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Evaluating the continuous monitorability and just-in-time management of goods and equipment in the country's electricity distribution company by a mathematical approach

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Abstract

Competitive functions based on political, social, cultural, and economic changes become more complex as social expectations and approaches change. Analysis methods are determined based on the Delphi objective, round structure, question type, and participant number. A just-in-time production system focuses on producing as little inventory as possible rather than keeping a large stock in the warehouse. An organization should design a unique system and maintain close relationships with its suppliers to ensure that materials and parts are provided on time when they are needed. Other past production management methods that have less integration into processes have lost their effectiveness because of the characteristics of new production environments and the nature of customers. Today, companies need to have integrity in all production processes.

Keywords: continuous monitoring, just-in-time management, just-in-time goods and equipment
2020 MSC: 62A86, 68V30

1 Introduction

Competitive functions will also become more difficult based on these political, social, cultural, and economic changes because the level of expectations and social approaches will change as one of the fundamental issues facing organizations, especially knowledge-based companies [15]. An institution or organization can have the capacity to participate and support stakeholders when it adheres to the dimensions of social responsibilities in implementing competitive processes to maintain the majority of interests. In today's competitive world, traditional methods of management in supply chain processes, which follow less integrity in their procedures, are no longer effective. Environmental changes, social development, technological development, and increasing cultural conflicts have all caused extensive changes in this field [30]. Making the right decision in various fields such as choosing the best manufacturer, distributor, customer acquisition area, and business partners in integrations, as well as the most effective pricing process, are some of the essential issues to create integrated values in supply chain management. Many of these decisions are of a micro or macro nature, and they can impose many costs on firms operating in a competitive market if made incorrectly [22]. Therefore, organizations should work with their suppliers and customers to gain competitive advantages and

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increase market share. Thus, organizations should cooperate in integrated supply chains and not as isolated islands [9]. Integration of values in pricing functions in the supply chain is one of the dimensions of integration. In other words, integration of values is defined based on the manufacturer's engagement in strategic cooperation with supply chain partners, from providing quality products to determining the price based on the needs of the market and its customers, and jointly manages internal and external organizational processes [23].

The integration of supply chain values is a promising yet complex tool that aims to reach maturity in the competitive environment and enhance businesses' developmental dimensions [5]. Therefore, paying attention to this issue can help companies as a competitive advantage even with inappropriate pricing to create stability and flexibility in the ever-changing environment. Many researchers have tried to develop a level of value integration based on the creation of different paradigms such as sustainability, and agility, based on the flexibility of the supply chain, to gain more competitive advantages. There are a variety of uncertainties in the supply chain, such as changes in customer demand and supplier capacity, due to turbulent economic conditions [20]. In other words, as markets and production processes become increasingly complex, the supply chain cycle should become more flexible to meet customers' needs as soon as possible. The supply chain's flexibility reflects the system's capacities and capabilities to respond quickly and competently to internal and external changes in the system. Competitive supply chain pricing can increase competitive effectiveness by reducing the cycle time and re-executing the process, promoting value integration in the supply chain. This study aimed to determine the continuous monitorability of the just-in-time management of goods and just-in-time equipment in the electricity distribution company of the entire country.

2 Theoretical foundations

2.1 Sustainable supply chain management

The concept of sustainable supply chain management has been widely studied in the last two decades. Development efforts since the 1960s have mainly focused on the economic aspects of sustainable development [19]. After the 1960s, non-economic aspects of development were also considered, and the concept of sustainable development emerged in the 1980s. Various aspects of supply chain sustainability literature were proposed in social, economic, cultural, and environmental dimensions, which often included common goals with expanding this concept. Elkington [14] divided sustainability literature into three main pillars: economy, environment, and society. Until 2000, a coherent and independent definition of sustainable supply chain management was not explicitly provided.

These definitions became more purposeful and broader from 2001 onwards, including different dimensions of sustainability. Sustainable supply chain management can be considered as integrating corporate sustainability into supply chain management, where the main dimensions of corporate sustainability are associated with the characteristics of supply chain management [3]. According to Srivastava's [37] definition of sustainable supply chain management, integrating environmental thinking with green supply chain management includes product design, material sourcing, selection, production processes, final product delivery to end customers, and end-of-life product management. Shen [31] considers network design one of the most critical strategic decisions in supply chain management for to long-term profitability and supply chain stability based on the effect of supply chain network design on the flexibility, profit, and competitive competencies of companies. Today, the path of sustainable chain management definitions revolves around a three-dimensional circle (3BL), including economy, environment, and society. Other interesting aspects of the definitions presented are the pressures of external stakeholders and the idea of sustainable supply chain management beyond the traditional concept of business but related to economic performance [2]. From an operational point of view, sustainable supply chain management is considered as a subset of internal and external processes, emphasizing the role of cooperation between supply chain partners. Strategic integration, transparency, and achieving the organization's social, environmental, and economic goals are defined through the systematic coordination of key inter-organizational processes to improve the long-term economic performance of companies and their supply chain [6].

