۵۳	./۰۴۵	./۳۷۰
Reduce the product development cycle time	۲/۳۴۷	۵۳	./۰۲۳	./۳۵۲
Improve relationships with customers	۲/۰۱۳	۵۳	./۰۳۹	./۳۸۹
Speed in delivery reliability	۹/۱۲۶	۵۳	./...	۱/۲۲۲
Agile supply chain factors	۴/۱۳۶	۵۳	./...	./۰۴۳
Fulfillment of material supply obligations	۰/۵۵۷	۵۳	./...	./۷۹۶
Ensure supply conditions	۶/۱۰۹	۵۳	./...	./۸۷۰
Demand-based management	۴/۹۳۹	۵۳	./...	./۷۴۱
Flexible sourcing	۷/۱۷۲	۵۳	./...	./۹۲۶
Ability to use additional capacity without using in critical situations	۶/۹۵۱	۵۳	./...	./۹۴۴
Production in small sizes (minimum category)	۶/۴۵۱	۵۳	./...	./۸۷۰
Use of expert workforce	۶/۲۱۹	۵۳	./...	۱/۰۰۰
Collaboration culture to reduce risk	۴/۴۲۵	۵۳	./...	./۸۳۳
Resilient supply chain factors	۸/۹۴۳	۵۳	./...	./۸۶۹
ISO ۱۴۰۰۱ certification of suppliers	۴/۰۷۰	۵۳	./...	./۵۵۶
Conducting meetings related to forecasting and solving environmental problems	۷/۷۷۳	۵۳	./...	./۹۶۳
Green sourcing, green procurement, green packaging, green distribution and sales	۴/۹۲۷	۵۳	./...	./۷۷۸
Use of reusable and recycled materials and pallets	۰/۹۷۹	۵۳	./...	./۷۹۶
Management Commitment to green supply chain management processes	۰/۶۹۸	۵۳	./...	./۷۷۸
Total Quality Environmental Management (TQEM)	۶/۳۴۵	۵۳	./...	./۹۰۷
Reducing energy consumption	۶/۳۷۴	۵۳	./...	./۹۴۴
Green supply chain factors	۸/۸۸۱	۵۳	./...	./۸۱۱

According to the obtained results, it can be stated that in all cases, the remaining factors from the Delphi stage have been completely approved by experts and should be considered ($p < 0,05$). It is noteworthy that in this study, Friedman test was used to determine whether the variables are different in weight or not, and the findings in this section confirmed that the criteria were different in criteria weight ($p < 0,01$) accordingly, hierarchical analysis technique was used to prioritize them.

Results of fuzzy hierarchical analysis

In this research, to determine the weight of the existing criteria and options, the hierarchical analysis technique with fuzzy approach has been used. A Saaty nine-degree scale was used to compare pairs of elements. The results obtained in Figures 1 to 4 are summarized as follows:

