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Analysis of Supply Chain Anti-fragility in the Textile Industry Using the Best-Worst Method and CoCoSo

Mohsen Hadizadeh [1*], peiman khodaparast [2], ahmadreza ghasemi [3], muhammad bagher fakhrzad [4]
۱ Department of Textile Engineering, Yazd University, Yazd, Iran
۲ Doktor Student Textile Engineering Yazd University, Yazd, Iran
۳ Department of Industrial Management, Tehran University, tehran, Iran
4 Department of Industry Engineering, Yazd University, Yazd, Iran
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Abstract

The economic conditions prevailing in the country, sanctions, rapid changes and transformations of the markets, and the complexity and disorder of the market environment, have made it necessary to pay attention to the anti-fragility approach in the industries. One of the most interesting industries is the textile industry. Hence, due to the strategic nature and having a large domestic consumption market, the textile industry must be anti-fragile in order to quickly adapt to new conditions and maintain and improve its competitive value in a safe and stable condition. This research was conducted with a review of the literature in order to achieve the anti-fragility of textile industries throughout the supply chain. We identified the anti-fragility components and weighed them using the best-worst method. Then, we reviewed the literature on the textile industry and interview the experts in this industry, to identify and evaluate the fragility factors. By using the CoCoSo method the most important factors that disrupt anti-fragility were ranked. Finally, the results of the research showed that the components: unexpectedness, Adequate supervisors, and Attraction are the most important components. Also, the results obtained from the CoCoSo method showed that the of "Lack of investment in the (clothing) industry", "Saturation of the market with counterfeit brands due to the structural weakness of the distribution and smuggling network", and "Undeveloped distribution network" are the most important in the supply chain of the textile industry
Keywords:
Antifragile Supply Chain, Textile Industry, Anti-fragility theory, BWM, CoCoSo.

Introduction

The textile industry is one of the largest global industries, and sustainable management concepts have been implemented in the industry's supply chain (SC) networks (Raian, et al., 2022). It is considered one of the oldest industries, which reached its peak during the industrial revolution. This industry is considered one of the largest active industries in the country after the oil industry (Ebadi et al., 2021). The textile industry was initially limited to the production of yarn, but over time it has expanded and created a variety of products and due to the completion of its value chain, it has included a wide range of industrial activities in the field of spinning, weaving, dyeing, printing, and finishing. The textile industry is one of the important economic fields, which by creating stable employment, causes the growth of the economic process and provides the practical necessities of human life (Khodadad Kashi & Firoozjang, 2013). The rapid growth of the population and the economy has resulted in a significant increase in the production and consumption of textiles. After the industrialization of the country and the establishment of manufacturing factories, the clothing industry has a long historical background, but its achievements are with a very small average share of 0.26 percent of the industrial added value and 0.14 percent of the industrial output value during the years 1383 to 1398, which is not proportionate with its history.

The supply chain is one of the basic elements in manufacturing industries, and if this chain fails, the entire industry may be destroyed. To achieve the sustainable textile industry, it should design anti-fragile. Today, due to its strategic business advantages, sustainability has gained significant importance in supply chain management; therefore, industries face the risks of supply chain instability caused by various sources (Lin & Bai, 2020). The importance of sustainable supply chain management (SSCM) has increased in recent decades due to global population growth, resource restrictions, consumption activities, and increasing levels of waste and pollution (Bui, et al., 2021). Antifragility is one of the concepts that is closely related to supply chain sustainability. A supply chain is not static and evolves and improves in case of unnecessary events and unpredictable irregularities that are among the inherent features of today's business world. Antifragility in the supply chain gives the opportunity to turn challenges into opportunities and progress in a random world (Abooyee Ardakan et al., 2017).

Knowing the fragile factors of the textile industry and the importance of each of these factors leads us to improve and fix them for more efficient planning. Decision-making methods are one of the most appropriate approaches to achieve this goal. The importance of anti-fragility in the supply chain of the textile industry has been the cornerstone of this research. The economic conditions prevailing in the country, sanctions, rapid changes and transformations of the markets, and the complexity and disorder of the market environment, are one of the most important needs to pay attention to this problem. For this purpose, the present research aims to identify the fragility components and fragile factors of the textile industry by reviewing the relevant literature and interviewing the experts of the mentioned industry, and using the Best-Worst Method and CoCoSo to rank these factors in order to find solutions to achieve ~~a~~ sustainable excellence for this industry .In section 2, we described the theoretical foundations and literature of the subject. In section 3, the methodology of the current research is explained. In section 4, the findings of the research are presented. The conclusion of the research is also stated in section 5.

2. Theoretical foundations & Literature review

The textile industry is one of the oldest industries that, with the progress and development of science and technology, has been able to create an economic advantage for countries along with other emerging industries. The development of the textile industry has been affected by changes in the turbulent environment, and it is necessary for the decision-makers at the macro level to design the connection between the various parts of the supply chain of this industry. In addition, micro-level decision-makers (artisans) guide their business with macro-orientations and are trying to gain a certain share of the market of textile products and other artifacts.