2.2 Supply chain flexibility

Today, flexibility has become a common term among supply chain managers, researchers, and consultants, which refers to "the ability of a system to survive, adapt and grow in the face of change and uncertainty" [36]. In another definition, flexibility is "the ability of the supply chain to return to the initial state (before the disorder) or to move to a new favorable state [16]. Supply chain flexibility can only be described by conceptual studies that review the literature and provide definitions or principled guidelines based only on attractive examples [32, 33, 34, 35]. Sapkauskiene and Leitoniene [28] defined supply chain flexibility as the speed of the supply chain in meeting customer demand as well

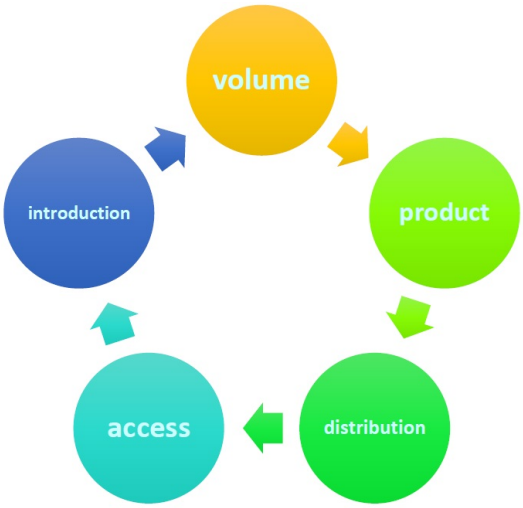

Figure 1: Five-dimensional model of supply chain flexibility

as the degree of adaptation of production volume in response to various market changes. Vickery et al. [41] presented supply chain flexibility in the following form:

Vickery et al. [41] stated a mutual relationship between the first two components, volume flexibility and product flexibility, causing the flexibility of the supply chain in the manufacturing systems sector from the above five dimensions. Distribution flexibility and access follow market process approaches, and new product introduction flexibility is also related to research and development teams to develop supply chain flexibility functions [20]. Sawhney [29] considered two essential aspects of supply chain flexibility: process and distribution flexibility. Moreover, Swafford et al. [39] mentioned the three dimensions of sourcing, manufacturing, and distribution flexibility in the supply chain flexibility.

2.3 Integration of supply chain pricing values

Integrating supply chain pricing is cooperating with partners in the supply chain and managing internal and external processes collaboratively to achieve competitive advantage [17]. For the first time, Stevens [38] considered value integration as including the following three dimensions:

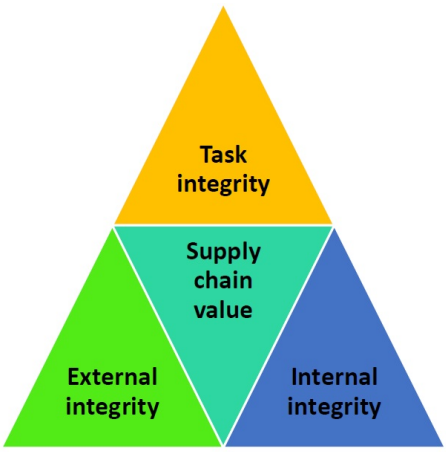

Figure 2: A three-dimensional approach to supply chain value integration

As shown, integration is defined based on Stevens [38] in three levels functional integration, internal integration, and external integration, which includes integration with suppliers and customers. Then, researchers identified and introduced other dimensions of integration. For example, Lee and Hang [24] also has the value integration of the supply chain in the following model:

The researchers introduced the supply chain value integration in the three dimensions of information integration, resource coordination, and organizational relations with partners, but they emphasized communication integration

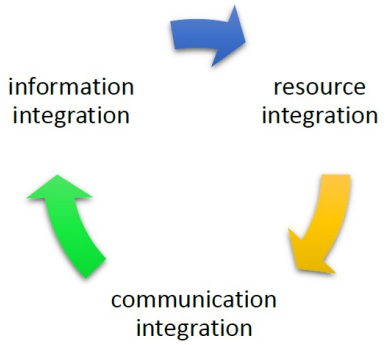

Figure 3: Supply chain value integration based on Lee and Hong [24]

considering the constantly changing environment. Thus, the internal, supplier, and customer integration dimensions were introduced as three dimensions of an integrated supply chain [40, 42]. This research classifies integration into two dimensions of internal and external integration [26]. External integration includes two dimensions of integration with customers and integration with suppliers.

3 Research literature

Abernathy et al. [1] investigated the impact of management ability on the timeliness of financial reporting in the United States. The results showed that higher managerial ability is related to faster processing, reducing the time of profit announcement and shortening the audit period. As a result, the results showed that managerial ability significantly positively affects the timeliness of financial reporting.

Cigdem and Anand [9] found that this dimension of integration leads to a deeper understanding of the expectations and opportunities of customers and the market with a more correct and faster response to customer needs and requirements by matching supply with demand.

Baofeng et al. [7] concluded that an organization has high levels of internal integration when the information systems used in different units are related. All units can access the correct and just-in-time information of other departments, and there is effective communication between all tasks. Integration with suppliers refers to the process of interaction and cooperation between an organization and its suppliers to ensure an effective supply flow to increase capacity and improve performance indicators such as delivery, quality, and cost. Customer integration refers to a central organization's strategic cooperation and customer coordination.

Wong et al. [42] defined internal integration as the process of interaction and cooperation between groups to create a coherent organization to bring other groups together. According to this study, internal integration significantly affects quality and cost.

Ghasemi et al. [21] investigated the smart business model based on effective factors in defense equipment manufacturing industries. The results of the conceptual model test using LISREL software indicated the significant impact of organizational, process, and technical and technological factors on the smart business of companies active in defense equipment manufacturing industries.

Amiri et al. [4] examined the feasibility of using the just-in-time production system to achieve lean production in South Pars gas complex companies. The results indicated establishing and implementing a just-in-time production system to achieve lean production in South Pars gas complex companies. Further, the company received raw materials and goods needed in production and an inventory of raw materials and manufactured goods.

Nikkar and Mohammadi [27] explored the effect of company strategy, political costs, and management power on the timeliness of financial reporting. The results showed that only the competitive strategies and the company's strategy concerning future information increase the timeliness of financial reporting. In addition, systematic risk and company size decreased and increased the timeliness of financial reporting, respectively. Therefore, as one of the indicators of management power, management ability significantly impacts the timeliness of financial reporting, and higher capacity increases the timeliness of financial reporting.