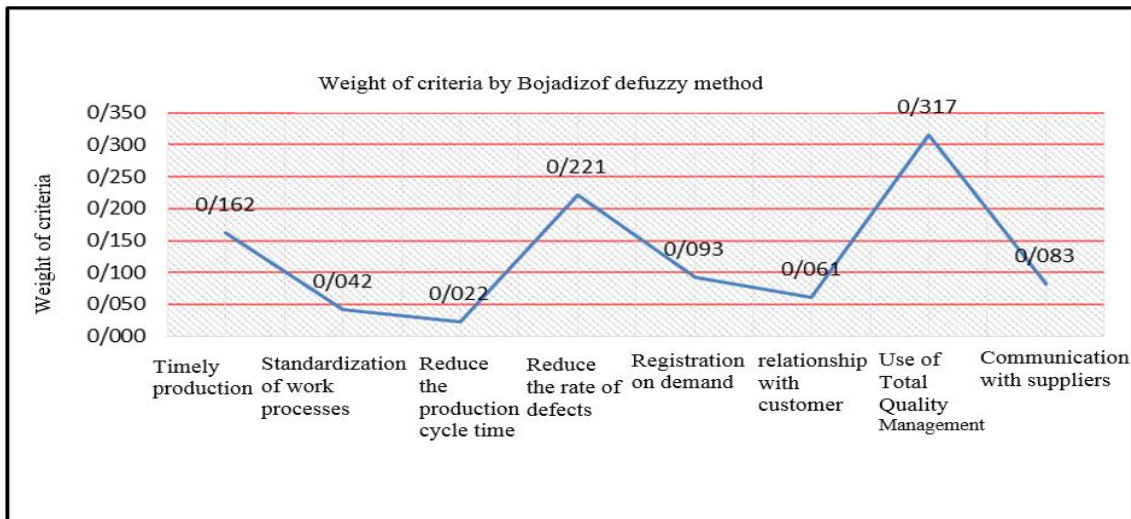


Figure 1: The final weight of the lean supply chain by the Bojadizof method

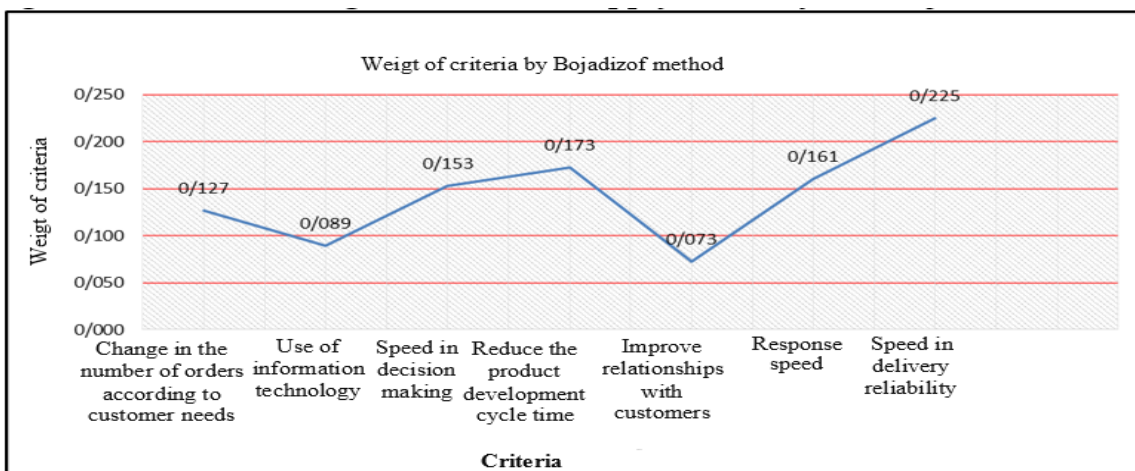


Figure 2: The final weight of the agile supply chain by the Bojadizof method

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

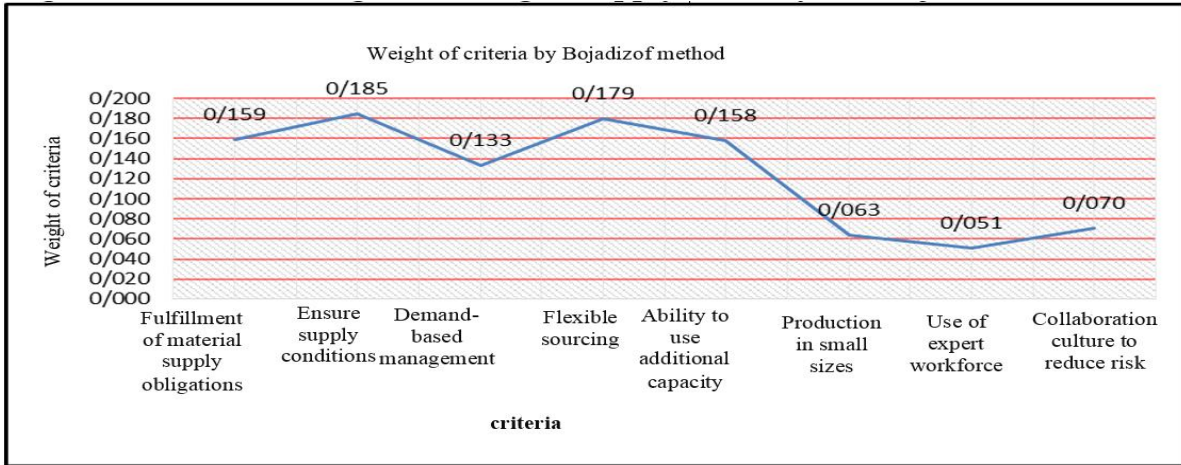


Figure ۳: The final weight of the resilient supply chain by the Bojadizof method

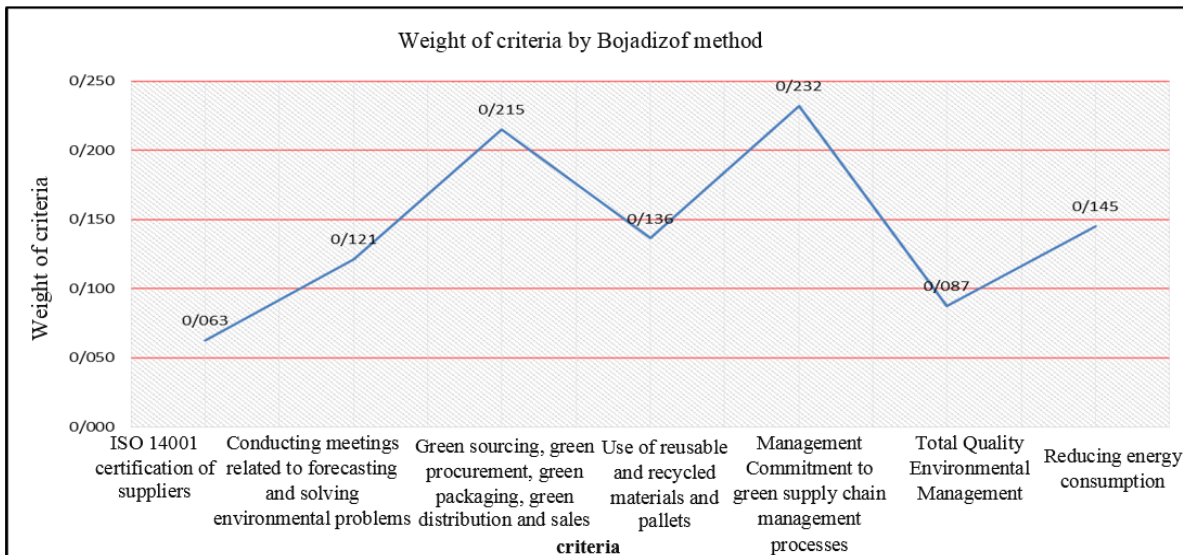


Figure ۴: The final weight of the green supply chain by the Bojadizof method

۹. Conclusions and suggestions

This study showed that the prioritization of indicators in the field of larg supply chain, in order to enable planning for their implementation is a serious necessity, and otherwise, companies can not achieve all of them without a specific prioritization. In general, it should be noted that the larg supply chain includes four main characteristics, namely lean, agile, resilient and green in the field of supply chain, which can improve the company's performance and its agility, especially in providing services. By realizing of these four elements, the

company can actually achieve a higher perceived value that did not exist before. The more the company can achieve the indicators of lean supply chain, agile supply chain, resilient supply chain and green supply chain at a more favorable level can be more successful compared to other companies in timely delivery of goods and increase the perceived value level for thier users. Accordingly, it is expected that with the realization of the larg supply chain, proper long-term relationships with suppliers are observed.