Ebadi et al., (2021) introduced strategies for the development of Iran's advanced textile industry in a study. The use of worn out and old machines and devices in the production of fibers and textiles, the problems of providing the necessary raw materials and the absence of foreign investors in the country were among the factors that can be solved by measures towards the development of the textile industry.

Shafiei et al., (2021) identified and ranked the challenges of product development, policies and strategies to improve the situation in the textile industry as a case study for black veil (Chador) production. The lack of raw materials with the right price and quality in Iran, the lack of skilled and specialized manpower in the field of production and operations, as well as the import of fake and cheap foreign black veil fabric (smuggled) were among the important challenges they identified. In addition, to improve these issues, they proposed solutions such as amending laws and regulations in importing high-quality raw materials, strengthening and developing companies supplying textile raw materials, and creating specialized textile technology and training centers in the country.

The term anti-fragility was first introduced by Nasim Nicholas Taleb in 2012 and he defined it as gaining strength in the face of pressure factors (Taleb, 2012). A fragile system is interested in absorbing pressure factors, and each factor, if it does not lead to the destruction of the system, increases its stability and durability. In fact, anti-fragility allows organizations to take advantage of unknown events to put themselves in a better position than before (Martinetti et al., 2017).

Khoshsepehr et al., (2017) investigated the effect of applying the theory of anti-fragility in the supply chain in order to improve the productivity of organizations. In their research, the anti-fragility criteria of organizations were identified and the importance of each of them was determined using the ANP method. Finally, risk acceptance and learning criteria were the most important. Johnson and George introduced learning from stressful factors as one of the most important components of anti- fragility (Johnson & Gheorghe, 2013). Using the anti- fragility theory, Fakhrpour et al., (2018) presented a model to realize the resistance economy in organizations and evaluated the criteria for making organizations anti-fragile by using DEMATEL Gray method, and the most important sub-criteria in their research was learning through controlled risk.

In previous studies, many decision-making methods have been used for the issue of sustainability in the supply chain. For example, Han and Rani (2022) used the CoCoSo method to identify and evaluate the barriers to the blockchain technology adoption in sustainable supply chain management in the manufacturing sector. Ecer and Pamucar (2020) used a novel integrated fuzzy best worst method (F-BWM) and fuzzy CoCoSo to selecting sustainable supplier.

Lahri et al. (2021) used BWM and TOPSIS methods to design a sustainable supply chain network design model, with purpose of minimizing the economic, environmental goals and maximizing the social sustainability goals. Amiri et al. (2021) presented a new model with a triangular fuzzy approach based on BWM method for sustainable supplier selection in the supply chain.

Anti-fragile systems are identified with special characteristics, and in this research, the components considered in Momeni et al., (2022) research have been used. These characteristics are as follows in table 1.

Table 1: Characteristics of Anti-fragility components

Characteristics	ID	Definition	References
Unexpectedness	Q1	Unexpected results occur when the output of a system does not fit with its input. If mechanisms are	(Johnson & Gheorghe, 2013)

		embedded in the system that prevent the influence of external factors on it, the outputs of the system will become more predictable and the system's anti-fragility will be higher	
Proportion of productivity and risk	Q2	In order to lower the risk, additional components may be used, however, this may reduce the efficiency of the system. Devices with fewer components are more efficient but more fragile. Therefore, it may increase the proportion between the productivity and the anti-fragility risk of the system	(Johnson & Gheorghe, 2013; Jackson & Ferris, 2013)
Balancing Constraints vs. Freedom	Q3	A system that is too open is exposed to unknown events. Therefore, anti- fragility in the system can be increased by creating a degree of restriction (to a reasonable extent)	(Johnson & Gheorghe, 2013)
Reducing system connections	Q4	Systems are more susceptible to failure due to the dependence between their components, because a change in one part can have many effects on other parts. In the reward system, the components act independently of each other and there are few connections between them	(Johnson & Gheorghe, 2013; Jackson & Ferris, 2013; Hole, 2016; Ramezani & Camarinha-Matos, 2019)
Sufficient supervisors	Q5	In order to control the behavior of system agents, there is a need for a sufficient number of supervisors. If the number of observers in the system is not enough, the behavior of the system becomes unpredictable and unknown events increase and cause system failure	(Johnson & Gheorghe, 2013; Jackson & Ferris, 2013; Hole, 2016)
Regular and controlled stress	Q6	The complete removal of stress from the system may lead to the weakness and fragility of the system. By applying tension in a regular and controlled manner, the system becomes stronger and eventually leads to anti- fragility	(Johnson & Gheorghe, 2013)
Redundancy	Q7	The capacity of a system to face unknown events increases by creating different ways to reach the goal and multiple methods to obtain the required information	(Johnson & Gheorghe, 2013; Jackson & Ferris, 2013)
Learning from mistakes	Q8	Learning from mistakes and negative consequences in a system leads to the production of new information and acts as a layer of defense against stresses and increases the anti- fragility of the system	(Johnson & Gheorghe, 2013)
Absorption	Q9	The system's ability to withstand a potential stress (of a given intensity and duration) to remain in a predetermined state. This ability of the system is called absorption power. The higher the absorption power, the lower the fragility of the system	(Johnson & Gheorghe, 2013; Jackson & Ferris, 2013)