4 Research method

4.1 Analysis of Delphi results

Analysis methods are determined based on the Delphi purpose, round structure, question type, and participant number. The main statistics used in Delphi studies are the main parameters (mean, median, and mean) and dispersion index (standard deviation and interquartile range) [25]. Using the median and the mean is desirable, although the mean can also be used. Delphi data can also be reported using the view since the Delphi process tends to show convergence or convergence. Therefore, using the results around one point or two points is appropriate. The content was analyzed to identify the main questionnaire themes without the initial structure and explore the Delphi results in the first round. The results of that unstructured questionnaire were transformed into a structured questionnaire to form the basis of the subsequent rounds [18]. The second round is the beginning of quantitative methods in which the ranking technique (median and quartiles) is used, and centrality and dispersion indicators are used in the third and subsequent rounds [25]. Further, main and face parameters are used in fuzzy Delphi, but fuzzy numbers are used in fuzzy Delphi. For example, the formula for calculating the average of fuzzy numbers (arithmetic or geometric) should be used to calculate the average.

4.2 Research variables

The degree of a particular risk to the company, its employees, its gals, and its probability its occurrence can be considered to determine significance. The importance of each component in electricity distribution companies is determined using Table 1 to avoid the influence of experts' subjective interpretations on their answers.

Table 1: Definition of expressive expressions of importance measure

Completely unimportant	**Very unimportant**	**unimportant**	**Somewhat unimportant**	**Important**	**Very important**	**Completely important**
1	2	3	4	5	6	7
• Partial cost • No reaction in the media • Not reportable to the supervisory body, but a minor violation of the company's internal regulations • No injury to employees and third parties • Occasional employee dissatisfaction	• Cost up to 1% of net profit • Short reaction of local media • Not reportable to the supervisory body, but a significant violation of the company's regulations • Outpatient treatment • Scattered employee dissatisfaction	• Cost up to 1% of net profit • Local reputational damage • The incident can be reported to the supervisory body without the need for further follow-up and handling • Outpatient surgery • General ethical issues and increased employee turnover	• Cost up to 2% of net profit • Short coverage of negative domestic news • Report the violation to the supervisory body requiring immediate corrective action • Limited care without hospitalization • Major ethical issues and high employee turnover	• Cost up to 5% of net profit • Long coverage of negative domestic news and market share decline • Reporting to the supervisory body requires significant corrective actions • Limited care and hospitalization of individuals • Several senior managers leaving the organization, high turnover of key employees, and a bad reputation among job seekers	• Imposing a fee higher than 5% of the net profit • Prolonged negative foreign news coverage and a critical decline in market share • Prosecutions, significant crimes, lawsuits, consumer class action lawsuits, and confiscation of managers • Major injury and disability of persons • Leaving the organization by several leaders	• Lack of continuity of activity • Prohibition of production and sale • Death of persons

The ideal risk for continuous monitoring methods should exist for a continuous stream of analyzable electronic data. The analysis should not be based so much on human judgment. There should be a model for its prediction that is not very expensive to implement, increases the accuracy, reliability, and (or) timeliness of risk predictions compared to the decision-making and judgment methods of experts in the organization and provides a practical index for managers [13]. Table 2 shows the measure of continuous monitoring capability to neutralize the effect of experts' subjective interpretations on their judgment.

4.3 Data analysis methods in fuzzy Delphi

This research presented an overview of the differences between the fuzzy Delphi method and the classic Delphi method. The steps of the fuzzy Delphi method are as follows:

1. Experts' opinions were mapped to fuzzy numbers in verbal expressions based on Likert's seven-point spectrum [8]. Table 2 is presented at the beginning of the interview questions to avoid the influence of experts' subjective interpretations in selecting options.

Table 2: Definition of expressive expressions of importance measure

Completely unimportant	**Very unimportant**	**unimportant**	**Somewhat unimportant**	**Important**	**Very important**	**Completely important**
1	2	3	4	5	6	7
Computerized continuous and automatic risk assessments are impossible due to the lack of digital data.	Acquiring the required data or continuous and automated evaluation by computer does not in any way outweigh the benefits.	Digital data can be acquired continuously and automatically evaluated by a computer, but the benefits of deployment may not outweigh the costs.	The necessary digital data can be obtained by spending time and money, and computerized evaluation can be done continuously and automatically. The benefits of the establishment are almost equal to its costs.	A computer can continuously and automatically evaluate the necessary digital data. The benefits of the establishment are expected to be relatively higher than the expenses.	Obtaining the required data or continuous and automatic evaluation by computer increases the benefits over costs.	Digital data can be obtained without wasting time or money, and continuous and automatic risk assessment can be done by computer.

Table 3: Seven-point Likert scale for fuzzy numbers

No.	**Verbal expressions of the importance**	**Verbal terms of continuous monitoring**	**Triangular fuzzy number**
1	Completely unimportant	Completely unmonitorable	(0,0,0.1)
2	Very unimportant	Very unmonitorable	(0,0.1,0.3)
3	Unimportant	Unmonitorable	(0.1,0.3,0.5)
4	Somewhat important	Somewhat monitorable	(0.3,0.5,0.7)
5	important	Monitorable	(0.5,0.7,0.9)
6	Very important	Very monitorable	(0.7,0.9,1)
7	Completely important	Completely monitorable	(0.9,1,1)

2. If the evaluation of each expert is the following triangular fuzzy number, the average evaluation of experts for each risk is based on formula (4.1) (*If the point of view of each expert is in the form of a triangular fuzzy number (l, m, u), then the fuzzy average of the experts' points of view is obtained from the following relationship:* $F_{AVE} = (L, M, U) = \frac{\sum l}{n}, \frac{\sum m}{n}, \frac{\sum u}{n}$).