According to the findings of this study, it can be suggested that medical equipment companies in order to establish long-term relationships with large supply chain suppliers (lean, agile, resilient and green) note the following separately for each of the four components:

Supply chain based on lean criteria

- Communication with suppliers
- Reduce the rate of defects
- Reduce the production cycle time

Supply chain based on agile criteria

- Speed in delivery reliability
- Reduce the product development cycle time
- Response speed

References

- Abdoli Bidhandi, R., & Valmohammadi, C. (۲۰۱۷). Effects of supply chain agility on profitability. *Business Process Management Journal*, ۲۳(۵), ۱۰۶۴-۱۰۸۲.
- Cabral, I., Grilo, A., & Cruz-Machado, V. (۲۰۱۲). A decision-making model for lean, agile, resilient and green supply chain management. *International Journal of Production Research*, ۵۰(۱۷), ۴۸۳۰-۴۸۴۵.
- Cao, S., Bryceson, K., & Hine, D. (۲۰۱۹). An Ontology-based Bayesian network modelling for supply chain risk propagation. *Industrial Management & Data Systems*.
- Carvalho, H., & Cruz Machado, V. (۲۰۱۳). "enteric Integration of Lean, Agile, Resilient, and Green Practices in Automotive Supply Chain". *Review of International Comparative Management*, ۱۴, ۲۳۷-۲۴۸.
- Chen, P. K., & Lu, Y. Y. (۲۰۲۰). Development of a revised taxonomic approach for improving supply chain integration and collaboration. *Journal of Business Economics and Management*, ۲۱(۴), ۹۴۵-۹۶۶.
- Das, D., & Hui, N. B. (۲۰۲۰). Outsourcing Strategies in a Two-Stage Supply Chain Model with Insufficient Production Capacity. In *Advances in Materials and Manufacturing Engineering* (pp. ۲۲۳-۲۲۹). Springer, Singapore.
- Duffuaa, S. O. (۲۰۲۰). A tabu search based algorithm for the optimal design of multi-objective multi-product supply chain networks. *Expert Systems with Applications*, ۱۴۰, ۱۱۲۸۰۸.
- Esfahbodi, A., Zhang, Y., & Watson, G. (۲۰۱۶). Sustainable supply chain management in emerging economies: Trade-offs between environmental and cost performance. *International Journal of Production Economics*, ۱۸۱, ۳۵۰-۳۶۶.
- Hader, M., Elmhamedi, A., & Abouabdellah, A. (۲۰۲۰, April). Blockchain Integrated ERP For Bette Supply Chain Management. In ۲۰۲۰ IEEE ۷th International Conference on Industrial Engineering and Applications (ICIEA) (pp. ۱۳۹-۱۴۳). IEEE.
- Heidari, R. A. Z. I. E. H., Tavakkoli-Moghaddam, R. E. Z. A., Yazdanparast, R. E. Z. A., & Aliabadi, L. E. Y. L. A.

Supply chain based on resilient criteria

- Ensure supply conditions
- Flexible sourcing
- Fulfillment of material supply obligations

Supply chain based on green criteria

- Management commitment to a green supply chain
- Green sourcing, purchasing and logistics, packaging
- Reduce energy consumption of equipment