3. Methods

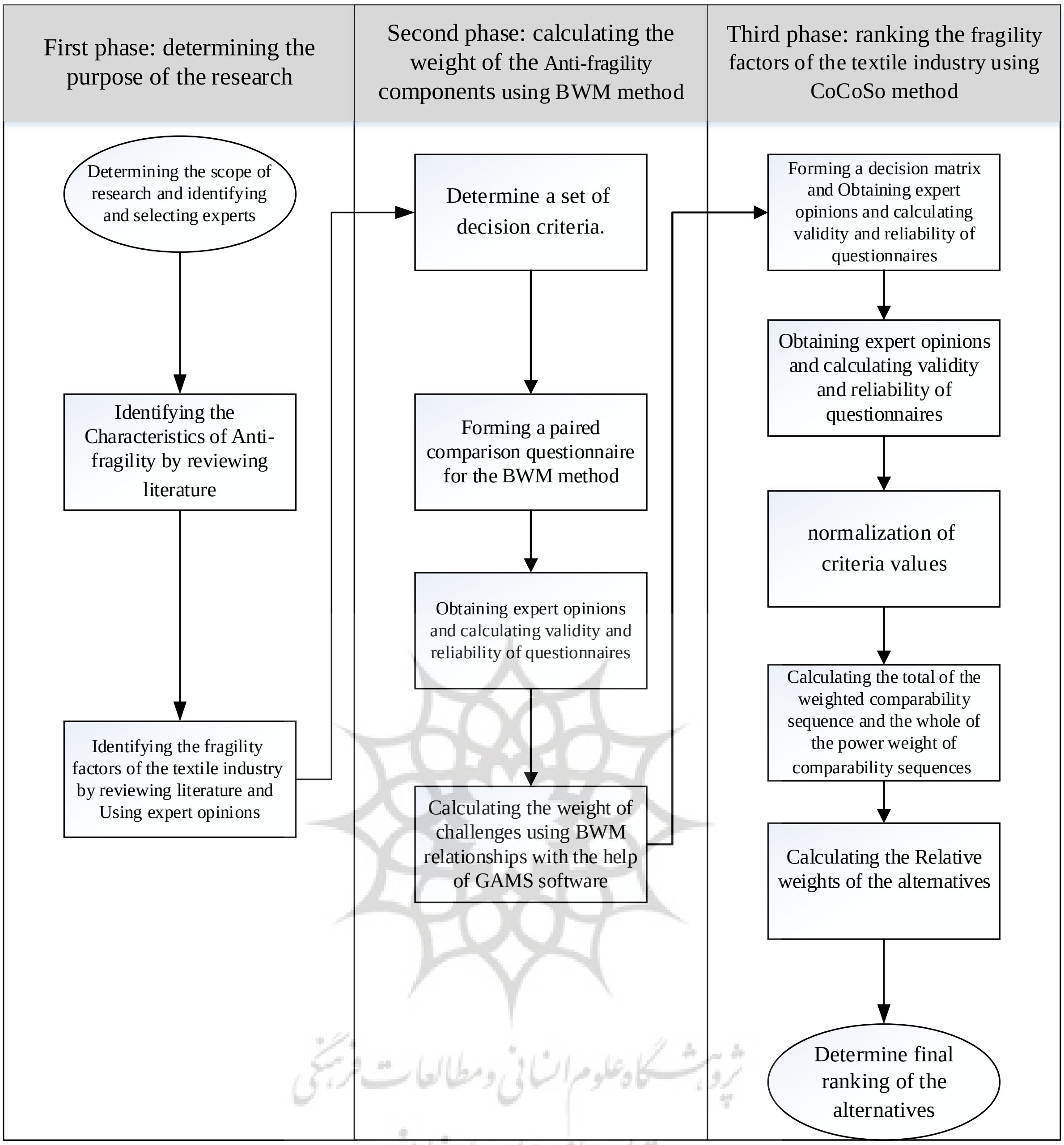
3.1. Research Framework

The current research is classified as applied in terms of its aim and its method, it is a descriptive survey. It is non-experimental in terms of how to obtain the required data. Also, since this research examines data related to a period of time, it is considered a cross-sectional type of research. In order to collect the theoretical foundations of the subject, the library method has been used. By using the library method, the literature and the background of the research were studied and analyzed, and by using the opinions of academic experts, a suitable framework was chosen for the study of the subject.

Based on the review of previous studies, 9 components of anti-fragility of industries were identified. Then, with the formal approval of academic experts, questionnaires were presented to collect information from informants and experts, and data analysis was performed using the Best-Worst method. Further, in order to design a sustainable supply chain for the textile industry, after reviewing the literature and surveying experts, 21 important factors of the fragility of the textile industry were identified and classified into three different categories. Then, these factors were ranked by considering the fragility indices in the previous step, using the CoCoSo method.