$$A_i = (l_i, m_i, u_i), \quad i = 1, ..., n$$

Step 1.

$$\tilde{A}_m = (l_m, m_m, u_m) = \left(\frac{1}{n} \sum_{i=1}^{n} l_i, \frac{1}{n} \sum_{i=1}^{n} m_i, \frac{1}{n} \sum_{i=1}^{n} u_i \right) \tag{4.1}$$

3. The evaluation distance from the average for each expert is based on Equation (4.2). Consensus is reached when the average and expert evaluation distance is less than 0.2. If there is a consensus of more than 75% among all expert evaluations, it goes to the next step; otherwise, it goes to the next Delphi round. Experts' views are fuzzy aggregated through fuzzy averaging.

$$d(\tilde{A}_m, A_i) = \sqrt{\frac{1}{3}[(l_m - l_i)^2 + (m_m - m_i)^2 + (u_m - u_i)^2]} \tag{4.2}$$

4. The aggregated fuzzy view of the experts is obtained from the following relationship in which the lower limit is the aggregated fuzzy number, the minimum of the lower limit is the experts' opinions, and the upper limit is the maximum of the experts' opinions [11]. The dispersion of experts' opinions is clearer by inserting the upper and lower limits. The arithmetic mean of the middle limit was calculated because the geometric mean cannot be calculated for non-positive numbers.

$$F_{AGR} = (L, M, U) = \left(\min(l_i), \frac{1}{n} \sum_{i=1}^{n} m_i, \max(u_i) \right) \tag{4.3}$$

5. The values should be de-fuzzified after summarizing the experts' opinions. Therefore, the triangular fuzzy number becomes a classical number as the best average by Equation (4.3) (*Another way to de-fuzzify the triangular fuzzy number:* $F = \frac{L+2M+U}{4}$).

$$F = \frac{L + 4 \times M + U}{6} \tag{4.4}$$

6. In this research, the indicators whose de-fuzzified number is more than the threshold (0.7) are considered essential, and the rest are unimportant [27].

5 Inferential analysis of research

In this section, the desirability of the research analysis is adjusted. The Fuzzy Delphi method was used to determine the most critical factors affecting the amount of risk on companies, and experts agreed. In this research, experts who had complete knowledge of the pharmaceutical industry were selected. The questionnaire related to the fuzzy Delphi method was developed to obtain experts' opinions about their agreement with the extracted factors. Since experts have different characteristics, they have different mentalities. If the options are answered based on different mindsets, the analysis of variables is worthless, but experts will answer the questions with the same mindset by defining the range of qualitative variables.

The selected experts should be justified about the research topic, method, and duration of the first stage of using the fuzzy Delphi method. The inclusion criteria for experts are as follows: be engaged with the issue under discussion, have ongoing knowledge of the issue to continue the collaboration, have sufficient motivation to participate in the Delphi process, and feel that the information resulting from a group agreement will be valuable. Another characteristic of the selected experts is the need to have a comprehensive view of the factors affecting the risks because the desired industry for the subject of the research is the pharmaceutical industry. Therefore, these selected experts should include managers and specialists in the pharmaceutical industry and people familiar with risk-related issues. Finally, 22 experts were selected as a sample using the judgment method, and initial preparation was made for the plan implementation. Two rounds of the Delphi method were repeated after determining the experts. In the first round, a list of factors affecting the risks was provided to the experts. In the next step, the average of experts' opinions about the importance of each factor was considered.

The fuzzy Delphi method was used to analyze the data after conducting the interview using a structured questionnaire.

Based on the importance in the first round of Delphi in political-social and geographical components, the percentage of agreement between the experts was 41% and 32%, respectively, which was less than the threshold of 75% considering the criteria mentioned in the research methodology section. Therefore, no consensus was reached, but a consensus was reached regarding other risk components of importance. Thus, the second round of Delphi has been performed again for the above two components. The experts were asked to confirm or change their previous answers for the opinions collected in the first round. In the second round, a consensus was reached for both components.

Based on the continuous monitorability, the percentage of agreement between the experts was 45%, 41%, 45%, 50%, 27%, and 55%, respectively, in the first round of Delphi for the components of industry risk, governance, technological change, socio-political, geographical, and planning, resource allocation and budgeting. These agreement percentages did not reach a consensus considering the consensus threshold higher than 75% (Table 4). A consensus was reached regarding other risk components from the point of view of continuous monitoring. Therefore, the second round of Delphi was conducted again for the above six components. The experts were requested to confirm or change their previous answers based on the total opinions of the first round. In the second round, the consensus was reached for all six components. In addition, the experts did not add new risks to the proposed risks. The results of evaluating the importance of just-in-time management of goods and equipment were presented after implementing the fuzzy Delphi method. According to the threshold, 15 components were selected as essential components, which are: Capital supply and cash flow (0.874), product portfolio (0.868), legal and regulatory changes (0.841), sales (0.835), purchasing and trading (0.832), economic indicators (0.783), technological change (0.768), governance (0.762), production (0.762), competitors (0.750), credit (0.741), human resources (0.732), reputation (0.726), planning, resource allocation and budgeting (0.720), and inventory management (0.705).