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

- (۲۰۱۷). A fuzzy data envelopment analysis for the supply chain resilience assessment: An Iranian car manufacturer. *Recent Applications of Data Envelopment Analysis*, ۹۷۸(۱), ۱۲۲.
- Hugos, M. H. (۲۰۱۸). *Essentials of supply chain management*. John Wiley & Sons.
- Jamali, G., Karimi Asl, E., Hashemkhani Zolfani, S., & Šaparauskas, J. (۲۰۱۷). Analysing large supply chain management competitive strategies in Iranian cement industries. *Economics and Management*.
- Kristianto, Y., Gunasekaran, A., Helo, P., & Hao, Y. (۲۰۱۴). A model of resilient supply chain network design: A two-stage programming with fuzzy shortest path. *Expert systems with applications*, ۴۱(۱), ۳۹-۴۹.
- Liu, S., Papageorgiou, L. G., & Shah, N. (۲۰۲۰). Optimal design of low-cost supply chain networks on the benefits of new product formulations. *Computers & Industrial Engineering*, ۱۳۹, ۱۰۶۱۸۹.
- Maroun, E. A., Daniel, J., Zowghi, D., & Talaei-Khoei, A. (۲۰۱۸). Blockchain in Supply Chain Management: Australian Manufacturer Case Study. In *Service Research and Innovation* (pp. ۹۳-۱۰۷). Springer, Cham.
- Mensah, P., Merkurjev, Y., & Longo, F. (۲۰۱۵). Using ICT in developing a resilient supply chain strategy. *Procedia Computer Science*, ۴۳, ۱۰۱-۱۰۸.
- Muduli, K., Govindan, K., Barve, A., & Geng, Y. (۲۰۱۳). Barriers to green supply chain management in Indian mining industries: a graph theoretic approach. *Journal of Cleaner Production*, ۴۷, ۳۳۵-۳۴۴.
- Ndirangu, L. W., & Gachuri, J. (۲۰۱۸). Effect of contractual governance practices on supplier performance: a survey of state corporations in Nakuru county, Kenya. *International Journal of Business and Processes* (ISSN ۲۶۱۶-۳۲۰۹), ۳(۲), ۸-۸.
- Ngai, E. W., Chau, D. C., & Chan, T. L. A. (۲۰۱۱). Information technology, operational, and management competencies for supply chain agility: Findings from case studies. *The Journal of Strategic Information Systems*, ۲۰(۳), ۲۳۲-۲۴۹.
- Parast, M. (۲۰۲۰). Logistics and supply chain network designs: incorporating competitive priorities and disruption risk management perspectives. *International Journal of Logistics Research and Applications*, ۱-۲۴.
- Rajesh, R. (۲۰۱۷). Study of select issues of resilient supply chains (doctoral dissertation, Indian Institute of Space Science and Technology).
- Sangari, M. S., Razmi, J., & Zolfaghari, S. (۲۰۱۵). Developing a practical evaluation framework for identifying critical factors to achieve supply chain agility. *Measurement*, ۶۲, ۲۰۵-۲۱۴.
- Sarraf, F., Razavi, S., & Mohammadi, M. (۲۰۱۳). Evaluate relationship between management accounting and control practices in lean system. *International Research Journal of Applied and Basic Sciences*, ۶, ۱۲۰-۱۲۳.
- Schewe, L., Schmidt, M., & Weninger, D. (۲۰۲۰). A decomposition heuristic for mixed-integer supply chain problems. *Operations Research Letters*.
- Sowlati, T. (۲۰۲۰). Hybrid optimization-simulation for integrated planning of bioenergy and biofuel supply chains. *Applied Energy*, ۲۵۹, ۱۱۴۱۲۴.
- Stadtler, H. (۲۰۱۵). Supply chain management: An overview. In *Supply chain management and advanced planning* (pp. ۳-۲۸). Springer, Berlin, Heidelberg.
- Thakur, S., & Breslin, J. G. (۲۰۲۰). Scalable and Secure Product Serialization for Multi-Party Perishable Good Supply Chains using Blockchain. *Internet of Things*, ۱۰۰۲۵۳.
- Vishnu, C. R., Sridharan, R., & Kumar, P. R. (۲۰۱۹). Supply chain risk management:

Identifying and prioritizing the factors affecting the establishment of long-term ...
Mahsa Taheri Tafreshi, Anahita Salari, Maryam Mosleh

- models and methods. *International Journal of Management and Decision Making*, ۱۸(۱), ۳۱-۷۰.
- Wu, H. (۲۰۰۹, October). The Lean manufacture research in environment of the supply chain of modern industry engineering. In ۲۰۰۹ ۱۶th International Conference on Industrial Engineering and Engineering Management (pp. ۲۹۷-۳۰۰). IEEE.
- Yang, H., Zhang, D., Chen, B., & Gu, B. (۲۰۱۹). Competitive consignment matching: applications in supply chain. *International Journal of Production Research*, ۱-۱۴.
- Zarei, J., & Amin-Naseri, M. R. (۲۰۱۹). An integrated optimization model for natural gas supply chain. *Energy*, ۱۸۰, ۱۱۱۴-۱۱۳۰.
- Zhang, T., Zhang, C. Y., & Pei, Q. (۲۰۱۹). Misconception of providing supply chain finance: Its stabilising role. *International Journal of Production Economics*, ۲۱۳, ۱۷۰-۱۸۴.