Considering that the research problem in question is an expert-oriented problem, therefore, the expertise criteria was used to select the experts. The selection criteria of the experts were to have an academic education in the field of textile engineering with a Ph.D. or Ms degree with at least 10 years of managerial experience. According to the opinion of "Al-Thomas Saati" in the sample size in expert-oriented methods, a questionnaire was designed and sent to 11 experts who were available and they were analyzed. The flowchart of the current research is according to Figure 1.

Figure 1. flowchart of the current research



3.2. The Best-Worst Method

The best-worst method (BWM) was invented by Rezaei in 2015. This method is one of the newest and most efficient multi-criteria decision-making methods, which is used to weigh defined criteria. In this method, the best and worst decision-making indicators and criteria and sub-criteria can be ranked by pairwise comparisons and analysis of experts' opinions, and they are ordered from the most important to the least important. Among the prominent features of the best-worst method model compared to other existing multi-criteria decision-making techniques, we can mention the fewer number of pairwise comparisons and the achievement of more consistent pairwise comparisons. Also, the use of this method leads to more reliable results (Rezaei, 2015). The BWM method includes the following steps:

Step 1: Determine a set of decision criteria. In this step, the decision-maker considers the criteria $C = (C_1, \dots, C_n)$ that should be used to arrive at a decision.

Step 2: Determine the best (e.g. the most important), and the worst (e.g. the least important) criteria. In this step, the decision-maker identifies the best and the worst criteria. No comparison is made at this stage. For example, for a particular decision-maker C_1, and C_4 may be the best and the worst criteria respectively.

Step 3: Determine the preference of the best criterion over all the other criteria using a number between 1 and 9 (or other scales). The resulting Best-to-Others (BO) vector would be: $A_B = (a_{B1}, \dots, a_{Bn})$. Where a_{Bj} indicates the preference of the best criterion B over criterion j.

Step 4: Determine the preference of all the criteria over the worst criterion using a number between 1 and 9 (or other scales). The resulting Others-to-Worst (OW) vector would be: $A_W = (a_{1W}, \dots, a_{nW})^T$. Where a_{jW} indicates the preference of the criterion j over the worst criterion W.

Step 5: Find the optimal weights by using model Formulas (1):

$$\min \xi$$

s.t:

$$\left|\frac{W_B}{W_j} - a_{Bj}\right| \leq \xi \ for\ all\ j$$
$$\left|\frac{W_j}{W_B} - a_{jW}\right| \leq \xi \ for\ all\ j$$
$$\sum W_j = 1$$
$$W_j \geq 0 .\ for\ all\ j \qquad (1)$$

Method inconsistency rate (CR) is obtained using equation (2). In this regard, CI is the consistency index, which is extracted from Table 2 according to a_{BW}, which indicates the superiority of the best selected index over the worst.

$$CR = \frac{\xi^*}{CI} \qquad (2)$$

Table 2: Compatibility Index

a_{BW}	1	2	3	4	5	6	7	8	9
CI	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

3.2. Combined Compromise Solution (CoCoSo)

The CoCoSo method was presented by Yazdani et al. (2018). This method provides a compromise hybrid solution for ranking. CoCoSo technique, like TOPSIS, VICOR, ELECTRE, etc., starts with the formation of the decision matrix and receives the weights of the criteria as input, and finally ranks. Ranking by the CoCoSo method includes the following steps:

Step 1: The initial decision-making matrix is determined as shown below:

$$x_{ij} = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & & x_{2n} \\ \vdots & & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{pmatrix} , \; i = 1,2,...,m \; , \quad j = 1,2,...,n \tag{3}$$

Step 2: The normalization of criteria values is accomplished based on compromise normalization equation (see Zeleny, 1973):

$$r_{ij} = \frac{x_{ij} - \underset{i}{Min}\, x_{ij}}{\underset{i}{Max}\, x_{ij} - \underset{i}{Min}\, x_{ij}} \quad for\, benefit\, criterian \tag{4}$$

$$r_{ij} = \frac{\underset{i}{Max}\; x_{ij} - x_{ij}}{\underset{i}{Max}\, x_{ij} - \underset{i}{Min}\, x_{ij}} \quad for\, \cos t\, criterian \tag{5}$$

Step 3: The total of the weighted comparability sequence and the whole of the power weight of comparability sequences for each alternative sum of the weighted comparability sequence and also an amount of the power weight of comparability sequences for each alternative as S_i and P_i, respectively:

$$S_i = \sum_{j=1}^{n} (w_j . r_{ij}) \tag{6}$$

this S_i value is achieved based on grey relational generation approach:

$$P_i = \sum_{j=1}^{n} (r_{ij})^{w_j} \tag{7}$$

this P_i value is also achieved according to the WASPAS multiplicative attitude.