The second Delphi round was done considering that only the symbols (Rasa, Raj) are less than 75% in terms of the average importance of the first fuzzy period, i.e., 60% and 53%, respectively, and also the level of agreement of experts related to the mentioned symbols is 41 and 32. However, the rest of the symbols in the first round of Delphi are reasonable regarding average importance and experts' agreement. According to table 5, in the second round of

Table 4: The results of assessing the importance of the just-in-time system of goods and equipment

Dimension	Component	First round			Second round			Rank	
		Fuzzy cumulative number	Mean	Agreement	Fuzzy cumulative number	Mean	Agreement	rational	Total
Strategic	Competitors	(0.3,0.8,1)	0.750	77	–	–	–	4	10
	Good Reputation	(0.1,0.732,1)	0.671	82	–	–	–	6	18
	Governance	(0.1,0.814,1)	0.726	91	–	–	–	5	13
	product code	(0.3,0.818,1)	0.762	86	–	–	–	3	8
	Technology change	(0.5,0.927,1)	0.868	91	–	–	–	1	2
	Social and political	(0.3,0.827,1)	0.768	91	–	–	–	2	7
	Geographical	(0,0.65,1)	0.600	41	(0.3,0.645,1)	0.647	96	7	20
Financial	Funding and cash flow	(0,0.555,1)	0.537	32	(0.1,0.595,1)	0.580	82	8	25
	credit	(0.5,0.936,1)	0.874	91	–	–	–	1	1
	Macroeconomic indicators	(0.1,0.836,1)	0.741	86	–	–	–	3	11
Operational	sale	(0.3,0.85,1)	0.783	91	–	–	–	2	6
	Shopping	(0.5,0.877,1)	0.835	100	–	–	–	1	4
	Inventory management	(0.5,0.873,1)	0.832	100	–	–	–	2	5
	Human resources	(0.1,0.782,1)	0.705	77	–	–	–	5	15
	Manufacturing	(0.3,0.773,1)	0.732	77	–	–	–	4	12
	Protection of assets	(0.3,0.818,1)	0.762	95	–	–	–	3	8
Reporting	Planning and allocation of resources	(0,0.709,1)	0.639	82	–	–	–	7	21
	Data accuracy	(0,0.759,1)	0.673	77	–	–	–	6	17
	Communication and access to information	(0.1,0.805,1)	0.720	82	–	–	–	1	14
Legal factors and compliance	Legal and regulatory changes	(0,0.755,1)	0.670	77	–	–	–	2	19
	Legal claims	(0,0.686,1)	0.624	82	–	–	–	3	23
	Compliance	(0.1,0.6,1)	0.583	77	–	–	–	4	24

Delphi, the agreement between experts for geographic components and capital supply and cash flow was 96 and 82, respectively.

Table 5: The results of assessing the continuous monitorability related to the just-in-time system of goods and equipment

Dimension	Component	First round			Second round			Rank	
		Fuzzy cumulative number	Mean	Agreement	Fuzzy cumulative number	Mean	Agreement	rational	Total
Strategic	Competitors	(0,0.677,1)	0.618	82	–	–	–	3	15
	Good Reputation	(0.1,0.591,1)	0.577	45	(0.1,0.636,1)	0.607	77	4	16
	Governance	(0,0.709,1)	0.639	82	–	–	–	2	11
	product code	(0,0.555,1)	0.537	41	(0.1,0.527,0.9)	0.518	82	7	24
	Technology change	(0.1,0.832,1)	0.738	86	–	–	–	1	4
	Social and political	(0,0.568,1)	0.545	45	(0.1,0.609,1)	0.589	86	5	19
	Geographical	(0,0.509,1)	0.506	50	(0,0.564,1)	0.543	82	6	21
Financial	Funding and cash flow	(0.3,0.809,1)	0.756	82	–	–	–	1	2
	credit	(0.3,0.782,1)	0.738	77	–	–	–	2	4
	Macroeconomic indicators	(0.1,0.709,1)	0.656	82	–	–	–	3	10
Operational	sale	(0.3,0.786,1)	0.741	82	–	–	–	2	3

	Shopping	(0.1,0.805,1)	0.720	91	–	–	–	3	7
	Inventory management	(0.3,0.823,1)	0.765	91	–	–	–	1	1
	Human resources	(0,0.705,1)	0.637	91	–	–	–	7	13
	Manufacturing	(0,0.805,1)	0.703	91	–	–	–	5	9
	Protection of assets	(0.1,0.805,1)	0.720	95	–	–	–	3	7
Reporting	Planning and allocation of resources	(0,0.709,1)	0.639	82	–	–	–	6	11
	Data accuracy	(0,0.727,1)	0.651	55	(0.3,0.759,1)	0.723	82	1	6
	Communication and access to information	(0,0.645,1)	0.597	82	–	–	–	3	17
Legal factors and compliance	Legal and regulatory changes	(0,0.7,1)	0.633	77	–	–	–	2	14
	Legal claims	(0.1,0.591,1)	0.577	77	–	–	–	4	20
	Compliance	(0,0.555,0.9)	0.520	82	–	–	–	3	23

The results of assessing the continuous monitorability of just-in-time management of goods and equipment were presented. According to the threshold, the experts considered nine components of inventory management (0.765), capital supply and cash flow (0.756), sales (0.741), product portfolio (0.738), credit (0.738), planning, resource allocation and budgeting (0.723), purchasing and trading (0.720), protection of assets (0.720), and production (0.703) as continuous monitorable. The number of components and the relative importance of dimensions are known. Strategic (0.331), operational (0.330), financial (0.205), legal and compliance (0.072), and reporting (0.062) dimensions have the highest relative importance, respectively, among the components of just-in-time management of essential goods and equipment. Among the critical components of continuous monitorability, operational (0.541), financial (0.231), strategic (0.124), reporting (0.103), and legal and compliance (zero) dimensions have the highest relative importance, respectively.