Step 4: Relative weights of the alternatives using the following aggregation strategies are computed. In this step, three appraisal score strategies are used to generate relative weights of other options, which are derived using Formulas (8)– (10):

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m} (P_i + S_i)} \tag{8}$$

$$k_{ib} = \frac{S_i}{\underset{i}{Min}\, S_i} + \frac{P_i}{\underset{i}{Min}\, P_i} \tag{9}$$

$$k_{ic} = \frac{\lambda(S_i) + (1-\lambda) P_i}{\lambda \underset{i}{Min}\, S_i + (1-\lambda) \underset{i}{Min}\, P_i} \; , \; 0 \le \lambda \le 1 \tag{10}$$

Step 5: It is interpreted that Equation (6) expresses the arithmetic mean of sums of WSM[1] and WPM[2] scores, while Equation (7) expresses a sum of relative scores of WSM and WPM compared to the best. Equation (8) releases the balanced compromise of WSM and WPM models scores. In Equation (8), λ (usually λ = 0.5) is chosen by decision-makers. However, the flexibility and stability of the proposed CoCoSo can rely on other values.

The final ranking of the alternatives is determined based on k_i, values (as more significant as better):

$$k_i = (k_{ia}k_{ib}k_{ic})^{\frac{1}{3}} + \frac{1}{3}(k_{ia} + k_{ib} + k_{ic}) \quad (11)$$

4. Result and Discussion

After reviewing the literature, anti-fragility components were identified, which can be seen in the second column of Table 3. Then, these components were weighted using the BWM method and the importance of each of them was determined. According to this method, questionnaires were prepared for experts to determine the most important and least important criteria in their opinion. Then they performed pairwise comparisons between the most important and the least important selected component compared to other components. The validity of these questionnaires was approved by academic experts. Using GAMS software (GAMS 24.1), the desired method was performed based on the opinion of each expert, and at the end, by taking the average of the obtained weights based on the opinion of each expert, the final weight of each component was calculated. The weight of the components and their rank are shown in the third and fourth columns of Table 3, respectively.

Table 3. The weight of Anti-fragility components

ID CODE	Anti-fragility components	WEIGHT	RANK
Q1	Unexpectedness	0.1766	1
Q2	Proportion of productivity and risk	0.0847	7
Q3	Balancing constraint versus freedom	0.0633	9
Q4	Reduce system connections	0.0857	6
Q5	Adequate supervisors	0.1718	2
Q6	Regular and controlled stress	0.1011	5
Q7	Redundancy	0.1157	4
Q8	Learning from mistakes	0.0827	8
Q9	Attraction	0.1184	3

Table 4. Ranking of fragility factors of textile industry using CoCoSo method

	ID CODE	FRAGIL FACTORS OF THE TEXTILE INDUSTRY	K_a	K_b	K_c	k	RANK	REFERENCES
Spinning chain	R1	The supply of raw materials in the stock market by major fiber producers in the country	0.138	2.346	0.864	1.770	10	Expert

1 Weighted Sum Method
2 Weighted Product Method

	R2	Lack of supply of raw materials in the country	0.138	2.346	0.861	1.768	12	(Ebadi et al., 2021; Shafiei et al., 2021; Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019; Parliament Research Office, 2020)
	R3	Lack of specialized and experienced manpower in the spinning chain	0.158	2.736	0.985	2.045	4	expert
	R4	Depreciation of machinery in the spinning chain industry	0.148	2.222	0.924	1.770	11	(Ebadi et al., 2021; Khoshsepehr et al., 2017; Parliament Research Office, 2019; Parliament Research Office, 2020; Business Reviews, 1999)
Weaving and sewing chain	B1	Lack of competitive industrial infrastructure	0.123	2.063	0.768	1.564	17	(Shafiei et al., 2021; Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019; Parliament Research Office, 2020; Business Reviews, 1999; [23] Abooyee Ardakan et al., 2017)
	B2	Lack of investment in the (clothing) industry	0.160	2.882	1.000	2.120	1	(Shafiei et al., 2021; Hole, 2016; Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019; Parliament Research Office, 2020; Hassan-Nejad & Maleki, 2015)
	B3	Importing clothes from cheap producing countries	0.136	2.216	0.851	1.703	14	(Shafiei et al., 2021; Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019; Hassan-Nejad & Maleki, 2015)
	B4	Saturation of the market with counterfeit brands due to the structural weakness of the distribution and smuggling network	0.160	2.833	1.001	2.099	2	(Shafiei et al., 2021; Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019; Hassan-Nejad & Maleki, 2015; Abooyee Ardakan et al., 2017; Khodadad Kashi & Firoozjang, 2013)
	B5	Facilitating imports and receiving low taxes and duties from clothing importers	0.153	2.498	0.955	1.916	5	(Parliament Research Office, 2019)
	B6	The heterogeneous growth of clothing design and fashion	0.140	2.476	0.878	1.838	7	(Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019)
	B7	Informal clothing production	0.148	2.232	0.925	1.775	8	(Parliament Research Office, 2019)
	B8	Undeveloped distribution network	0.159	2.778	0.993	2.070	3	(Parliament Research Office, 2019)
	B9	Lack of access to foreign capital and main export markets	0.104	1.809	0.649	1.349	20	(Shafiei et al., 2021; Parliament Research Office, 2019)
	B10	Lack of specialized and experienced manpower in the knitting and clothing chain	0.123	2.220	0.771	1.633	15	(Taleb, 2012; Montazeri, e., Talebpour, 2021)
	B11	Depreciation of weaving and clothing chain machinery and using old technology	0.141	2.487	0.880	1.845	6	(Ebadi et al., 2021; Shafiei et al., 2021; Parliament Research Office, 2019; Hassan-Nejad & Maleki, 2015; Business Reviews, 1999; Jahanmard-Hosseinabadi & Amani-Tehrani, 2019)
printing and finishing	C1	Restrictions on building factories with emissions higher than level 2	0.119	1.987	0.742	1.508	18	expert
	C2	Importing raw materials of dyes and specialized textile chemicals	0.138	2.302	0.861	1.749	13	(Tehran Chamber of Commerce, 2015; Parliament Research Office, 2019)

	C3	Lack of trust in the cooperation of production circles (spinning, weaving, dyeing and clothing)	0.114	1.650	0.711	1.336	21	expert
	C4	Lack of development due to the technical knowledge and capital-intensive nature of this chain	0.138	2.351	0.864	1.773	9	(Abooyee Ardakan et al., 2017)
	C5	Lack of specialized and experienced manpower in the dyeing, printing and finishing chain	0.119	1.869	0.742	1.458	19	expert
	C6	Depreciation of the machinery of the dyeing, printing and finishing chain	0.131	1.996	0.821	1.582	16	(Ebadi et al., 2021; [Johnson & Gheorghe, 2013; Parliament Research Office, 2019; Business Reviews, 1999)

The results obtained by the BWM method show that unexpectedness, adequate supervisors, and attraction are the most important components of anti-fragility. The inconsistency rate was calculated using equation 2, which was equal to 0.0019, and since it is less than 0.02 (Rezaei, 2015), it indicates the consistency of the method. The weights obtained in this step will be used in the next step to rank the fragile factors of the textile industry.

In the next step, the fragile factors of the textile industry have been identified by reviewing the literature and surveying experts, and these factors are shown in the third column of Table 4. These factors were ranked using formulas (3) to (11) after forming the CoCoSo questionnaire and polling experts.

Three appraisal score strategies are used to generate relative weights of other options, which are derived using Formulas (8)– (10), respectively, which are shown in the fourth, fifth and sixh columns of Table 4. Next, using equation (11), The final ranking of the alternatives is determined, which is shown in the seventh column of Table 4. The results of the CoCoSo method show that the factors of "Lack of investment in the (clothing) industry" and "Saturation of the market with counterfeit brands due to the structural weakness of the distribution and smuggling network", and "Undeveloped distribution network" are the most important factors in the supply chain of the textile industry, which are ranked first to third respectively. Figure 2 shows the average scores given by experts to 6 important factors of fragility of the textile industry according to the antifragility components. As it is clear in the figure, the dispersion of scores for the factor of "Lack of investment in the (clothing) industry" and "Saturation of the market with counterfeit brands due to the structural weakness of the distribution and smuggling network" is more than other factors, and for this reason, they were ranked first and second.