Table 6: The number of components and the relative importance of the dimensions related to the just-in-time system of goods and equipment separately

Dimensions / Components	All		Important		continuously monitorable		Important and continuously monitorable	
	Qty	Importance	Qty	Importance	Qty	Importance	Qty	Importance
Strategic	8	0.319	5	0.331	1	0.124	1	0.137
Financial	3	0.132	3	0.205	2	0.231	2	0.255
Operational	7	0.286	5	0.330	5	0.541	4	0.495
Reporting	4	0.143	1	0.062	1	0.103	1	0.114
Legal and compliance	3	0.119	1	0.072	0	0	0	0
Total	25	1	15	1	9	1	8	1

Finally, the necessary components for continuous monitoring of just-in-time management of goods and equipment were provided. Eight components of capital supply and cash flow, product portfolio, sales, purchase, production, credit, resource allocation and budgeting, and inventory management were proposed as priority components to create a continuous monitoring system for just-in-time management of goods and equipment. The most critical dimensions of the proposed model were strategic (0.495), financial (0.255), strategic (0.137), and reporting (0.114). No component was capable of continuous monitoring from the legal and compliance side. Therefore, this dimension is not in the proposed model.

Table 7: Components of continuous monitoring related to the just-in-time system of goods and equipment

Dimension	**Relative weight**	**Component**	**Average Importance**	**Relative weight**	**Importance rating**	**Continuous monitoring capability rating**
Operational	0.495	Sale	0.835	0.132	4	3

The experts' opinion was obtained regarding the importance and ability of continuous monitoring of each indicator to determine the key risk indicators under each component. Based on the importance in the first round of Delphi, the percentage of agreement in 49 indicators (strategic dimension (3), financial dimension (8), operational dimension (18), reporting dimension (12), and legal and compliance dimension (8)) among experts was not more than the threshold of 75%, and no consensus was reached. Based on the average opinions of the first round of Delphi, the experts were asked

		Purchasing	0.832	0.131	5	7
		Product	0.762	0.120	8	9
		Inventory management	0.705	0.111	15	1
Financial	0.255	Funding of capital/ cash	0.874	0.138	1	2
		Credit	0.741	0.117	11	4
Strategic	0.137	Product portfolio	0.868	0.137	2	4
Reporting	0.114	Resource allocation and budgeting	0.720	0.114	14	6

to revise or confirm their previous answers for these indicators. In the second round, the consensus was reached for 28 of these indicators (strategic dimension (2), financial dimension (5), operational dimension (9), reporting dimension (7), and legal and compliance dimension (5)), and the rest were removed. In the first round of Delphi, no consensus was reached from the point of view of continuous monitorability in 54 indicators (strategic dimension (5), financial dimension (4), operational dimension (24), reporting dimension (15), and legal and compliance dimension (6)). The second round was implemented for these indicators, and the experts were requested to confirm or change their previous answers according to the first round opinions. In the second round, the consensus was reached for 14 indicators (1 strategic dimension indicator, two financial dimension indicators, nine operational dimension indicators, and two legal and compliance dimension indicators), and the rest were removed. In addition, the experts did not add a new index to the proposed indices.

Indicators are selected as key indicators of just-in-time management of goods and equipment that are both important and continuously monitorable. A maximum of five components with ten critical indicators with the highest importance under each component was selected to avoid the multiplicity of indicators of the model of continuous monitoring of just-in-time management of goods and equipment. The following results are presented according to strategic, financial, operational, reporting, legal, and compliance dimensions.

The selected critical indicators of the strategic dimension belong to the product portfolio component. Indicators of other components of this dimension were either unimportant (such as geographical risk) or did not have continuous monitorability (such as competitors, good reputation, governance, and socio-political). Table 8 presents the selected indicators of this dimension in the order of importance.

Table 8: Critical indicators of selected strategic dimension risk

Component	**Index**	**Importance**				**Continuous monitorability**			
		Fuzzy number	Mean	Rank	Consensus round	Fuzzy number	Mean	Rank	Consensus round
Product portfolio	Sale margin	(0.72,0.91,1)	0.885	1	1	(0.635,0.81,0.925)	0.795	5	1
Product portfolio	Revenue share of three main products	(0.7,0.88,0.975)	0.859	2	1	(0.67,0.865,0.975)	0.844	2	1
Product portfolio	New product revenue	(0.68,0.875,0.985)	0.854	3	1	(0.7,0.865,0.95)	0.845	1	1
Product portfolio	Number of new product sales	(0.66,0.855,0.975)	0.836	4	1	(0.67,0.835,0.93)	0.818	4	1
Product portfolio	Number of productions of three main products	(0.63,0.83,0.96)	0.813	5	1	(0.65,0.845,0.96)	0.825	3	1

Ten key indicators of just-in-time management of goods and equipment were selected under profitability, credit, economy, cash flow, and capital supply regarding the financial dimension. All components of this dimension are essential and can be continuously monitored. The key indicators of the financial component are presented in order of importance in Table 9.

Table 9: Key indicators of the selected component of the financial dimension

Component	**Index**	**Importance**				**Continuous monitorability**			
		Fuzzy number	Mean	Rank	Consensus round	Fuzzy number	Mean	Rank	Consensus round
Profitability	Earnings before interest, taxes, and depreciation	(0.73,0.905,0.99)	0.883	1	1	(0.68,0.84,0.93)	0.823	3	1
Credit	receivables collection period	(0.73,0.9,0.98)	0.878	2	1	(0.71,0.865,0.94)	0.845	1	1

Economic	exchange rate	(0.62,0.805,0.93)	0.805	3	2	(0.535,0.73,0.88)	0.719	10	1
Profitability	Operating Profit	(0.63,0.81,0.935)	0.796	4	1	(0.56,0.755,0.91)	0.745	8	1
Capital supply	Interest expense to income ratio	(0.62,0.805,0.94)	0.793	5	1	(0.57,0.77,0.93)	0.760	6	1
Liquidity	Current ratio	(0.605,0.785,0.91)	0.771	6	1	(0.59,0.78,0.925)	0.769	5	1
Economic	swelling	(0.59,0.78,0.92)	0.768	7	1	(0.54,0.74,0.905)	0.731	9	1
Liquidity	average payment period	(0.57,0.77,0.92)	0.758	8	1	(0.68,0.855,0.955)	0.836	2	1
profitability	return on investment	(0.585,0.77,0.9)	0.756	9	1	(0.575,0.76,0.9)	0.749	7	1
Capital supply	Debt interest rate	(0.56,0.755,0.915)	0.746	10	1	(0.59,0.785,0.94)	0.775	4	1

The key indicators of the operational dimension were selected under sales, purchase, and production. In addition to the indicators of human resources, inventory management, information technology, and asset protection components of the operational dimension, the indicators of other operational dimension components were removed. Operational dimension indicators are presented in order of importance in Table 10.