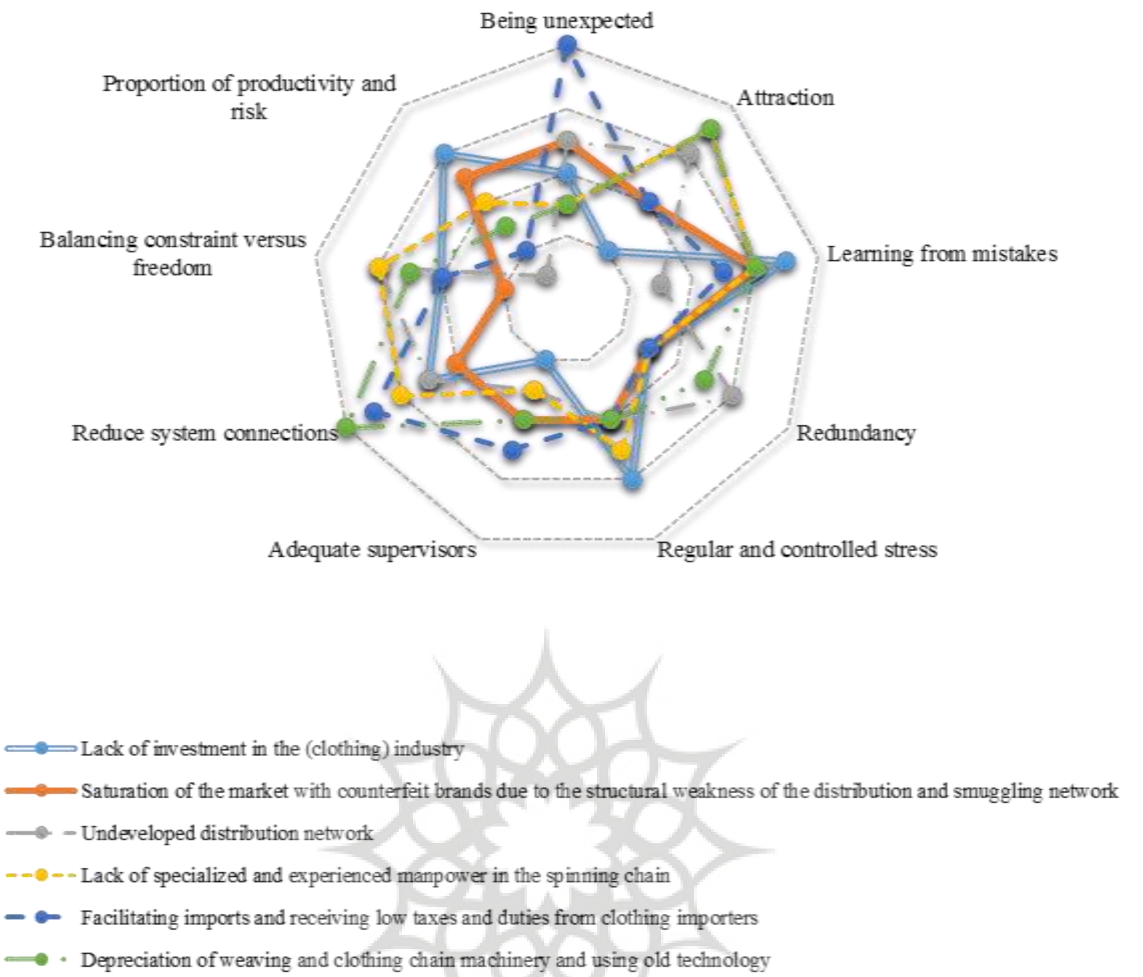


Fig. 2. Average points given by experts to 6 fragility factors of the textile industry based on anti-fragility components.

4. Conclusion

The importance and necessity of the present research is to pay attention to the problem of designing a sustainable, anti-fragile supply chain of textile industry. For this purpose, anti- fragility components were identified and their importance was calculated. Then, based on these components, the fragility factors of the textile industry were ranked. The clothing industry, due to its direct connection with daily life and the basic needs of the household, is the third in terms of importance after food and housing. Therefore, it is necessary to design a sustainable supply chain for the textile industry so that the influence of exogenous and endogenous factors does not reduce the efficiency of its supply chain.

In the statistics related to the added value and the output value, there are problems and challenges that the textile industry in the supply chain is faced with, which make its productivity questionable, and it is necessary to identify and investigate these disruptive factors in the current dynamic conditions. By reviewing the conducted studies, anti-fragility components were identified and weighed using the Best-Worst Method. The most important components obtained were unexpectedness, adequate supervisors and attraction. According to the weight of the obtained components, the fragile factors identified in the supply chain of the textile industry were ranked by the CoCoSO method. The results indicate that the factors of "Lack of investment in the (clothing) industry" and "Saturation of the market with counterfeit brands due to the structural weakness of the distribution and smuggling network", and "Undeveloped distribution network" are respectively in the first to the third place of the greatest importance in the supply chain of the textile industry.

According to the result, the weaving and sewing chain is the most important area of the supply chain of this industry due to the number of fragile factors and the amount of weight obtained. Li et al., (2022) emphasizes sewing operations are highly dependent on the workers. During the sewing process, cognition and perception complexities have an impact on weaving efficiency and garment quality. which is in line with the results of the present study. In order to extend this research, the authors intend to analyze scenarios for effective management in the textile industry to control the risks caused by sanctions and lack of resources and facilities so that ultimately sustainable employment in the textile industry can come true. Considering the uncertainty of experts' opinions can be a development for this article. For this purpose, methods Fuzzy BWM and Fuzzy CoCoSo can be used.

REFERENCES

Abooyee Ardakan, M.; Motamedi, M.; Amin, M. (2017). "An Investigation on Magnitude of Drivers and Barriers Affecting Development of Yazd Textile Cluster Using FCM Model". Improvement Management, 9(2), 77-96.

Amiri, M., Hashemi-Tabatabaei, M., Ghahremanloo, M., Keshavarz-Ghorabaee, M., Zavadskas, E. K., & Banaitis, A. (2021). A new fuzzy BWM approach for evaluating and selecting a sustainable supplier in supply chain management. International Journal of Sustainable Development & World Ecology, 28(2), 125-142.

Bui, T. D., Tsai, F. M., Tseng, M. L., Tan, R. R., Yu, K. D. S., & Lim, M. K. (2021). Sustainable supply chain management towards disruption and organizational ambidexterity: A data driven analysis. Sustainable production and consumption, 26, 373-410.

Business Reviews. (1999). The production and export of the textile and clothing industries is facing a bottleneck. 142, 130-133.

Ebadi,S. V.; Kazerooni, H.; Semnani, D. (2021). "The Compilation of Strategic Plan for Advanced Textile Industry of Iran, Strategic management studies, 12(45), 141-159.

Ecer, F., & Pamucar, D. (2020). Sustainable supplier selection: A novel integrated fuzzy best worst method (F-BWM) and fuzzy CoCoSo with Bonferroni (CoCoSo’B) multi-criteria model. Journal of cleaner production, 266, 121981.

Fakhrpoor, S.H.; Khoshsepehr, Z.; Maleki, M. H. (2018). "Presenting a model for the realization of resistance economy in organizations by applying the theory of invincibility", Strategic management thought, 12(1).

Han, X., & Rani, P. (2022). Evaluate the barriers of blockchain technology adoption in sustainable supply chain management in the manufacturing sector using a novel Pythagorean fuzzy-CRITIC-CoCoSo approach. Operations Management Research, 15(3-4), 725-742.

Hassan-Nejad. A.; Maleki, M. (2015). "Identify plausible scenarios textile industry". Future studies management, 26(3), 53-64.

Hole, K.J. (2016). Anti-fragile ICT systems, Springer Nature.

Hwang, C.-L.; and Yoon, K. (1981). Methods for multiple attribute decision making: ‘Multiple attribute decision making’, Springer, 58-191.

Jackson, S.; and Ferris, T.L. (2013). "Resilience principles for engineered systems", Systems Engineering, 16(2), 152-164.

Jahanmard-Hosseinabadi, F., Amani-Tehrani, M. (2019). Comprehensive Comparison Between Mechanical Properties of Nanofiber Matrix and Single Nanofibers. Journal of Textiles and Polymers, 7(2), 37-46.

Johnson, J.; and Gheorghe, A.V. (2013). "Antifragility analysis and measurement framework for systems of systems", International Journal of Disaster Risk Science, 4(4), 159-168.

Khodadad Kashi, F.; Firoozjang, H. (2013). "The Effects of Smuggling on Productivity: The case of Textile and Clothing Industry in Iran (1996-2007) ", Economics research, 13(49), 49-74.

Khoshsepehr, Z.; Fakhrpoor, S.H.; Maleki, M. H. (2017) "Improving the productivity of the supply chain by applying the theory of invincibility", Productivity Management, 41(41), 31-56.

Kolagar, M.; Hosseini, S.M.H.; Felegari, R.; and Fattahi, P. (2020). "Policy-making for renewable energy sources in search of sustainable development: A hybrid DEA-FBWM approach", Environment Systems and Decisions, 40(4), 485-509.

Lahri, V., Shaw, K., & Ishizaka, A. (2021). Sustainable supply chain network design problem: Using the integrated BWM, TOPSIS, possibilistic programming, and ε-constrained methods. Expert Systems with Applications, 168, 114373.

Li, H., Kong, F., Chen, T., & Kong, L. (2022). Method for Evaluation and Application of Production Process Chain Complexity in Sewing Workshops considering Human Factor. Complexity, 2022.

Lin, B.; Bai, R. (2020). "Dynamic energy performance evaluation of Chinese textile industry", Energy, 199, 117388, 2020.

Martinetti, A.; Moerman, J.J.; van Dongen, L.A. (2017). "Storytelling as a strategy in managing complex systems: using antifragility for handling an uncertain future in reliability", In Safety and Reliability, 37(4), 233-247.

Momeni, S. M.; Ghasemi, A.; Shahvazi, M.; Safari, A. (2022). "Analtsis of service supply chain anti-fragility in Iran insyrance industry". Future Management, 20(67), 183-198.

Montazeri, e., Talebpour, F. (2021). Investigating the Effect of Children's Clothing Patterning to Reduce Fabric Waste in the Industry. Journal of Textiles and Polymers, 9(4), 3-14.

Parliament Research Office. (2019). "The need to complete the value chain in the textile industry and provide a solution". No 17728.

Parliament Research Office. (2020). "Disruption and support of production in the industrial sector, issues and solutions". No 17723.

Raian, S., Ali, S. M., Sarker, M. R., Sankaranarayanan, B., Kabir, G., Paul, S. K., & Chakrabortty, R. K. (2022). Assessing sustainability risks in the supply chain of the textile industry under uncertainty. Resources, Conservation and Recycling, 177, 105975.

Ramezani, J.; & Camarinha-Matos, L.M. (2019). "A collaborative approach to resilient and antifragile business ecosystems", Procedia Computer Science, 162, 604-613.

Rezaei, J. (2015). "Best-worst multi-criteria decision-making method", Omega, 53, 49-57.

Shafiei, S.; Abbasi, R.; Habibirad, A. (2021). "Identifying and ranking production development challenges, policies and approaches to improve the situation in the textile industry (Case study: production of silver scarf textile) ", Development of industrial technology, 18(41), 65-78.

Taleb, N. (2012). Things that gain from disorder, New York City: Random House & Penguin.

Tehran Chamber of Commerce, Industries, Mines and Agriculture. (2015). "An overview of the state of textile, clothing, leather and related products industries in Iran".

Zeleny, M. (1973). Compromise programming. Multiple criteria decisions making.