Table 10: Critical indicators of just-in-time management of selected goods and equipment in the operational dimension

Component	**Index**	**Importance**				**Continuous monitorability**			
		Fuzzy number	Mean	Rank	Consensus round	Fuzzy number	Mean	Rank	Consensus round
Sale	Sales budget deviation	(0.76,0.92,0.99)	0.898	1	1	(0.7,0.875,0.965)	0.854	3	1
Sale	sales amount	(0.7,0.88,0.98)	0.860	2	1	(0.7,0.875,0.975)	0.856	2	1
Purchase	The frequency of raw material inventory depletion	(0.7,0.87,0.96)	0.850	3	1	(0.72,0.88,0.96)	0.860	1	1
Production	Substance abuse	(0.68,0.86,0.965)	0.841	4	1	(0.58,0.775,0.93)	0.765	7	1
Sale	Lost customer rate	(0.67,0.86,0.975)	0.841	5	1	(0.63,0.805,0.92)	0.790	5	1
Purchase	Inventory turnover	(0.67,0.845,0.95)	0.828	6	1	(0.51,0.705,0.88)	0.700	10	1
Production	The percentage of non-acceptance of quality assurance	(0.65,0.835,0.96)	0.820	7	1	(0.57,0.765,0.91)	0.753	9	1
Production	Return percentage due to quality to the total production	(0.66,0.835,0.945)	0.819	8	1	(0.58,0.77,0.92)	0.760	8	1
Purchase	Material rate deviation	(0.64,0.835,0.96)	0.818	9	1	(0.69,0.87,0.975)	0.851	4	1
Production	Sales margin per unit	(0.64,0.83,0.95)	0.813	10	1	(0.59,0.78,0.925)	0.769	6	1

For the reporting dimension, eight critical indicators of just-in-time management of goods and equipment were selected under budget, planning, and reporting accuracy (Table 11). There was no continuous monitoring of communication components, access to information, and timeliness.

Table 11: Critical indicators of selected risk after reporting

Component	**Index**	**Importance**				**Continuous monitorability**			
		Fuzzy number	Mean	Rank	Consensus round	Fuzzy number	Mean	Rank	Consensus round
Budget	Profit deviation from the budget	(0.685,0.845,0.93)	0.826	1	1	(0.565,0.755,0.895)	0.743	3	1
Accuracy	Tax crimes	(0.675,0.84,0.93)	0.821	2	1	(0.525,0.715,0.87)	0.706	6	1
Accuracy	Auditor's statement	(0.635,0.81,0.92)	0.794	3	1	(0.51,0.705,0.88)	0.700	8	1
Accuracy	The number of corrective registration of offices	(0.59,0.785,0.93)	0.773	4	1	(0.59,0.79,0.925)	0.774	1	1
Accuracy	The amount of book correction registration	(0.595,0.78,0.905)	0.765	5	1	(0.58,0.78,0.93)	0.768	2	1
Accuracy	Definitive tax deviation from the declaration	(0.585,0.775,0.91)	0.761	6	1	(0.51,0.71,0.89)	0.705	7	1
Budget	Project delay	(0.565,0.75,0.89)	0.739	7	1	(0.535,0.725,0.87)	0.714	5	1
Accuracy	Realization of the budget	(0.54,0.735,0.895)	0.726	8	1	(0.535,0.725,0.885)	0.718	4	1

The components of the reporting dimension, the average significance level, their continuous monitorability, and their consensus threshold are suitable for the suggested and proposed levels. Based on average importance and fuzzy Delphi, the budget component ranks first in terms of profit deviation from budget and average importance. However, this component and index are ranked third based on the continuous monitoring capability and fuzzy Delphi. According to Table 11, the component of accuracy related to the index of constant realization of the budget is placed in the last stage from the perspective of the importance of the average calculations performed related to fuzzy Delphi. However, the component and proposition mentioned in terms of continuous monitorability and the performed calculations are related to fuzzy Delphi in the fourth stage. In addition, the correctness component related to the auditor's opinion index is placed at the last stage regarding continuous monitoring capability and the calculations performed in the fuzzy Delphi stage.

The key indicators of just-in-time management of goods and equipment of legal dimension and compliance are presented in Table 12. The legal dimension and compliance components, including legal claims, compliance, and changes in laws and regulations, have indicators in the proposed model.

Table 12: Critical indicators of just-in-time management of selected goods and equipment, legal dimension, and compliance

Component	**Index**	**Importance**				**Continuous monitorability**			
		Fuzzy number	Mean	Rank	Consensus round	Fuzzy number	Mean	Rank	Consensus round
Claims	The percentage of failure in Claims	(0.67,0.865,0.98)	0.845	1	1	(0.63,0.815,0.95)	0.803	2	1
Change the law	Days to stop production: cancellation of license	(0.65,0.835,0.955)	0.819	2	1	(0.6,0.795,0.93)	0.780	3	1
Compliance	The amount of non-compliance in the audit	(0.65,0.83,0.945)	0.814	3	1	(0.63,0.82,0.95)	0.805	1	1
Claims	Number of Claims	(0.55,0.75,0.905)	0.739	4	1	(0.55,0.745,0.91)	0.738	4	1

The components of the legal dimension and compliance, the average significance level, their continuous monitorability, and their consensus threshold are higher than the proposed and proposed amount. Based on average importance and fuzzy Delphi, the component of legal claims ranks first for the index of the percentage of failure in claims. This component and index were ranked second from the point of view of continuous monitoring capability and the point of view of fuzzy Delphi. The legal claims component related to the index of the number of legal claims was placed in the last stage of the legal and compliance dimension from the perspective of average importance, continuous monitoring capability, and fuzzy Delphi calculations.

6 Conclusions

This study determined the key components of the country's electricity distribution company, their identification, importance, and continuous monitorability. The results are as follows:

Operational (0.495), financial (0.255), strategic (0.137), and reporting (0.114) aspects have the most importance (weight), respectively, in the continuous monitoring model related to the just-in-time system of goods and equipment, including essential components that can be continuously monitored. Four of the eight components selected to create a continuous monitoring system for the just-in-time supply of goods and equipment (sales, purchase, production, and inventory management) are operational. The second weighted dimension is the financial dimension, with two risks (funding and cash flow). Among the essential components, the strategic dimension (0.331) with five components was the most crucial dimension related to the just-in-time system of goods and equipment. However, four components (technological change, governance, competitors, and good reputation) lack continuous monitorability, which can be caused by the difficulty of collecting the data needed to measure these components from current digital sources. Hence, the only component of the product portfolio from now on is in the proposed model. Finally, the reporting dimension has one risk (resource allocation and budgeting) in the proposed model. Despite being the third most crucial component of the legal dimension and compliance, the legal changes and regulations cannot be continuously monitored. Therefore, the proposed model has no component of the latter dimension.

Management defines a sustainable supply chain from an environmental perspective and states that the integration of environmental thinking with green supply chain management includes product design, material sourcing, production processes, final product delivery to end customers, and end-of-life product management. Shen [31] considers the supply chain network design one of the most critical strategic decisions in supply chain management with long-term

profitability and sustainability, considering the effect of supply chain network design on the flexibility, profit, and competitive abilities of companies. Today, the path of sustainable chain management definitions revolves around a three-dimensional cycle (3BL), including economy, environment, and society. Other interesting aspects of the definitions presented are the pressures of external stakeholders and the transcendence of sustainable supply chain management from the traditional concept of business which, at the same time, is related to economic performance [2]. From an operational point of view, sustainable supply chain management was considered a subset of internal and external processes emphasizing the role of cooperation between supply chain partners. Strategic integration, transparency, and achievement of the organization's social, environmental, and economic goals are defined through the systematic coordination of key inter-organizational processes to improve the long-term economic performance of companies and their supply chains [6].

Just-in-time production is a philosophy that seeks to eliminate waste and inefficient factors related to time, human resources, materials, and the production process. Based on the concept of just-in-time production, the organization produces and supplies its product based on the demand it receives from its customers, at the right time and with the right quality. Just-in-time production emphasizes facilitating sales operations, eliminating waste, and improving efficiency and quality. Thus, the flow of raw materials in production, the organization's commitment to implementing the just-in-time production method, and supply management should be considered to assess the organization's achievement of just-in-time production methods. In a just-in-time production system, organizations try to produce with the least amount of inventory instead of keeping a large inventory in the warehouse. Such a method requires designing a unique system, and an organization must be in close contact with its suppliers to provide materials and parts on time. Other past production management methods, which have a less integrated role in processes, lose their effectiveness due to the characteristics of new production environments and the nature of customers. Companies need integrity in all production processes, from raw materials to the end consumer. In this regard, supply chain management can be used to manage the flow of materials and goods, as well as information and money. Logistics management is a part of supply chain management whose main task is to plan, implement, and control the direct and reverse flow of materials, goods, and related information and store them efficiently between the point of origin and consumption to meet customer requirements. In other words, logistics activities include activities that support the organization in fully implementing its mission.

An effective logistics system aims to provide the right goods and services in the right quantity, quality, time, place, and price, along with the right information for the final customers' satisfaction [12]. Ever-growing competition has forced organizations to review their business strategies to achieve excellence in product quality. Organizations provide quality products and services at minimum cost to maintain competitiveness in the market. Many production improvements strategies such as JIT, TQM, Kanban, and 5S have been used in various organizations to achieve their goals. Just-in-time manufacturing has emerged as a leading strategy in the world of manufacturing since the 1980s because of making everyone responsible for quality in the manufacturing process [10].

Recommendations

1. Production organizations are recommended to consider the increasing importance of just-in-time production systems in companies with the potential to implement this system.

2. Manufacturing organizations are advised to eliminate all activities that lack added value and avoid redoing and repeating processes to implement the production system on time.

3. Organizations that take steps towards timely production and quality improvement should emphasize continuous improvement. It is essential to try to simplify production operations in this direction.

4. Production organizations should pay attention to the standardization of production operations and apply the accepted approaches to managing production systems to reduce waste.

5. It is recommended that production organizations be flexible in response to customer demands, integrate all processes and link them with customers to improve quality and implement lean production.

6. Production organizations should focus on group activities with mutual task teams to realize the agile and timely production of goods and equipment. These production organizations can establish business partnerships with other companies and integrate their processes. On the other hand, it is necessary to develop a close relationship with the suppliers to realize the agile and just-in-time production of goods and equipment.

7. It is essential to create a culture of thinking, innovation, and transformation in the organization, which requires delegation of authority to the employees and their satisfaction. In addition, the managers of production organizations should consider the training of multi-skilled employees and updating knowledge and skills in implementating the agile program.

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